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Local Development Framework

The Sustainable Design and Construction Evidence Base:

Climate Change in the Planning System 2010

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The Sustainable Design and Construction Evidence Base: Climate Change in the Planning System 2010

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1) **Introduction**

Delivering sustainable development is one of the key priorities of the planning system. Sustainable development is often defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”[1]. The government set out four aims for sustainable development in 1999, these are:

- Social progress which recognises the needs of everyone;
- Effective protection of the environment;
- The prudent use of natural resources;
- The maintenance of high and stable levels of economic growth and employment.

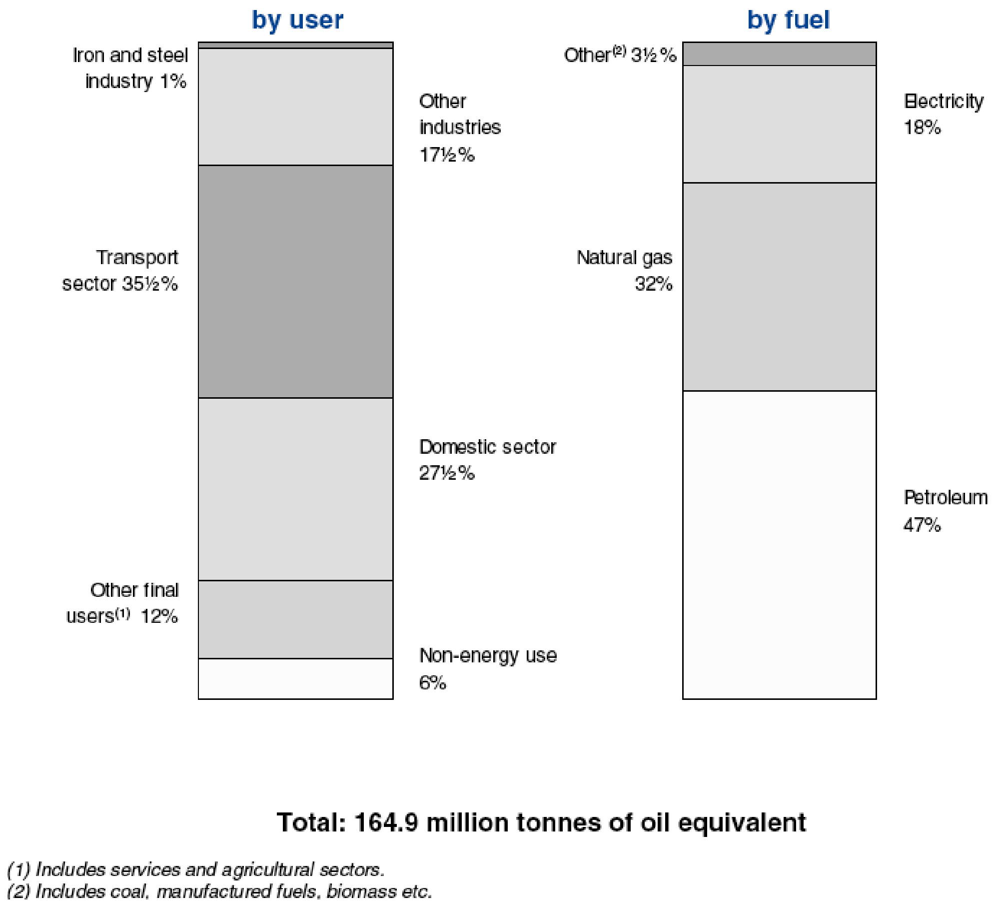

Figure 1.1 UK final energy use by user and by source. (*Digest of United Kingdom Energy Statistics*. 2009).

[1] World commission on environment and development

The need to tackle greenhouse gas emissions is becoming an increasingly pressing priority to mitigate against the effects of climate change. The UK has legally binding greenhouse gas emissions reduction targets that go beyond international agreements to combat climate change, and continues to work towards a new international agreement as a successor to the Kyoto Protocol. The UK's emissions by sector and fuel type are shown in Figure 1.1. From this we can see that UK is still heavily dependent on fossil fuels as a primary energy source.

The UK is expected to become increasingly dependent on imported energy over the coming years as the productivity of indigenous fossil fuel production declines[2,3]. The UK must put in place climate change and energy policies that will help deliver on emissions reductions targets and improve energy security to protect against future increases and spikes in fuel prices.

The London Borough of Merton is situated in the South of the capital and is bordered by the boroughs of Wandsworth, Lambeth, Croydon, Sutton and Kingston upon Thames. The borough is mix of urban environments and open space, the main town and district centres are Wimbledon, Morden and Mitcham but these are balanced by Mertons many parw ks and open spaces. The river Wandle is the main river in the borough and is the main contributor to flood risk. Around 10,000 properties are at risk from flooding, predominantly from the river Wandle.

Table 1.2 Merton's emissions by sector for 2006 and 2008 (LEGGI 2008).

	2006		2008		2006 - 2008
Sector	**Emissions**	**% of Emissions**	**Emissions**	**% of Emissions**	**% reduction**
Domestic	467170	48.6	446870	49.4	4.3
Industrial and comercial	323393	33.7	292900	32.4	9.4
Transport	169988	17.7	165557	18.3	2.6
Total	960552		905327		5.7

2 *Energy Security: A national challenge in a changing world.* 2009. http://www.decc.gov.uk/en/content/cms/what_we_do/change_energy/int_energy/security/security.aspx

3 *Project Discovery: Energy Market scenarios.* 2009. http://ofgem.gov.uk/markets/whlmkts/discovery/Pages/ProjectDiscovery.aspx

Mertons emissions, as measured by London's Emissions and Greenhouse Gas Inventory (LEGGI) for 2006 and 2008 are shown in Table 1.2. The majority of Mertons greenhouse gas emissions arise from its domestic stock, which accounts for approximately 50% of its total emissions, with industry and commercial activities and transport making up the rest (33% and 17%). Merton's emissions fell by around 6% between 2006 -2008 with the biggest reduction coming from the industrial and commercial sector.

This study will bring together a number local studies and investigation and original research in order to provide guidance on appropriate policies to ensure that the Merton's planning policy is able to deliver on the governments objective for sustainable development.

This study will:

- Review national, regional policy.
- Examine local policy case studies
- Determine the key environmental issues facing the borough
- Examine the potential for low and zero carbon technologies in the Borough
- Assess the viability of the introduction of minimum sustainable design and construction standards (E.g. Code for Sustainable homes, BREEAM)
- Provide recommendations for Merton's Local Development Framework core strategy climate change and sustainable design and construction policies.

2) **Policy Review**

Climate change policy in the UK can be seen to operate on hierarchy of three different levels; National policy, Regional policy and Local policy. Each level of policy must be aligned with those that sit above it. Local policy must sit within regional policy and regional policy with national policy. This creates a unified national approach to tackling climate change whilst allowing room for the creation of new and innovative policy approaches at a local level. This section outlines the National and Regional climate change policies and gives examples of Local policy.

2.1) **National Policy**

2.1.1. Climate Change Policies

Stern Review

The report published in 2007 by leading economist Sir Nicholas Stern[4] looked at a number of different aspects of climate change including the effect on the world economy. The report concluded that early action was vital and that the costs to the global Gross Domestic Product of the required action was minimal compared to the eventual costs of inaction. It goes on to state that:

> *"The effects of our actions now on future changes in the climate have long lead times. What we do now can have only a limited effect on the climate over the next 40 or 50 years. On the other hand what we do in the next 10 or 20 years can have a profound effect on the climate in the second half of this century and in the next."*

[4] *Stern Review: The Economics of Climate Change*. 2006, www.hm-treasury.gov.uk/stern_review_report.htm

The Energy White Paper

The 2007 White Paper, *Meeting the Energy Challenge*[5] sets out the Government's international and domestic energy strategy to address the long-term energy challenges faced by the UK, and to deliver 4 key policy goals:

- To put the UK on a path to cut carbon dioxide emissions by some 60% by 2050, with real progress by 2020 (since superseded by the *Climate Change Act* 2008);
- To maintain reliable energy supplies;
- To promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve productivity;
- To ensure that every home is adequately and affordably heated.

The scope of energy policy includes the production and distribution of electricity, transport fuel usage, and means of heating (significantly natural gas). The policy recognises that energy is essential in almost every aspect of our lives and for the success of the UK economy.

The policy identifies two long-term energy challenges:

- Tackling climate change by reducing carbon dioxide emissions both within the UK and abroad;
- Ensuring secure, clean and affordable energy as we become increasingly dependent on imported fuel.

The policy also recognises that the UK will need around 30-35GW of new electricity generation capacity over the next two decades as many of the UK's current coal and nuclear power stations, built in the 1960's and 1970's, reach the end of their lives and are set to close.

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[5] *Energy white Paper*. 2007
http://nds.coi.gov.uk/environment/fullDetail.asp?ReleaseID=286525&NewsAreaID=2

Climate Change Act 2008

The Climate Change Act 2008[6] set out the most radical targets for CO_2 emissions reduction to date. The headline targets are:

- 34% reduction over 1990 levels by 2020;
- 80% reduction over 1990 levels by 2050.

The bill requires the government to set out carbon budgets that cap emissions over five year periods. The first three periods will be 2008 - 2012, 2013 - 2017 and 2018 - 2022. The carbon budgets were released in May 2009 and are presented alongside policy proposals to achieve them in *The UK Low Carbon Transition Plan*.

The UK Low Carbon Transition Plan

The UK Low Carbon Transiton Plan - National Strategy for Climate Change[7] was published by the Departmnet for Energy and Climate Change (DECC) in July 2009. This White Paper sets out the UK's transition plan, to deliver emission cuts of 18% on 2008 levels by 2020 (34% on 1990 levels) as set out in the *Climate Change Act* 2008. Other goals include maintaining secure energy supply, maximising economic opportunities and protecting the most vulnerable.

The plan aims to cut emissions from the power sector and heavy industry by 22% on 2008 levels; from workplaces by 13%; domestic transport by 14% and farming and waste emissions by 6%[8]. The plan places the greatest emphasis on the housing sector, aiming to achieve a 29% reduction[8] on 2008 emissions levels.

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6 *Climate Change Act 2008*. 2008.
http://www.decc.gov.uk/en/content/cms/legislation/cc_act_08/cc_act_08.aspx

7 *The UK Low Carbon Transition Plan*. 2009.
http://www.tsoshop.co.uk/bookstore.asp?FO=1159966&Action=Book&ProductID=9780108508394&From=SearchResults

8 *The low carbon transition plan at a glance*, The Gaurdian, 15 July 2009
http://www.guardian.co.uk/environment/2009/jul/15/renewableenergy-carbon-emissions

Microgeneration and Renewable Technologies

There are a number of existing and proposed policies for supporting the implementation and financing of renewable energy generation, in particular microgeneration and other energy efficiency measures. They include the:

- Microgeneration Strategy;
- Renewable Obligation;
- Heat and Energy Saving Strategy;
- The Green Investment Bank;
- Clean Energy Cashback schemes:
    - Feed in Tariff;
    - Renewable Heat Incentive.

Microgeneration Strategy

The government published the microgeneration strategy In March 2006[9], to support small-scale installations. The strategy ensured that most domestic scale renewable instalments were recognised as permitted development under planning procedures to avoid the lengthy process of a full planning application.

In line with the microgeneration strategy, the *Low Carbon Buildings Programme*[10] introduced April 2006 provides grants for microrenewables for various building types. Phase 1 offers householders of up to £2,500 per property to install microgeneration technology. Phase 2 of the *Low Carbon Building Program* is now closed as the policy is being replaced by the governments Clean Energy Cashback schemes.

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[9] *Our Energy Challenge. Power from the people. Microgeneration Strategy.* 2006. http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/microgen/strategy/strategy.aspx

[10] *Low Carbon Buildings Programme.* 2006. http://www.berr.gov.uk/energy/environment/etf/lcbp/page30472.html

Renewable Obligation

The *Renewable Obligation*[11] is a financial incentive scheme designed to encourage the creation of new renewable energy generation capacity. It places an obligation on UK energy suppliers to source an increasing proportion of their electricity from renewable sources.

Renewable Obligation Certificates (ROC's) are issued to accredited generators per megawatt hour (MWh) of eligible renewable output generated. Installations with a capacity of 50KW or less are offered support under the Renewables Obligation in the form of ROC's, which can be sold to energy providers failing to meet their obligation. Since 2007, Renewable Obligation support has been improved for microgenerators, by allowing flexibility in frequency of payments, agents to deal with accreditation, and energy to be used on site prior to selling on to energy companies (replacing the previous 'sell and buy back' arrangement).

Since April 2009 all microgenerators receive two rather than one ROC's/MWh, however, the introduction of the clean energy cashback scheme and Feed In Tariff offers greater financial reward to microgenerators, eclipsing the benefits from the banded ROC's.

Heat and Energy Saving Strategy

The Heat and Energy Saving Strategy consultation[12] was launched in February 2009, the policy aims to tackle the emissions from the existing building stocks and decarbonise the generation and supply of heat. The aim is to reduce annual emissions by up to 44 million tonnes of CO_2 in 2020, the equivalent of a 30% reduction in emissions from households compared to a 2006 baseline. Ultimately the ambitious goal of this policy is to reduce emissions to close to zero for existing buildings by 2050.

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[11] *Renewables Obligation, Ofgem* http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Pages/RenewablObl.aspx
[12] *The Heat and Energy Saving Strategy*. 2009. http://hes.decc.gov.uk/

The policy aims to ensure that all lofts and cavity walls are adequately insulated by 2015, and that by 2030 all homes are fitted with cost effective energy saving measures and where appropriate renewable energy and heat generation is installed. The policy focuses on district heating networks where appropriate. It examines the potential to link the *Heat and Energy Saving Strategy* to building regulations, which would require that energy saving measures are taken alongside certain types of building work. The strategy also examines the development of new ways to provide financial support schemes for energy efficiency measures and the renewable energy generation.

Responses to *the Heat and Energy Saving Strategy* showed that there was broad support for its direction. There was support for the extension of the obligation on large energy suppliers to reduce emissions in households through the *Carbon Emissions Reduction Target* (CERT) up until the end of 2012 and pioneering more coordinated, area based whole house approaches to improving energy efficiency. This whole house approach is being trailed through the *Community Energy Savings Program* (CESP).

There was general support for the principals of financing energy efficiency improvements through Pay as You save schemes, however, it has been noted that this will need to form part of a wider mix of financial and policy tools to help encourage the levels of action required.

The Energy Security and Green Economy Bill

The *Green Deal* announced in the *Energy Security and Green Economy Bill* puts into legislation the powers to establish Pay as You Save schemes in which the upfront costs of installing energy efficiency measures are recouped by the installer through charges levied on customer energy bills.

The bill also gives powers to create a new obligation on energy suppliers to tackle their customers' emissions. This would see the current obligation (CERT) replaced when it expires in 2012 with a new obligation, designed to work alongside the *Green Deal* and targeted towards areas where additional support will be most needed such as those on low incomes and hard to treat houses.

The Green Investment Bank

To help with the challenge of financing new green infrastructure the government intends to establish the 'Green Investment Bank'. *Unlocking investment to deliver Britain's low carbon future*[13]*,* examines some of the market failures that are hampering green investment.

> "To support the delivery of the UK's emissions reduction targets as set by the *Climate Change Act 2008*. The support should be based on a public-private investment model and address specific market failures and investment barriers in a way that will achieve emission reductions at least cost to taxpayers and energy consumers."

The barriers to green investment are identified as:

- Increase political and regulatory risk from changing/inconsistent policy;
- Confidence gaps in bringing new technologies to market;
- Increasing the investment opportunity in bringing forward the large number of small, low carbon investments.

According to the report the Green Investment Bank's mandate should involve:

- Identifying and addressing market failures limiting private investment in carbon reduction activities;
- Providing coherence to public efforts to support innovation in relation to climate change by rationalising existing government established bodies and funds;
- Advising on financing issues in central and local government policy making.

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[13] *Unlocking investment to deliver Britain's low carbon future.* 2010. http://www.climatechangecapital.com/thinktank/ccc-thinktank/publications.sspx

Clean Energy Cashback

These schemes offer a guaranteed cash return for the generation of Low or Zero Carbon electricity and heat. This reduces the payback period for Low and Zero Carbon technologies and increases the their rate of uptake. The most well known clean energy cashback schemes is the 'Feed in Tariff' which covers the generation of electricity from renewable resources, the 'Renewable Heat Incentive' scheme supports the generation of heat in a similar way to the Feed in Tariff.

Feed in Tariff

Renewable energy systems installed after the 15th of July 2009 are eligible for the Feed in Tariff support, which went live on the 1st of April 2010. Microgeneration systems under 5MW installed capacity will be eligible to receive payment from the Feed in Tariff. The Feed in Tariff not only gives payments for the electricity that is exported to the grid but also on the energy is generated. Whilst the generation tariff may differ the export tariff remains the same for all technology types. The technology types covered by the Feed in Tariff are: wind, solar photovoltaic's (PV), micro-hydro, anaerobic digestion and micro-scale Combined Heat and Power (CHP).

Renewable Heat Incentive

The Renewable Heat Incentive will come into effect a year later than the Feed in Tariff and will come into force in April 2011. Almost every home in the UK generates its own heat and there is no national grid for heat to be exported to, this means that the Renewable Heat Incentive is only interested in the generation of heat and not its export. The UK has a target of increase the level of renewable heat generation from 1% to 12% between now and 2020. Difficulties with the measurement and monitoring of heat mean that financial incentive schemes for heat production are harder to establish than for the generation of renewable electricity. This issue has however been addressed by some renewable energy suppliers who offer a clean energy cashback by deeming the level of heat generated rather than measuring it directly.

2.1.2. Policy for the Built Environment

Building Regulations

Building regulation approval is required for most building work in the UK. Building regulations for England, Wales and Scotland were set out in *The Building Act* 1984[14] and *The Building (Scotland) Amendment Regulations* 2006[15] regulations. The building regulations cover a range of different areas as outlined below:

- Part A. Structure
- Part B. Fire safety
- Part C. Site preparation and resistance to contaminants and moisture
- Part D. Toxic substances
- Part E. Resistance to the passage of sound
- Part F. Ventilation
- Part G. Hygiene
- Part H. Drainage and waste disposal
- Part J. Combustion appliances and fuel storage systems
- Part K. Protection from falling, collision and impact
- Part L. Conservation of fuel and power
- Part M. Access to and use of Buildings
- Part N. Glazing - safety in relation to impact, opening and cleaning
- Part P. Electrical safety - Dwellings

It is Part L of the building regulations that is of the most interest in this report and will be looked at in greater detail in Section 3, although the Part G of the building regulations is also of interest as this relates to water consumption within a dwelling.

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[14] *The Building Act.* 1948. http://www.legislation.gov.uk/ukpga/1984/55
[15] *The Building (Scotland) Amendment Regulations.* 2006. http://oqps.gov.uk/legislation/ssi_20060534_en_1

Zero Carbon Building

In the 2006 consultation document, *Building a Greener Future: Towards Zero Carbon Development*[16] and the subsequent *Building a Greener Future: Policy Statement*[17] the Government set out its proposals to reduce the carbon emissions for new housing to zero over the coming decade. The mechanisms proposed for achieving this target are to increase the energy efficiency requirements in Part L of Building Regulations and use of The Code for Sustainable Homes (or Code).

The definition of what constitutes a 'zero carbon building' has been a matter of some discussion. The current accepted meaning in the context of new development is described as zero carbon in use[18], i.e. the energy use in the day-to-day operation of the building does not result in any CO_2 emissions over the course of a year. The CO_2 emitted during the construction and demolition stages of the buildings lifecycle are not counted.

One complication in defining zero carbon derives from the method by which the energy use and CO_2 emissions of buildings has been historically calculated for compliance with Building Regulations. In these calculations, known as the 'regulated emissions' only the energy used for hot water, heating and lighting are considered. The energy use for cooking and appliances in dwellings is referred to as the 'unregulated emissions', while in non-domestic buildings, the energy use not covered by Part L is known as the 'occupant energy'. The definition of zero carbon requires that there are no resultant CO_2 emissions from both regulated and unregulated energy use.

[16] *Building a Greener Future: Towards Zero Carbon Development.* 2006
http://www.communities.gov.uk/archived/publications/planningandbuilding/buildinggreener
[17] *Building a Greener Future: Policy statement.* 2007
http://www.communities.gov.uk/publications/planningandbuilding/building-a-greener
[18] *Definition of Zero Carbon Homes and Non-domestic buildings*. 2008.
http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

2.1.3. National climate change policy approach

UK Climate Change Programme

The UK Climate Change Programme was launched in 2000 in response to Britain's international greenhouse gas emissions targets. Re-launched in 2006[19], its role is to detail how the UK plans to meet those targets and present yearly progress reports. One of the areas it identifies as key, was local government:

> "Action by local authorities is likely to be critical to the achievement of Government's climate change objectives. Local authorities are uniquely placed to provide vision and leadership to local communities, raise awareness and help change behaviors. In addition, through their powers and responsibilities (housing, planning, local transport, powers to promote well-being and through activities such as their own local procurement and operations) they can have significant influence over emissions in their local areas".

Planning Policy Background

There are a range of national planning policy drivers influencing regional and Local Planning Strategies, still being consolidated into a set of working policies. Many of these encourage innovative thinking by local authorities to exceed national policy and existing legislation on mitigating, and adapting to climate change. Alongside policies, assessment procedures have been introduced to aid the control of new developments.

The Planning White Paper, *Planning for a Sustainable Future*[20], published May 2007, highlights the significance of the role of local planning authorities in tackling energy efficiency and supporting sustainable development. It

[19] *UK Climate Change Programme*. 2006, http://www.decc.gov.uk/en/content/cms/what_we_do/change_energy/tackling_clima/programme/programme.aspx

[20] *Planning for a Sustainable Future: White Paper.* 2007 http://www.communities.gov.uk/publications/planningandbuilding/planningsustainablefuture

advocates streamlining the planning system, improving the ability of local authorities to shape their communities, and ensuring sustainable economic development alongside climate change mitigation.

The paper suggests that long-term objectives such as climate change must be considered in planning policy at all levels, and that development should be environmentally, socially and economically sustainable. Implementation examples include supporting zero carbon developments, and addressing transportation issues such as appropriate siting and integrated public transport, including provision of suitable pedestrian and cycling facilities in new developments.

In 2006 and 2008 respectively the government announced ambitions to make all new housing developments zero carbon from 2016, and non-residential developments zero carbon by 2019. The Department of Communities and Local Government have since issued further plans to define zero-carbon[21] and to achieve these targets. This was outlined in *Building a Green Future*, 2007, which set up moves to tighten Building Regulations to reduce carbon emissions from new homes.

The Code for Sustainable Homes assessment procedure (replacing Ecohomes in 2006) introduced mandatory requirements for energy and water categories, along with optional credits to achieve higher code levels. The code was introduced as a path towards zero carbon, and a rating has been mandatory since 2008, due to rise to level 6 rating (zero carbon) by 2016.

National Planning Policy

Planning Policy Statements (PPS) provide guidance to local authorities in drafting Local Development Documents and determining applications. A number of PPS relate to climate change to varying degrees. Most notably relevant to this evidence base is *PPS1: Delivering Sustainable Development,*

[21] *Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation*. 2008. http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

which will be explored in more detail.

PPS3: Housing, calls for well designed homes and making best use of land, along with encouraging new building technologies to deliver sustainable development.

Other relevant PPSs deal with more specific sustainability factors: *PPG4: Industrial, Commercial Development and Small Firms*, *PPS6: Planning for Town Centres* and *PPG13: Transport*, primarily address transportation. *PPS12: Local Development Frameworks* and *PPS23: Planning and Pollution Control* deal with energy concerns (as well as local pollution). *PPS7: Sustainable Development in Rural Areas* and *PPS9: Biodiversity and Geological Conservation* deal with ecology (PPS7 also deals with energy). *PPS 25: Development and Flood Risk* deals specifically with flooding and surface water issues.

PPS22: Renewable Energy, deals with site based generation of renewable energy and local authorities' powers to determine percentage requirements for new developments. These are given with the caveat that the specified amount of renewable energy is technologically viable and will not 'place an undue burden on developers'.

PPS1: Delivering Sustainable Development sets out generic policies for local authorities on the facilitation and promotion of sustainable development. PPS1 states that:

> "Regional and local planning authorities should … (establish) … policies which reduce energy use, reduce emissions and promote the development of renewable energy resources. In particular, … encourage rather than restrict the use of renewable resources."

A supplement to PPS1 was issued in 2007 to set out how planning should aid emissions reduction to stabilise climate change whilst adapting to the unavoidable consequences. The supplement attempts to clarity the relationship between planning policies, the Building Regulations and Code for Sustainable Homes. It is intended to read along side other PPSs but takes precedent where climate change emphasises differ.

The PPS1 supplement explains that policy guidance, regulation and assessment methods are designed to complement each other and local authorities should work within this framework to encourage developers to build sustainably. The Local Development Document should set ‘significant’ policies on the provision of low carbon and renewable energy generation, including a percentage requirement for developments where viable, increasing targets for specific areas or sites where appropriate.

> “Planning authorities should have an evidence-based understanding of … potential for renewable and low-carbon technologies … to supply new development in their area. This may require … drawing in other appropriate expertise, to make their own assessments.”

This evidence-base, together with housing and economic objectives should be used to set percentage targets for renewable energy generation for new developments, avoiding prescription on technologies and giving flexibility for methods of securing carbon savings from local energy supplies. Opportunities for increase on the target percentage should be explored and higher area or site-specific targets set. The type and size of development relating to targets should be specified with a clear, tested rationale for the target.

The PPS1 supplement requires local authorities to “engage constructively and imaginatively” with developers and other partners “to encourage the delivery of sustainable buildings”. It encourages planning authorities to “anticipate levels of building sustainability in advance of those set out nationally” by demonstrating clearly “local circumstances that warrant and allow this”.

The PPS1 supplement urges local authorities to use existing standards for specifying development requirements, for example to require that "identified housing proposals (are) to be delivered at a specific level of the Code for Sustainable Homes". This can apply to a whole Code level, or purely a requirement in relation to the energy standard.

When setting out requirements in Development Plan Documents (DPDs) the local authority should fully consider economic implications, and in the case of housing ensure that policies do not adversely affect housing provision, particularly affordable housing. The PPS1 supplement states that local authorities should:

> "*Ensure what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market … and the need to avoid any adverse impact on the development needs of communities;*
>
> *In the case of housing development … demonstrate that the proposed approach is consistent with securing the expected supply and pace of housing development … and does not inhibit the provision of affordable housing;*
>
> *Set out how they intend to advise potential developers on the implementation of the local requirements, and how these will be monitored and enforced*".

In summary, the PPSs clearly indicate a need for local authorities to be proactive in securing development that exceeds the national standards on sustainable building. The need to consider economic viability and not to impede housing trajectories (particularly social housing) is also spelled-out, therefore, any attempts to exceed national expectations for sustainable design and construction must take viability into consideration.

2.2) **Regional Planning Policy**

The London Plan

The London Plan[22], adopted in February 2008 contains a strengthened Chapter 4A 'Climate Change and London's Metabolism'. The chapter identifies planning as a key driver in tackling climate change both through mitigation and adaptation. Energy efficient design along with decentralised energy supply is prioritised over site based renewables.

Policy 4A.1 'Tackling Climate Change' requires local authorities to produce DPDs that ensure the fullest contribution from developers to minimise and adapt to climate change. It advocates a hierarchy of measures from 'be lean' (use less energy), 'be clean' (supply energy efficiently) to 'be green' (use renewable energy).

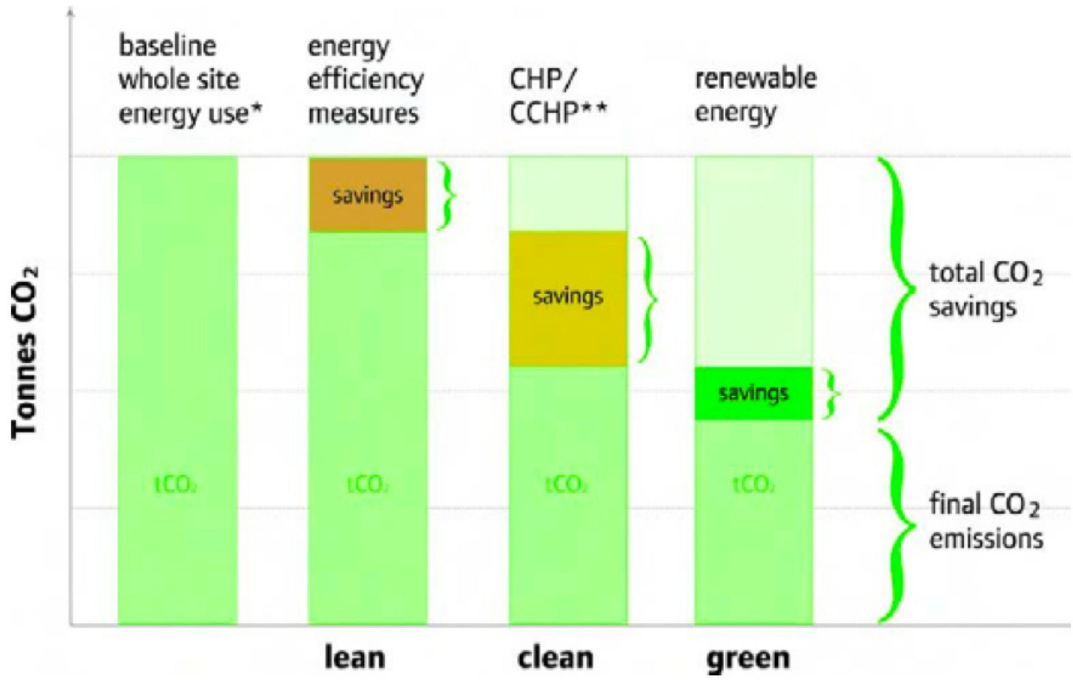

Figure 2.1 The Hierarchy of actions for tackling climate change. (*The London Plan* 2008).

[22] *The London Plan. Spatial Development Strategy for Greater London*. 2004 http://www.london.gov.uk/thelondonplan/thelondonplan.jsp

Policy 4A.2 ‘Mitigating Climate Change’ specifies specific targets for reduction of CO_2 against a 1990 base as follows:

- 15% by 2010;
- 20% by 2015;
- 25% by 2020;
- 30% by 2025.

Policy 4A.3 ‘Sustainable Design and Construction’ requires developers to make the most efficient use of land and existing buildings, and to minimise the need to travel. Policies 4A.3, 4A.6 ‘Decentralised Heat, Cooling and Power’, 4A.9 ‘Adaptation’, and 4A.10 ‘Overheating’ address energy efficient building design and promote the use of passive solar design, natural ventilation, natural heating and cooling and vegetation on buildings.

Policy 4A.7 ‘Renewable Energy’ requires that all new developments will be required to reduce CO_2 emissions by 20% by using on site renewables, unless the developer can prove that this is not feasible. It also requires that local authorities identify specific areas or types where certain targets and technologies are appropriate.

The London Plan – Consultation draft replacement plan

In October 2009 consultation on the draft replacement of the London Plan began. The majority of the climate change policies remain little changed, however, the draft replacement plan does include some important alterations to regional climate change policies.

The emissions reductions targets for the region have been doubled, and now stand at a 60% reduction (on 1990 baseline) by 2025. Sector specific targets, set against part L 2006, backup this target:

Residential buildings:

- 2010 – 2013 = 44%
- 2013 – 2016 = 55%
- 2016 – 2031 = Zero Carbon

Non-residential:

- 2010 – 2013 = 44%
- 2013 – 2016 = 55%
- 2016 – 2019 = As per building Regulation requirements
- 2019 – 2031 = Zero Carbon

There are two important changes to renewable energy policies within the draft replacement London plane. The first is that there is now a target for London to produce 25% of its energy form CHP generation and Decentralised Energy Networks (DEN). The removal of the requirement to achieve a 20% reduction in CO_2 emissions from onsite renewable energy production is an interesting change in policy direction. This change signifies a move away from locally derived prescriptive renewable energy targets, towards national energy efficiency backstops enshrined in and enforced through building regulations.

South London Sub Region

The South London sub-region comprises the boroughs of Bromley, Croydon, Merton, Sutton, Kingston and Richmond. It is identified as 'a relatively prosperous sub-region, noted for its high environmental quality, with a diverse economy'. The area is identified as having mostly 'small scale development opportunities compared with other London sub-regions' and the Wandle Valley corridor is identified as 'the part of South London most in need of renewal'. Although only one of London's worst 20% of deprived wards lie within the sub-region, parts of Merton are identified as problematic and some large social housing estates (such as St Helier) feature in estate renewal programmes. Transport links, training programmes, and capacity-building initiatives are highlighted as mechanisms for regenerating these communities.

Policy 2.13 'Opportunity Areas and Intensification Areas' from the London Plan draft replacement states that higher density redevelopment should be promoted 'at key transport nodes of good accessibility and Capacity and in town centres, and seek to achieve higher levels of provision wherever possible, especially for housing. South Wimbledon / Collier's Wood is identified as the area for intensification in this sub-region, and targets of 500 new jobs and 1,300 new homes by 2016 are given.

‘Four major opportunities for ‘intensification and brown-field redevelopment’ are identified within the South Wimbledon / Collier’s Wood area: Wandle Valley Sewage Works, Wimbledon football club and dog track sites, Durnsford Road industrial estate and Colliers Wood. It is asserted that improvements in public transport, incentives for intensification of use and ‘encouraging changes from current inappropriately located retail provision to more sustainable business activities’ would improve the viability of these potential sites.

It is also suggested that potential for intensification around Mitcham/Willow Lane should be explored as a ‘key node in the Wandle Valley’, providing public transport could be improved.

As part of the draft replacement London Plan Policy 3.3 ‘Increasing housing supply’ an annual target of 320 additional residential units are sought. This falls within a London wide target of 457,950 homes in total and 23,000 annually.

Policy 3.3 states that local authorities should seek to exceed the figures above and ‘address the suitability of housing development in terms of location, type of development and impact on the locality’. Methods should include; ‘change of use of unneeded industrial/employment land to residential or mixed use development’; ‘redevelopment in town centres, suburban heartlands and small scale residential infill’; ‘intensification of housing provision through development at higher densities particularly where there is good access to public transport’. Existing identified housing sites should be reviewed, and capacities determined in accordance with London Plan urban design and density policies.

2.3) **Local Planning Policy Examples**

This section gives examples of different aspects of Core Strategies Developed by other local authorities in the UK, which deal with sustainable development.

London Borough of Richmond upon Thames

The *Local Development Framework Core Strategy* for Richmond[23] was adopted April 2009. In the *Core Strategy Section 8 'Spatial Policies' - 8.0.2 'For a Sustainable Future'* outlines proposals for developing within a sustainable framework. Borough specific challenges are identified as 'an older housing stock, an affluent population and high levels of car ownership', and accordingly there is a focus on sustainable travel, along with minimising energy and other resource use for new and existing buildings. Sustainable waste handling and protection of biodiversity are also priorities, along with measures to mitigate flooding risk due to Richmond's location on the river Thames.

CP1 Sustainable Development requires all new development to conform to the Sustainable Construction Checklist SPD, which was adopted by the council in 2006. The checklist currently specifies that the following standards should be met:

- Code for Sustainable Homes level 3 (for new domestic developments)
- Ecohomes Excellent (for conversions)
- BREEAM Excellent (for other non-development)

CP1 calls for 'appropriate location of land use' to ensure communities are provided with facilities locally to reduce travel distances. 'Making Best use of land' is required for instance by co-location or dual use, and redevelopment of sites only where increase in floor area is achieved. 'Reducing environmental Impact' should be achieved by considering environmental benefits of refurbishment over redevelopment, minimisation of open land use for

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[23] *London Borough of Richmond upon Thames, Local Development Framework Core Strategy*. Adopted April 2009 http://www.richmond.gov.uk/core_strategy-3.pdf

development and retention of natural vegetation. Local air and noise pollution and contamination should also be minimised. CP1 also states that 'Environmental gain to compensate for any environmental cost of development will be sought'.

CP1 states that its policies should be encouraged in both the public and private sector. It is recognised that although funding for some measures is available there will be additional costs to be met by developers. The following targets are set:

Brownfield development: 95% of all new / converted housing to be built on previously developed land (as a percentage of all new and converted dwellings).

Density:

1. Less than 35 dwellings per hectare - no more than 10% of gross units completed
2. From 35-50 dwellings per hectare - at least 10% of gross units completed
3. Over 50 dwellings per hectare - at least 80% of gross units completed

Code for Sustainable Homes:

4. 95% of all development over 5 residential units meeting CSH level 3 / Ecohomes Excellent standards (for conversions)
5. 95% of all commercial development above 1,000m^2 meeting BREEAM Excellent standard (thresholds under review).

Contaminated land remediation: 5 contaminated land sites remediated each year

CP2 'Reducing Carbon Emissions' states that CO_2 reduction measures will be required in new development and encouraged in existing buildings, and that this should apply particularly to local authority owned buildings; Decentralised energy should also be evaluated and used for 'appropriate development'; CO_2

emission reductions of 20% are required from onsite renewable energy generation in new developments unless proven unfeasible; onsite renewables will be promoted for existing development. CP2 identifies specific decentralised energy schemes for consideration.

CP3 'Climate Change - Adapting to the Effects' states that 'development will need to be designed to take account of the impacts of climate change over its lifetime, including Water conservation and drainage; The need for Summer cooling; Risk of subsidence; and Flood risk from the River Thames and its tributaries' it also states that Development in areas of high flood risk will be restricted. CP3 states that 'No planning permissions granted contrary to Environment Agency advice on flooding and water quality grounds'.

CP4 'Biodiversity' states that Richmond's biodiversity 'including SSSIs and Other Sites of Nature Importance will be safeguarded and enhanced'. Areas of deficiency are identified for biodiversity enhancement, along with areas of new development 'along wildlife corridors and green chains such as the River Thames and River Crane corridors.' Priority will be given to protected species and habitats identified in the 'UK, Regional and Richmond upon Thames Biodiversity Action Plans'. Percentage targets are set for protection of SSSIs, access to sites of nature importance and positive conservation management.

CP5 'Sustainable Travel' states that appropriate local level provision of employment, shops and services should be used to reduce the need to travel. This will include protection and enhancement of local facilities and employment, and locating developments generating significant amounts of travel close to public transport hubs.

CP5 further states the following aims: Land will be safeguarded for sustainable transport, new bicycle and walking networks will be created and conditions improved for cyclists and pedestrians elsewhere. Specific opportunities are identified for pedestrian links, and pedestrians will be prioritised particularly in town and shopping centres. The needs of pedestrians and cyclists will be prioritised in the design of new developments, including links to existing networks and requiring the provision of adequate cycle parking.

Additionally, CP5 proposes improvement of bus provision and traffic impact reduction measures particularly in specified sensitive areas. Improvements to interchange facilities at stations and orbital public transport, and new car free housing in areas where there is good public transport. Car clubs, use of low emission vehicles should be encouraged and long-term commuter parking discouraged.

Ashford Borough Council

Ashford Borough Council Core Strategy[24], adopted July 2008, covers the 15-year period 2006 to 2021. Ashford Growth Area was identified in the government's *Sustainable Communities Plan* in 2003. The levels of new housing and employment provision required for the Greater Ashford Urban Area are therefore a priority of the strategy.

Several growth scenarios have been evaluated for Ashford to meet the Sustainable Communities Plan requirements, concluding that Ashford town has the capacity to provide an additional 31,000 homes and 28,000 jobs over the period 2001 to 2031. The growth area will not be spread across the Borough, and therefore widely differing development profiles for the town and surrounding rural areas are proposed by the strategy.

The Greater Ashford Development Framework (GADF) underpins the spatial strategy pursued through the Core Strategy. It tests and refines the outline spatial framework measures set out in the Regional Planning Guidance for the South East (RPG9) to provide the basis for the Local Development Framework. A master-plan has been developed and a strategic growth model phasing strategy developed to deliver the expansion of the town up to 2031.

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[24] *Ashford Borough Council Local Development Framework Core Strategy.* adopted July 2008 http://www.ashford.gov.uk/pdf/Planning_Adopted_Core_Strategy_July08.pdf

The 'Vision for the core strategy' states that 'An emphasis on sustainable development and high quality design is central to the Council's approach to plan making and deciding applications.' Policy CS1 presents 'key overarching objectives from which the policies in the rest of the document are derived'

Policy CS1: 'Guiding Principles' include a need for:

- Working towards achieving zero carbon developments that are designed to mitigate and adapt to the effects of climate change, and that minimise flood risk, provide for adequate water supply, protect water and air quality standards; minimise the use of resources and waste, and enhance biodiversity;
- A mixture of uses and adaptable building types, respect the site context and create a positive and distinctive character and a strong sense of place and security;
- Protecting countryside, landscape and villages and promotion of strong rural communities;
- Provision of integrated and connected network of green spaces;
- The best use of previously developed land and buildings to help regenerate urban areas and the carefully phased release of green field land;
- Provision of community services and employment to provide for the needs arising from development and a growing population;
- A wider range of sustainable transport;
- Encouraging new and existing businesses;

Section 9: 'Design and Sustainability' introduces sustainable development as an imperative, and no longer an option. It advocates new thinking and an innovative approach and capitalizing on the opportunity offered by Ashford Growth Area. It refers back to the emphasis on sustainable development and high quality design in Regional Planning Guidance (RPG9) and the emerging Regional Spatial Strategy (RSS)

Policy CS10: 'Sustainable Design and Construction' states that all major developments must reduce the consumption of natural resources and to help deliver the aim of zero carbon growth in Ashford, (unless proven technologically impracticable, or would make the scheme unviable). Developers have the option of offsetting residual carbon emissions elsewhere in the borough where applicable.

Table 2.2 gives requirements in terms of: Energy and water efficiency; Sustainable construction materials; Waste reduction and Carbon dioxide emissions reduction.

Table 2.2. Sustainable design and construction targets (A) and Emissions reduction targets (B) for different locations (Ashford LDF 2007 – 2014)

			(CS3) Town Centre & (CS4) Brownfield Urban Sites	**(CS5) Urban Extensions & (CS4) Greenfield Urban Sites**	**(CS6) Tenterden, the Villages, and (CS7)**	**Existing and refurbishment**
A	**CODE**	**Residential**	Code Level 3	Code Level 4	Code Level 2	EcoHomes 'Very Good'
	BREEAM	**Overall level**	Very good	Excellent	Good Very	good
		Energy Credits	Excellent	Excellent	Excellent	Excellent
		Water Credits	Maximum	Maximum	Excellent	Excellent
		Materials Credits	Excellent	Excellent	Very Good	Very Good
B		**Minimum Carbon Dioxide reduction**				
			20%	30%	10%	10%

'Biodiversity and Geological Conservation' aims to ensure that biological diversity is conserved and enhanced particularly identified habitats of importance within the Borough, as well as SSSIs and ancient woodlands. Biodiversity throughout rural and urban areas of high importance and all should be protected in accordance with 'Government and Kent Structure Plan Policies'.

Policy CS11: 'Biodiversity and Geological Conservation' states that 'Development proposals should avoid harm to biodiversity and … enhance and expand biodiversity … to sustain wildlife in accordance with the aims of the National and Kent Biodiversity Action Plans...'

Havering Borough Council

The *Core Strategy and Development Control Policies Development Plan Document* for Havering[25] (Adopted 2008), draws on national policy as set out in Planning Policy Guidance and Planning Policy Statements, and Regional Policy objectives as set out in the London Plan, and specifically the East London sub-region.

The aging population is identified as a borough specific issue, with Havering having the highest proportion of older people of any London Borough in 2001. Housing the aging population is a key issue for the strategy, specifically extra care and accessible accommodation.

Core Policy CP15: 'Environmental Management' requires that new development should:

- Minimise their use of natural resources including the efficient use of land;
- Reduce and manage surface water and flood risk;
- Sustainable water supply and drainage;
- Conserve water quality; air quality targets;
- Address contaminated land issues;
- Avoid a noise and lighting pollution.

High standards of sustainable construction and design will be required along with onsite renewables in line with regional and national policy. This includes Code for Sustainable Homes Level 3, which will help reduce water usage and tackle water consumption.

[25] *Core Strategy and Development Control Policies Development Plan Document*. Adopted 2008. http://www.havering.gov.uk/CHttpHandler.ashx?id=18279&p=0

Development Control Policy DC49: 'Sustainable Design and Construction' states that 'planning permission for major new developments will only be granted where they are built to a high standard of sustainable construction.'

Major developments will be required to achieve a rating under the BREEAM rating scheme (or equivalent methodology), for non-residential developments of at least 'Very Good'; and for residential developments at least 'Level 3' Code for Sustainable Homes from 2008, 'Level 4' from 2010, 'Level 5' from 2013 and 'Zero Carbon' from 2016.

Development Control Policy DC50: 'Renewable Energy' requires CO_2 emission reductions of at least 20% for major developments in line with the London Energy Strategy and *PPS22: Renewable Energy.* A need for major investment in decentralised smaller-scale renewable energy generation is also identified. DC50 also states that renewable installations will be considered with regard to the type, location, and design of development, and providing they are not 'detrimental to the character of the surrounding area.'

3) **Sustainability in the built environment**

3.1) **Reducing CO_2 Emissions from Buildings**

There are two methods of reducing CO_2 emissions from buildings:

- Reducing the energy use, through energy efficiency measures;
- Supplying the buildings energy through 'Low or Zero Carbon' (LZC) technologies.

The 'Energy Hierarchy' concept of reducing the CO_2 emissions of a building demands that all opportunities for energy reduction are explored before Low or Zero Carbon technologies are specified. In practice, financial considerations or prescriptive renewable energy generation targets often preclude this.

3.1.1. Energy efficiency

A buildings energy profile is made up of three categories:

- Heating and Hot Water
- Cooling
- Electrical

A typical UK dwelling will have an energy use profile in which the heating and hot water component makes up the majority of the energy used with the remainder consisting of electricity use. As homes become more thermally efficient however, the electrical load forms a greater proportion of the total.

Non-domestic buildings, particularly deep plan offices, are likely to have a far greater cooling load, especially if there is a high level of thermal gain from lighting and equipment. There are a number of methods of reducing the energy requirements of a building.

Insulation

Fabric elements with high levels of insulation reduce heat loss. Associated with this are heat losses through thermal bridging which should be minimized through skilful design and detailing.

Air-tightness

Once high levels of insulation have been attained, the major source of heat loss becomes the flow of air through the building. Reducing this flow to a minimum improves the thermal performance, though a certain amount of controlled ventilation is required for a healthy environment.

Ventilation

An airtight building requires ventilation to maintain indoor air quality. Passive or mechanical ventilation systems with heat recovery can reclaim up to 85% of the thermal energy of exhaust air.

Thermal Mass

Heavyweight materials that can store a lot of heat energy are useful in regulating building temperature both in hot and cold conditions. Thermally massive buildings are much less likely to overheat especially if they have well designed night time cooling capabilities.

Day Lighting and Solar Gain

Correct orientation and good use of glazing can reduce the need for artificial lighting and allow solar gain during winter months, lowering both the heating and electrical load.

Shading

Solar gain can also be a problem in the hotter months of the year and clever use of shading is a natural method of alleviating this problem.

Low Energy Appliances and Lights

As the proportion of CO_2 emissions from electricity use grows, it becomes increasingly important to specify low energy lighting and electrical equipment.

3.1.2. Low and Zero Carbon Technologies

Onsite Low and Zero Carbon energy generation will become increasingly important as we move towards the zero carbon buildings requirement in 2016 and beyond. Low and Zero Carbon energy is required when the limits of energy efficiency have been met. The table below gives a summary of the most common current technologies.

Table 3.1 Summary of Low and Zero Carbon Technologies.

Technology	Suitability and Key Issues	Performance & Lifetime	Cost per unit CO_2 saved
Wind Turbines 1kW – 30kW building mounted or stand alone	Requires good uninterrupted wind resource. No fuel costs, offsets high CO_2 content electricity; very site-specific; requires regular maintenance; may be visually intrusive and require separate planning permission.	Dependent on wind flow at site. 15-25 years	Low / Medium
Solar Photovoltaics Roof or wall mounted panels convert sunlight to DC electricity	Requires south-east to south-west facing non-shaded roof or wall. Can be used to replace roof or wall cladding. Proven technology, widespread in UK and Europe; no fuel costs; easy to integrate into building; low maintenance; offsets high CO_2 content electricity; UK has poor conditions for performance.	800-850 kWh per annum per kWp 30 years+	High
Solar Thermal Roof mounted panels generate hot water	Requires south-east to south-west facing non-shaded roof, heat store and conventional boiler. Proven technology widespread in UK and Europe; no fuel costs; only provides max 60% of hot water; length of pipe runs key to performance which can preclude use in high blocks of flats; performance dependent on correct boiler timing.	400-500 kWh of thermal energy per m^2 per annum 15-25 years	Low
Hydro Water turbine technology generating electricity	Requires suitable water flows: generally high head or very large flow volume. Offsets high CO_2 content electricity; no fuel costs; very site-specific; can have high visual impact.	Varies Indefinite subject to maintenance	Low

Technology	Suitability and Key Issues	Performance & Lifetime	Cost per unit CO_2 saved
Biomass Heat Generating heat from organic fuel either for large building or groups of flats/houses as community system	Requires good local supply of fuel Proven technology widespread in UK and Europe; CO_2 savings very dependent on energy input to fuel source through manufacture and shipping; smaller units very sensitive to fuel quality; ongoing fuel costs; requires regular maintenance, slow response time	Can provide 100% of heating and hot water demand 25 years	Low/medium
Biomass CHP Generating electricity and heat from organic fuel	Requires good local supply of fuel Proven technology in large-scale European installations, less common in UK; smaller scale plant in unproven; CO_2 savings very dependent on energy input to fuel source through manufacture and shipping: ongoing fuel costs; requires regular maintenance	Generally sized to provide 100% of heating and hot water load Dependent on size	Medium
Ground Source Heat Pumps Converts electricity to heat or coolth	Requires large horizontal or vertical ground area with suitable geology for collector loops Proven technology; high energy efficiencies of 300–500%; coverts electricity to heat so CO_2 efficiencies can be substantially lower, depending on emission factor of electricity used; best efficiencies require low heat distribution system; high set up costs, low fuel costs	Can provide 100% of heating and hot water load 20 years	Medium
Air Source Heat Pumps Converts electricity to heat or coolth	Provide same function as GSHP without the need for large ground area. Proven technology; in use performance in the UK is yet to be proven efficiencies of 300% + are claimed; coverts electricity to heat so CO_2 efficiencies can be substantially lower, depending on emission factor of electricity used; best efficiencies require low heat distribution system; low fuel costs; can be used to provide cooling in summer	Can provide 100% of heating and hot water load 20 years	Low
Fossil Fuel CHP Unit replaces traditional heating system and produces both heat and electricity	Reduces CO_2 emissions by producing heat and electricity from fuel. Proven technology in community situations, micro CHP for individual homes still emerging; best linked to variety of heat users to spread load throughout day and year; can be modular and connected to district system; facilitates upgrade of heat provision to emerging low carbon technology	Generally sized to provide 100% of heating and hot water load 25 years	Medium

Heat Pump Technologies

The proposed changes to the carbon emission factors used in SAP and SBEM are likely to have a big effect on the use of heat pumps in the UK. The relevant changes are as follows:

- Mains gas 0.194 to 0.206 kgCO_2/kWh
- Grid electric 0.422 to 0.591 kgCO_2/kWh

These changes take gas transmission losses and the effects of leaks in to account and give a fairer representation of the actual emissions from the electricity grid.

The table below shows the effect of grid emission factors on the CO_2 saving of heat pumps when they are used to replace mains gas heating.

Table 3.2 International comparison of the Heat pump efficiency and emissions saving (Energy information Administration).

	Emission Factor Heat Pump Energy (kgCO_2/kWh)					% improvement over gas		
	Grid emissions Factor	Gas emissions Factor	Heat pump COP3	Heat pump COP4	Heat pump COP5	Heat pump COP3	Heat pump COP4	Heat pump COP5
Iceland	0.001	0.206	0.0005	0.0003	0.0003	99.78%	99.83%	99.87%
Norway	0.005	0.206	0.0018	0.0013	0.0011	99.14%	99.36%	99.48%
Sweden	0.048	0.206	0.0159	0.0119	0.0095	92.30%	94.23%	95.38%
France	0.083	0.206	0.0276	0.0207	0.0165	86.62%	89.97%	91.97%
Austria	0.197	0.206	0.0658	0.0493	0.0395	68.07%	76.06%	80.84%
Canada	0.223	0.206	0.0744	0.0558	0.0446	63.91%	72.93%	78.34%
UK	0.591	0.206	0.1970	0.1478	0.1182	4.37%	28.28%	24.62%
Ireland	0.699	0.206	0.2330	0.1750	0.1400	-13.05%	15.21%	32.17%
Australia	0.924	0.206	0.3081	0.2311	0.1849	-49.57%	-12.18%	10.26%

N.B. These figures have not factored in the efficiency of the gas boiler used at heating point or the auxiliary load of the heat pump system.

The effect of these changes is to render heat pumps with an average 'Coefficient Of Performance' (COP) of less than 4 extremely marginal for CO_2 reduction compared to gas heating; this will affect air source heat pumps more then ground source heat pumps due to their generally lower COPs.

The case for using heat pumps has always maintained that their benefit will increase as the grid becomes greener. The 'marginal capacity factor' of 0.422kgCO_2/kWh used for predicting emissions from grid supplied electricity was intended to represent this greening over a 15-20 year period. In fact the carbon intensity of the grid has risen relentlessly since it's historic low of 0.49 $kgCO_2/kWh$ in 1999 and now sits at 0.53 $kgCO_2/kWh$. With the number of nuclear power stations coming to the end of their life and no clear strategy in place for their replacement, either by new nuclear or renewable generation, there is a case to be made that the carbon intensity of the grid will continue to rise over the short to medium term.

It could also be argued that, by adding load to the grid through their installation, heat pumps actually make it harder to green the grid as the extra capacity is likely to be met by the more carbon intensive sources such as coal and oil fired power stations.

The purpose of discussing the issue of COP and grid emissions factors on the performance of heat pumps isn't intended to be attack on a particular technology but rather as an illustration of how the environmental performance of a technology can be influenced by technological and political factors.

3.2) **Energy efficiency Vs Low and Zero Carbon Energy**

In the consultation document, *Definition of Zero Carbon Homes and Non Domestic Buildings*[26], the Government's desire that all new developments should be built to high energy efficiency standards was set out. The report stated that:

> "High energy efficiency standards will help secure energy and carbon savings over the lifetime of the building, without relying on the investment or behavioural choices that occupants will make. This is because energy efficiency measures that are part of the fabric of the home, should have a longer lifetime than energy supply technologies such as microgeneration. They should be less vulnerable than microgeneration to the risk of occupants not using them or removing them altogether."

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[26] *Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation*. 2008. http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

This belief links to policy frameworks such as the Greater London Authority's Energy Hierarchy as detailed in The London Plan[27], which requires that developers should first look to fully exploit energy reduction opportunities before resorting to Low and Zero Carbon technologies. In addition, one of the concepts that underpinned the original Merton Rule was that requiring renewable energy generation would encourage developers to reduce the predicted energy use of buildings in order that the expensive renewable system would be as small as possible.

In practice the decision on how CO_2 reduction targets are met is driven largely by costs and available skills. Costing research done by Cyril Sweett[28] has shown that energy efficiency measures can be more expensive than a comparative renewable solution. Evidence coming through from local planning authorities suggest that developments being built to Code 4 standards are generally using Low and Zero Carbon technologies to meet around half of the required 44% CO_2 reduction even when they are not required to by planning policy.

The governments suggested solution to this is to require higher energy efficiency backstops, enforced through Part L of Building Regulations. The table below lists some of the benefits and drawbacks of the two methods of CO_2 reduction in buildings.

Table 3.3 Comparison of LZC technologies and Energy Efficiency Measures in buildings.

	Benefits	Drawbacks
Low and Zero Carbon Technologies	Drive innovation and cost reduction in LCZ industry Often provide visual reminder of energy issues No need for construction workers to have higher skill	Inappropriate systems and untried technology can lead to poor performance Many LZC techs require ongoing maintenance and renewal to keep delivering savings

27 *The London Plan. Spatial Development Strategy for Greater London*. 2004 http://www.london.gov.uk/thelondonplan/thelondonplan.jsp

28 *Definition of Zero Carbon Homes: Impact Assessment.* 2009 http://www.communities.gov.uk/documents/planningandbuilding/pdf/1284609.pdf

	levels for some technologies Can be lowest cost solution	Resident behaviour may affect performance Can have high embodied energy
Improved Fabric and Energy Efficiency Measures	No running costs Keep delivering savings with minimal/no need for maintenance and renewal Low embodied Energy	Requires highly skilled workmen to deliver required levels of detailing Lends itself to offsite manufacture often leading to lightweight buildings Requires higher levels of design Higher levels can be expensive

The choice of energy efficiency vs. LZC may also be affected by whether the development in question is speculative or not. The ongoing cost of fuel maintenance and renewal of an LZC system will not be of concern to a speculative developer, whereas the eventual owner of a client commissioned build is more likely to consider the lifecycle costs of the building.

3.3) **The Built Environment**

Building Regulations

Building Regulations were originally developed to ensure that buildings are constructed to be safe and suitable for application. There have since been a number of amendments including the issuing of Part L which focuses on fuel and energy consumption in new and existing buildings.

The most recent revision to Part L was introduced in 2006 and is being used as the main mechanism for implementing key aspects of the *European Energy Performance of Buildings Directive*[29]. Consultation is currently underway on the next revision of Building Regulations, which will involve substantial changes to Part L and Part G.

[29] *European Energy Performance of Buildings Directive.* 2010 http://www.diag.org.uk/

2010 Building Regulations Revision

Domestic Part L

The changes to Part L for dwellings were first proposed in the Department for Communities and Local Government Green Paper *Homes for the future: more affordable, more sustainable*[30]. The Government signalled its intent to use Part L as one of the mechanisms to meet its legally binding CO_2 reduction targets as set out in the 2008 *Climate Change Act*.

Table 3.4 sets out the proposed timetable for future improvements in CO_2 emissions over the 2006 standards and how they equate to the performance standards in Code for Sustainable Homes.

Table 3.4 Proposed energy efficiency improvements over Part L 2006 as outlined in *Building a Greener Future*.

Date	2010	2013	2016
Carbon improvement as compared to Part L (2006)	25%	44%	Zero Carbon
Equivalent energy/carbon standard in Code	Code level 3	Code level 4	Code level 6

Changes to the Standard Assessment Procedure

As well as changes to Building Regulations there are proposed changes to the Standard Assessment Procedure (SAP), which is used to model the energy use and emissions in dwellings. To minimise the disruption to the construction industry SAP revisions are timed to coincide with amendments to Part L.

Key changes include:

- Move from annual energy calculation to a monthly one;
- Changes in fuel emission factors;
- Fuel based target emission rate;
- Notional dwelling calculation made more robust;
- Elemental U-values made less stringent;

[30] *Homes for the future: more affordable, more sustainable.* 2007 http://www.communities.gov.uk/documents/housing/pdf/439986.pdf

- Changes to Air-tightness testing regime;
- Allow Mechanical Ventilation with Heat Recovery (MVHR testing post-completion).

Non-Domestic Part L

The government's ambition is for all new non-domestic buildings to be net zero carbon by 2019**.** This will be done through phased steps in energy efficiency, similar to those already in place for dwellings. The first step has been identified as a 25% reduction in CO_2 emissions in 2010 in line with the reduction in dwellings. The difference is that the 25% will be an aggregate for all new non-domestic buildings – some buildings will be allowed to achieve less than 25% while others will be expected to exceed the target[31]. The size and date of the second step has yet to be finalised.

The changes in Part L for non-domestic will also address loopholes in the current regulations, such as the one that lets air-conditioned buildings comply more easily than naturally ventilated schemes.

Part G

The new edition of Part G (sanitation, hot water safety and water efficiency) announced in May 2009[32], brings about significant changes to the design of hot and cold water supplies in buildings.

The introduction of water efficiency targets for new homes supports sustainability targets through saving water and associated carbon emissions without impacting on customer behaviour. It opens the way to use alternative technologies such as harvested rainwater and grey water recycling for toilet flushing.

[31] *Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation*. 2008. http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

[32] Written Ministerial Statements for 13 May 2009 http://www.publications.parliament.uk/pa/cm200809/cmhansrd/cm090513/wmsindx/90513-x.htm

3.4) **Sustainable design and construction standards**

3.4.1. Code for Sustainable Homes

The Code for Sustainable Homes (Code) was introduced in 2006 as a way of measuring the sustainability of new domestic housing. It was developed based on the Building Research Establishment's (BRE) EcoHomes System, which has already achieved success in reducing the environmental impact of many housing projects and in particular within the social housing sector. The Code builds upon EcoHomes in a number of ways, for example 'the Code introduces minimum mandatory standards for energy and water efficiency. Credits must apply to each dwelling and cannot be averaged across a site.' The Code includes new areas such as Lifetime Homes and composting facilities

Catagories, Scoring & Weighting

The Code contains nine different categories covering a range of issues. This gives the Code a more holistic approach to sustainable development. Within each category that makes up the Code there are a number of credits that can be awarded if the criteria are met. Each credit category also has a weighting that relates to the perceived importance of the category across the whole assessment.

The total achieved scores from each category are multiplied by the weighting factor to give the final score for that category, which is then translated into a level of the Code. In Table 3.5 below, the categories that have the highest weighting factors have been highlighted. Achieving credits in these categories with higher weightings will gain the developer a higher score for achieving fewer credits.

Table 3.5 Credit categories and weightings for the Code for Sustainable Homes.

Credit Categories	Credits Available	Weighting*	Score
Energy and CO_2 Emissions	29	1.26	36.54
Water	6	1.5	9
Materials	24	0.3	7.2
Surface Water Run-off	4	0.55	2.2
Waste	7	0.91	6.37
Pollution	4	0.7	2.8
Health and Wellbeing	12	1.17	14.04
Management	9	1.11	9.99
Ecology	9	1.33	11.97
Totals	104		100%

***Weightings figures are only approximate and calculations should be made using an approved calculator**

Mandatory Standards

Minimum standards have been set for a number of categories. These mandatory credits must be achieved for a development to achieve level of Code. The most challenging of these targets are those for energy efficiency and water efficiency (Table 3.6).

Table 3.6 Minimum requirements for water use, emissions levels and score for achieving different levels of the Code for Sustainable Homes.

Code Level	Water Litres / pp / per day	Energy Improvement on part L	Target Score
Level 1	120	10%	36
Level 2	120	18%	48
Level 3	105	25%	57
Level 4	105	44%	68
Level 5	80	100%	84
Level 6	80	Zero carbon	90

In other categories there is a single mandatory requirement to be met whatever Code level is sought. These categories are:

- Embodied Impacts of Construction Materials
- Surface Water Runoff
- Construction Site Waste Management
- Household Waste Storage Space and Facilities

Compliance and Timeline

At the present time only the provision of social housing is required to achieve a specified level of Code. The government is driving an increase in energy and water efficiency standards through Building regulations, however, mandatory levels of Code are enforced in other development sectors. Meeting Code level 3 has been a requirement of all new homes built on central government land released through the surplus public sector land programme since April 2008.

The Housing Corporation, the Government agency responsible for investing in new affordable homes and regulating over 1,500 housing associations across England, has a current requirement that all homes must achieve at least Code for Sustainable Homes Level 3 in their latest bidding criteria and a proposed timetable for increasing standards as set out in the *Design and Quality Strategy* 2007[33].

This timetable is:

- 2012 - Code 4
- 2015 -Code 6 (subject to cost effective technological feasibility)

Examples of Code in use

Code level 3

There are now numerous examples of Code level 3 dwellings, many of them in the social housing sector. The technical feasibility of meeting Code three is not in question. As will be examined in greater detail later, it is possible to meet the mandatory energy standard for Code 3 through energy efficiency measures only.

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[33] *Design and Quality Standards*. 2007 http://collections.europarchive.org/tna/20100710184205/www.housingcorp.gov.uk/upload/pdf/Design_quality_standards.pdf

Code level 4

There are increasing numbers of Code 4 dwellings being built. The London Borough of Croydon has been requiring all new developments over 10 units to meet Code 4 since September 2007.

Case Studies for the Code for Sustainable Homes

Code level 5

The Old Apple Store, Stawell, Somerset, is a development of 5 homes built to Code level 5, developed by Pippin Properties Ltd and Ecos Homes Ltd. It was the first private sector housing development built to the Code Level 5 in the UK and was awarded 'Best Housing Scheme' by Regen South West in November 2008[34].

The buildings are constructed from a Glulam Frame with Orientated Strand Board, and key sustainability features include Photovoltaic cells, solar thermal water heating, passive solar design, wood pellet boilers, rainwater harvesting[35].

CO_2 Zero, Bristol, is a development of 9 two-bedroom, three storey live-work units by developer/contractor Logic CDS Ltd, also achieving Code level 5. It is constructed with solid cross-laminated timber panels with external insulation and render. Key sustainability features include passive solar design, low flow rate sanitary ware, rainwater recycling, low energy LED lighting, PV array, biomass pellet boiler, low energy rated white goods, FSC timber, green roof and Mechanical Ventilation and Heat Recovery[36].

Code level 6

In May 2009 a six house development by Metropolitan Housing Partnership (MHP) in Upton on the edge of Northampton, became the first commercially

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34 *Eco Development Wins 'Best Housing Scheme'.* 2008 http://www.greenbuildingpress.co.uk/article_print.php?article_id=52

35 *The Code for Sustainable Homes Case studies.* 2009 http://www.communities.gov.uk/documents/planningandbuilding/pdf/1161997.pdf

36 *The Code for Sustainable Homes Case studies.* 2009 http://www.communities.gov.uk/documents/planningandbuilding/pdf/1161997.pdf

built homes in the UK achieving code level 6.[37] The design and development by Zedfactory, Mansells, Davis Langdon and Arup, includes a biomass boiler, double glazed Rational windows and 157sqm of Solar PV with an estimated output of 16,230 kilowatt hours per year.[38]

Prior to the Upton development the only example of Code level 6 was the demonstration house by Barratt Homes at the BRE Innovation Park at Watford, designed by architects Gaunt Francis. This three bedroom family home uses high thermal mass concrete floor slabs to mitigate peak temperatures, an air source heat pump, thermal stratification for clothes drying, solar hot water and PV, automatic window shutters and a rainwater harvesting system for toilet flushing[39].

3.4.2. BREEAM

The BRE Environmental Assessment Method (BREEAM) was first created in 1990 with the first two versions covering offices and homes. The development of the early domestic BREEAM scheme lead to the creation of EcoHomes and then the Code, therefore there is a high level of similarity between the both Code and BREEAM. The BREEAM standard has since been developed and expanded into a number of different schemes that can be used to assess the environmental performance of the full range of non-domestic building types. There are a number of different BREEAM schemes that can be used to measure different building types but the creation of the BREEAM Bespoke standard now allows all buildings to assessed through a tailor made assessment methodology that can be adapted to any building type or use by working with the BRE to ensure that a high level of comparability with other BREEAM schemes. The BRE have updated the BREEAM schemes regularly in line with UK building regulations but in 2008 it saw more significant

[37] *Hit for six.* 2009. http://www.insidehousing.co.uk/story.aspx?storycode=6505159#comments
[38] *HCA and Metropolitan Housing Partnership lead the way with UK's first carbon zero homes.* 2009. http://www.homesandcommunities.co.uk/uk-first-carbon-zero-homes?p=3
[39] *The Barratt Green House*. 2008 http://www.bre.co.uk/page.jsp?id=1221

changes made that allowed all buildings to be assessed using the same methodology by modelling BREEAM 2008 on the BREEAM Bespoke standard. Now all types of non-domestic building can be assessed using the same methodology. BREEAM 2008 also saw the inclusion of:

- A new two stage assessment process: Design stage assessment and Post Construction assessment
- Mandatory credit requirements
- A new rating level for BREEAM Outstanding

Categories, Scoring & Weighting

In a similar way to the Code, BREEAM is based upon nine credit categories each awarded different weightings depending on their level of importance. The different catagories can be briefly defined as follows:

- Management (M) - An assessment of the clients' commitment to management of the environmental impact of the project during construction or operation.
- Health and Wellbeing (HW) - An assessment of the risks posed to occupant health and comfort in the design or operation of the building.
- Energy (E) – This assessment primarily measures the energy efficiency of the project and measures taken to minimise energy use (i.e. CO_2 production).
- Transport (T) - An analysis is made of the location of the project so that the environmental impact due to the production of CO_2 and other pollutants from commuter transport may be assessed.
- Water Consumption (W) - This part of the assessment measures the level of water economy and awareness within the building/organisation.
- Materials & Waste (MW) - Primarily an assessment of the embodied environmental impact of the project due to material specification, and of measures to facilitate the collection of recyclable waste.
- Land Use and Ecology (LE) - At a local level a building project directly impacts upon the ecology that it interferes with or displaces. An

assessment of the degree to which a project detracts from or improves the local environment is provided.

- Pollution (P) - An assessment of measures taken to limit the main pollutants (other than CO_2) that inflict damage upon the atmosphere, land or local watercourses.

Within these nine credit categories are a varying number of individual credit criteria (over 70 in total), which can be scored as outlined in Table 3.7 below.

An environmental weighting is applied to each credit scored and this varies from category to category. The weighting factors have been derived from consensus based research with various groups such as government, material suppliers and lobbyists. This research was carried out by BRE to establish the relative importance of each environmental issue. The use and weighting of different catagories can be altered to reflect different building projects such as ‘Shell only’ constructions.

The total achieved scores from each category are multiplied by the weighting factor to give the final score for that category. In the table below the categories that have the highest weighting factors have been highlighted.

Table 3.7 Credit categories and weightings for BREEAM.

Category	Weighting*
Management	12%
Health and Wellbeing	15%
Energy and CO_2 Emissions	19%
Transport	8%
Water	16%
Materials	12.5%
Waste	7.5%
Ecology	10%

***Weightings figures are only approximate and calculations should be made using an approved calculator.**

"Shell and Core" or "Fit Out"

The credits and categories within the different BREEAM schemes can be adjusted to cover either a "Shell and Core" development or a "Fit Out" development or refurbishment. A shell and core development will cover the building structure and other building elements and any the fit out of any communal areas. There are a number of BREEAM credits and issues that are either specific to or contain criteria that related to and influenced by the fitting out of a property and other issues less reliant on building fabric.

Mandatory Standards

Just as there are mandatory requirements to achieve a minimum level of water use and carbon emissions reductions to achieve different levels of Code, there are minimum credit requirements for different levels of BREEAM.

The mandatory credit requirements for different BREEAM credits/categories are shown in Table 3.8. As with Code there is an increasing level of importance placed on energy and water efficiency at higher levels of BREEAM. Minimum mandatory credit requirements for CO_2 are only introduced for BREEAM Excellent and Outstanding.

In addition to achieving all the mandatory credit requirements for any particular level the development must also achieve a minimum overall score to achieve various levels of BREEAM. The score boundaries for the different levels of BREEAM are shown in Table 3.9.

Table 3.8 Minimum credit requirements for mandatory credit categories for achieving different levels of BREEAM.

BREEAM issue	BREEAM Rating / Minimum number of credits				
	PASS	GOOD	VERY GOOD	EXCELLENT	OUTSTANDING
Man 1 - Commissioning	1	1	1	1	2
Man 2 - Considerate Constructors	-	-	-	1	2
Man 4 - Building user guide	-	-	-	1	1
Man 9 - Publication of building information (BREEAM Education only)	-	-	-	-	1
Man 10 - Development as a learning resource (BREEAM Education only)	-	-	-	-	1
Hea 4 - High frequency lighting	1	1	1	1	1
Hea 12 - Microbial contamination	1	1	1	1	1
Ene 1 - Reduction of CO_2 emissions	-	-	-	6	10
Ene 2 - Sub-metering of substantial energy uses	-	-	1	1	1
Ene 5 - Low or zero carbon technologies	-	-	-	1	1
Wat 1 - Water consumption	-	1	1	1	2
Wat 2 - Water meter	-	1	1	1	1
Wst 3 - Storage of recyclable waste	-	-	-	1	1
LE 4 - Mitigating ecological impact	-	-	1	1	1

Table 3.9 Minimum score requirements for achieving different levels of BREEAM.

BREEAM Rating	Minimum Score
Pass	30
Good	45
Very Good	55
Excellent	70
Outstanding	85

Compliance and Timeline

There is no set timeline for the phased introduction of higher BREEAM standards. Some planning authorities require non-domestic buildings over a certain size to meet a BREEAM level, such as London Borough of Croydon which require all new non-domestic developments over 1000m^2 to meet BREEAM Excellent standards. In addition a number of Government departments require non-domestic buildings built for their use to meet a BREEAM standard, and all designed for inclusion in the *Building Schools for the Future* project were designed to achieve a minimum of BREEAM Very Good.

Technical Feasibility and financial Viability

The wide variety of non-domestic building types makes it impossible to generalise on the matter of technical viability. Progress in some fields has been swift with the first ‘Outstanding’ rating awarded to a distribution centre in Staffordshire in March 2009.

The difference in use and energy profile of different buildings makes it far easier for some to attain higher standards and reduce CO_2 emissions.

Examples of BREEAM in use

The annual BREEAM Awards recognise those developments achieving the highest levels of sustainable design and construction. The 2010 winners include the Sanderstead Road development in Croydon and the VLA Stores in Surrey.

The Sanderstead Road development of 42 domestic units has been awarded a BREEAM score of 75.41% at design stage under the EcoHomes 2006 scheme. The development has good access to local amenities and public transport and deals with all its surface water runoff is fully attenuated onsite. The building is constructed from a well insulated timber frame and fitted with energy efficient lighting and PV panels, whilst daylight factors has been carefully considered during the design to maximise the use of natural light.

The Veterinary Laboratories Agency (VLA) Store Buildings have been awarded 83.73% under the BREEAM Industrial scheme at the design stage. The ecological features include microgeneration technologies and a biomass boiler. The building has been built with a high level of insulation and airtightness helping to reduce emissions and energy use.

Possibly the most interesting of all the BREEAM case studies is that of the Campus M Business Park in Munich, Germany[40]. The building features; Natural ventilation, High daylight factors and low energy lighting, Good likes to public transport and excellent cycling facilities, Good recycling facilities, efficient heating systems and an effective use of Brownfield land. The thing that makes this particular case study so interesting is that it was able to achieve BREEAM Excellent without incurring significant uplift costs. The cost of achieving BREEAM Excellent were reduced and eliminated by bringing all the parties involved with the sustainability brief together at an early stage to ensure that all parties have a thorough understanding of the sustainable design and construction process. Paul Gibbon, Director of Sustainability at the BRE believes that this has powerful implications for the construction industry:

> “Campus M is an exciting development and delivers an important message to investors, developers and the industry as a whole that with good design, achieving a BREEAM Excellent rating does not require extra cost.”

[40] *BREEAM Excellent at no extra cost*. 2009. http://www.worldarchitecturenews.com/index.php?fuseaction=wanappln.projectview&upload_id=11277

4) **Review of Local Policy and Circumstances**

4.1) **Local policy**

The Merton Rule planning policy

In 2003 the London borough of Merton was the first Local Authority to introduce prescriptive renewable energy targets for new developments in its Unitary Development Plan 2003. The Merton Rule as it became know required all new non-domestic developments over 1000m^2 were required to produce 10% of the building's required energy from renewable sources. The 10% figure could be demonstrated using either energy used or CO_2 reduced.

Following the adoption of this groundbreaking policy in 2003 central government encouraged other planning authorities to adopt similar policies through the use of *PPS22: Renewable energy*. The *Planning Policy Statement: Planning and Climate Change – Supplement to PPS1* (sustainable development); outlined the need for local authorities to push for locally distributed energy policy.

4.2) **Energy Efficiency in Merton**

Carbon assessment of domestic housing in Merton

Merton Council commissioned Parity Projects[41] to undertake a carbon assessment of Merton's domestic housing stock. The report investigated the domestic housing stock by building type and modelled their expected emissions. This model was then used to examine the potential emissions savings measures and estimate their pay-back periods (Table 4.5).

Figure 4.1 shows the predominant age of housing for Merton broken down by Census output areas. It can clearly be seen that the majority (40%) of Merton's housing stock was constructed between 1905 and 1924. The age boundaries are not set at equal intervals. An interesting trend emerges when

[41] *Carbon Assessment of Domestic Housing in London Borough of Merton*. 2010 http://www.merton.gov.uk/living/planning/planningpolicy/ldf/planningresearch.htm

the rate of house building in each of the age boundaries is examined (Figure 4.2). By looking at the building rate we can see that the housing boom between 1905 – 1935 is being matched by increased building rates that has occurred since the 1990.

The borough's railway lines provide the clearest delineation between housing developments of different ages, with rail and underground links influencing the stages of development throughout the borough. There is a cluster of pre-1905 housing round the historical centres of Wimbledon, Wimbledon Village, Merton and Raynes Park. The housing boom from 1905 – 1935 and the resulting suburban housing estates are clustered around rail and underground stations. The areas of high-density housing built between 1940 – 1970 would appear to be in areas with relatively poor historic transport connections. However, more modern areas of high-density housing are concentrated close to Collier's Wood and Phipps Bridge tram stops (Figure 4.3).

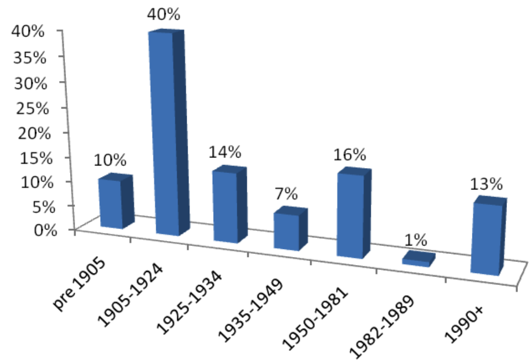

Figure 4.1 Percentage of Merton's dwellings built per age band (Parity Projects).

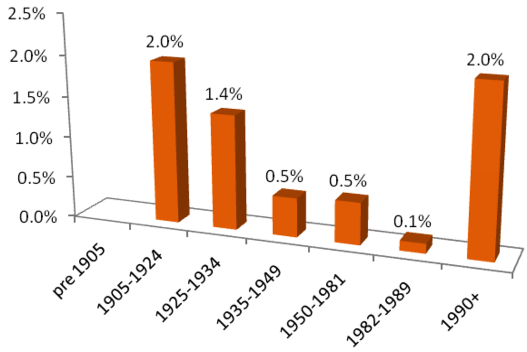

Figure 4.2 Rate of domestic development. The percentage of dwellings built per year by age band (Parity Projects).

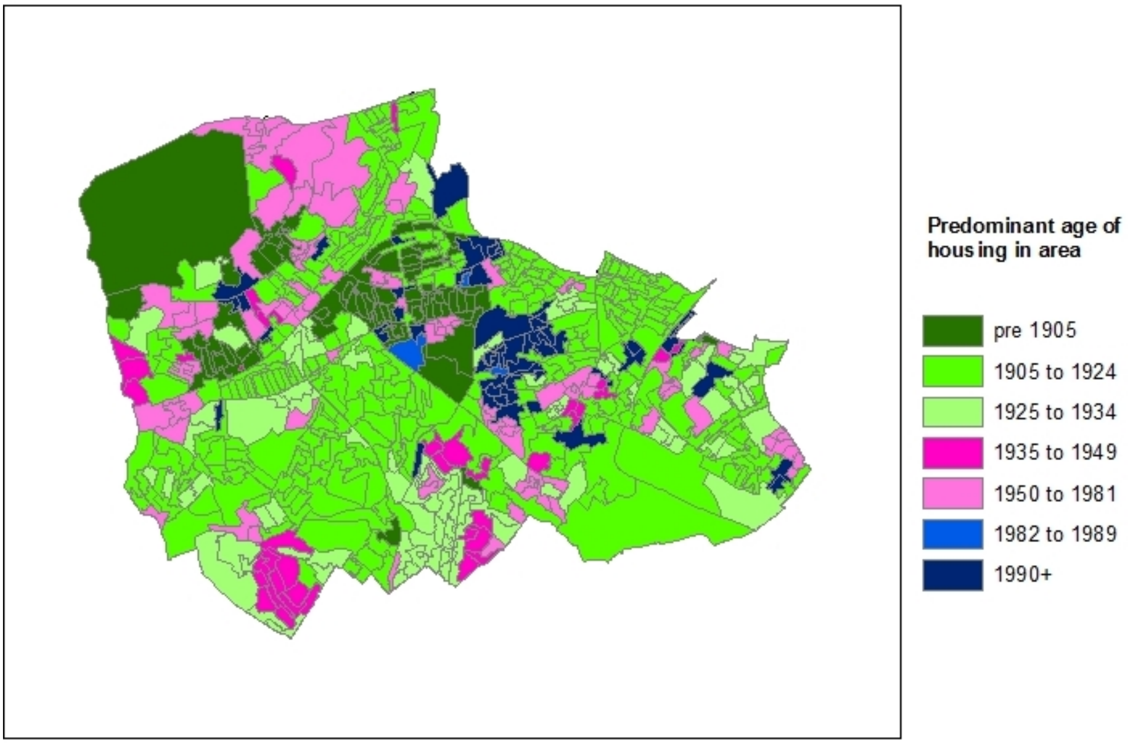

Figure 4.3 Predominant age of housing in Census Areas across Merton (Parity Projects).

The report modelled the effect of 33 energy efficiency solutions along with opportunities for behavioural change (heating levels at 18°C, 22°C, 24°C) and microgeneration from PV instillations. Theses different measures were then separated into four categories:

1. **Key Measures** – Average CO_2 savings potential greater than 10% of domestic Merton footprint. Payback period of under 10 years.
2. **Other important measures** – Average CO_2 savings potential greater than 2% of Merton domestic foot-print.
3. **High Impact Poor Payback** – Average CO_2 saving potential greater than 2% of Merton footprint. Payback period greater than 30 yrs (The Feed in Tariff would reduce payback period for Feed In Tariff supported technologies to around 5-7 years)
4. **Strategically less important measures** – Average CO_2 savings potential less than 2% of Merton footprint.

The different emissions reductions measures are and there relative costs per kg/ CO_2e saved are shown in Figure 4.4 and their potential carbon savings and pay-back periods are shown in Table 4.5.

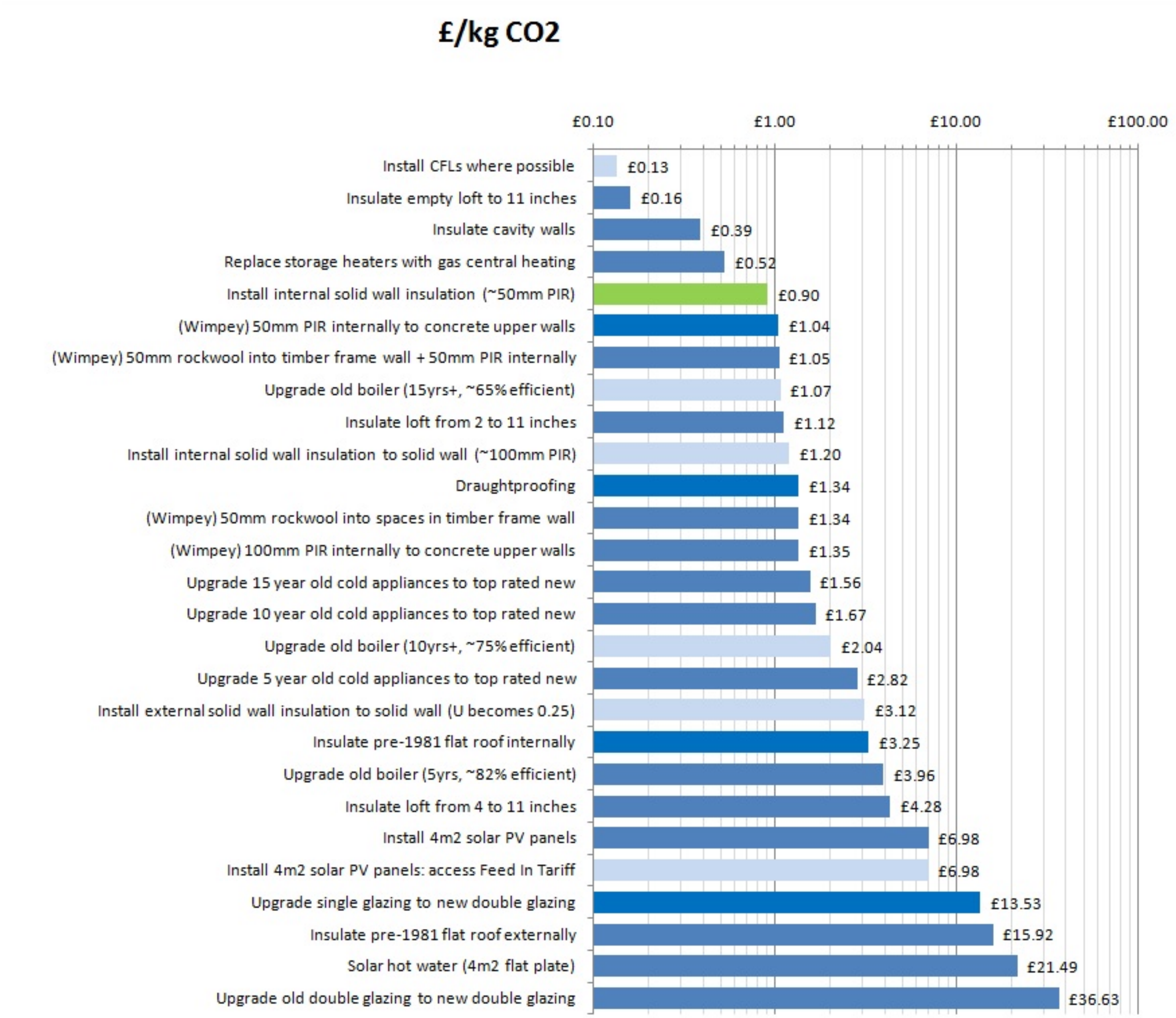

Figure 4.4 Carbon cost (£/kg CO_2) for the range of energy saving measures considered in the *Carbon Assessment of Domestic Housing in London Borough of Merton* (Parity Projects).

This exercise showed that:

- Conventional projects of high importance in other areas might not be of strategic importance in Merton. e.g. Cavity wall insulation.
- Behavioural change has the potential to deliver a 34% reduction in CO_2 emissions.
- Internal solid wall insulation and PV with the support of the Feed in Tarrif stand out as the physical measures with boiler upgrades and Compact Florescent Lamps (CFLs) also provided good returns.

There is a dynamic interaction between measures taken and the levels of behavioural change achieved. Different combinations of measures and behaviour will produce a wide variety of results. For example solid wall insulation has a payback period of around 8 years, whilst a combination of boiler upgrades and behavioural change (18°C) will have a payback period of 10 years.

Behavioural change is difficult to instigate but benefits greatly from increased information provision and monitoring. Efforts to encourage behavioural change can range from low-tech solutions such as face-to-face advice and home energy assessments and more technical solutions improving controls and installing smart metering.

There is a strong case for the utilisation of the Feed in Tariff with respect to the domestic housing stock in Merton with 75% of homes estimated to be reading for a $4m^2$ solar PV installation. Whilst the Feed in Tariff greatly improves the potential of PV measures it remains an expensive carbon reduction method (£13.81 Kg/ CO_2)

The report examined the possible funding for projects through Pay As You Save schemes. Schemes offering up to £10,000 per home for measures with a payback period of under 10 years might deliver 2.2 tonnes CO_2 or 38% of the average Merton home. Savings of over 35% will require some assistance from behavioural change.

Table 4.5 Performance of different carbon saving measures (Parity Projects)

#	Initiative	Average tCO2 saving per measure	Average payback (yrs)	Count of measures possible	Total tCO2 saving possible	% saving of Merton CO2 possible
1	Install internal solid wall insulation to solid wall (U becomes 0.175 ~100mm PIR)	1.85	10.1	50920	94050	18.13%
2	Install external solid wall insulation to solid wall (U becomes 0.25)	1.77	26.5	50920	90300	17.41%
3	Install internal solid wall insulation to solid wall (U becomes 0.35 ~50mm PIR)	1.7	7.7	50920	86500	16.68%
4	2 shorter heating periods instead of 1 all-day heating period	1.88	0	40550	76080	14.67%
5	Turn down heating from 22 to 18 degrees C	2.03	0	24190	49030	9.45%
6	2 shorter heating periods instead of heating 24 hours	6.41	0	4130	26470	5.10%
7	Turn down heating from 24 to 18 degrees C	3.29	0	7980	26240	5.06%
8	Install CFLs where possible (most light fittings in dwelling)	0.67	0.6	36400	24310	4.69%
9	Turn down heating from 20 to 18 degrees C	0.91	0	24440	22320	4.30%
10	Upgrade old boiler (15yrs+, ~65% efficient)	1.5	8.9	12130	18150	3.50%
11	Install 4m^2 solar PV panels	0.33	63	49720	16200	3.12%
12	Install 4m^2 solar PV panels: access Feed In Tariff	0.33	19.9	49720	16200	3.12%
13	Upgrade old boiler (10yrs+, ~75% efficient)	0.79	16.9	20160	15840	3.05%
14	Install CFLs where possible (half of light fittings in dwelling)	0.33	0.6	36480	12160	2.34%
15	Upgrade single glazing to new double glazing	0.78	103.6	14420	11180	2.16%
16	Upgrade old double glazing to new double glazing	0.28	280.3	39090	11070	2.13%
17	Solar hot water (4m^2 flat plate)	0.16	136.6	66300	10800	2.08%
18	Insulate cavity walls	0.77	4.2	13650	10530	2.03%
19	Insulate empty loft to 11 inches	1.58	1.3	6120	9665	1.86%
20	Upgrade old boiler (5yrs, ~82% efficient)	0.4	32.6	20350	8220	1.59%
21	Replace storage heaters with gas central heating	5.53	n/a	990	5460	1.05%
22	Upgrade 15 year old cold appliances to top rated new	0.22	7.1	16080	3610	0.70%
23	Upgrade 10 year old cold appliances to top rated new	0.21	7.6	16340	3430	0.66%
24	Insulate loft from 2 to 11 inches	0.27	6.1	12570	3370	0.65%
25	Draughtproofing	0.07	11.2	35400	2380	0.46%
26	Upgrade 5 year old cold appliances to top rated new	0.12	12.8	16196	2010	0.39%
27	Insulate loft from 4 to 11 inches	0.07	13	16066	1130	0.22%
28	Insulate pre-1981 flat roof externally	0.39	174.4	2590	1020	0.20%
29	Insulate pre-1981 flat roof internally	0.39	37.4	2590	1020	0.20%
30	*Add 50mm rockwool into spaces in timber frame wall and 50mm PIR internally	0.65	7.6	1450	940	0.18%
31	*Add 100mm PIR internally to concrete upper walls	0.26	10.4	1450	380	0.07%
32	*Add 50mm PIR internally to concrete upper walls	0.24	8.1	1450	350	0.07%
33	*Add 50mm rockwool into spaces in timber frame wall	0.23	9.7	1450	330	0.06%

*These measures specifically apply to the 'Wimpey' houses and flats in the borough.

4.3) **Renewable Energy Resources in Merton**

Local Renewable Energy Resources and Technological Suitability

The performance of a number of the technologies mentioned in Section 3 will be dependent on local conditions. This is especially true of Wind and Hydro technologies. As part of its LDF policy development process, the London Borough of Merton has commissioned Altechnica to undertake a renewable energy resource study to examine the potential and limits of renewable energy generation within the borough boundaries[42].

Wind Energy

Wind energy projects at present require annual mean wind speeds of 6.5 m/s or greater to be viable. To assess the potential for renewable energy generation from wind across Merton the estimated annual mean wind speed (AMWS) at 10m, 25m and 45m above ground level was modelled. The results of this modelling are shown in Table 4.6, and the distribution of wind speeds across Merton at 45m above ground level are shown in Figure 4.7.

Table 4.6 The Average Mean Wind Speed (AMWS) (meters per second) at different heights above ground level (meters).

Above	AMWS
10	1 - 2.4
25	2.8 - 3.5
45	3.8 - 4.6

Even when the annual mean wind speed estimates are extrapolated to 130m above ground level for the windiest part of the borough they still fail to exceed 6 m/s. Even at 103m above ground level a freestanding wind turbine is unlikely to be viable in the borough. It is therefore highly unlikely that renewable energy generation from wind will play a large role in tackling climate change in Merton.

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42 *Renewable Energy Resources in Merton: A Preliminary Assessment*. 2010 http://www.merton.gov.uk/living/planning/planningpolicy/ldf/planningresearch.htm

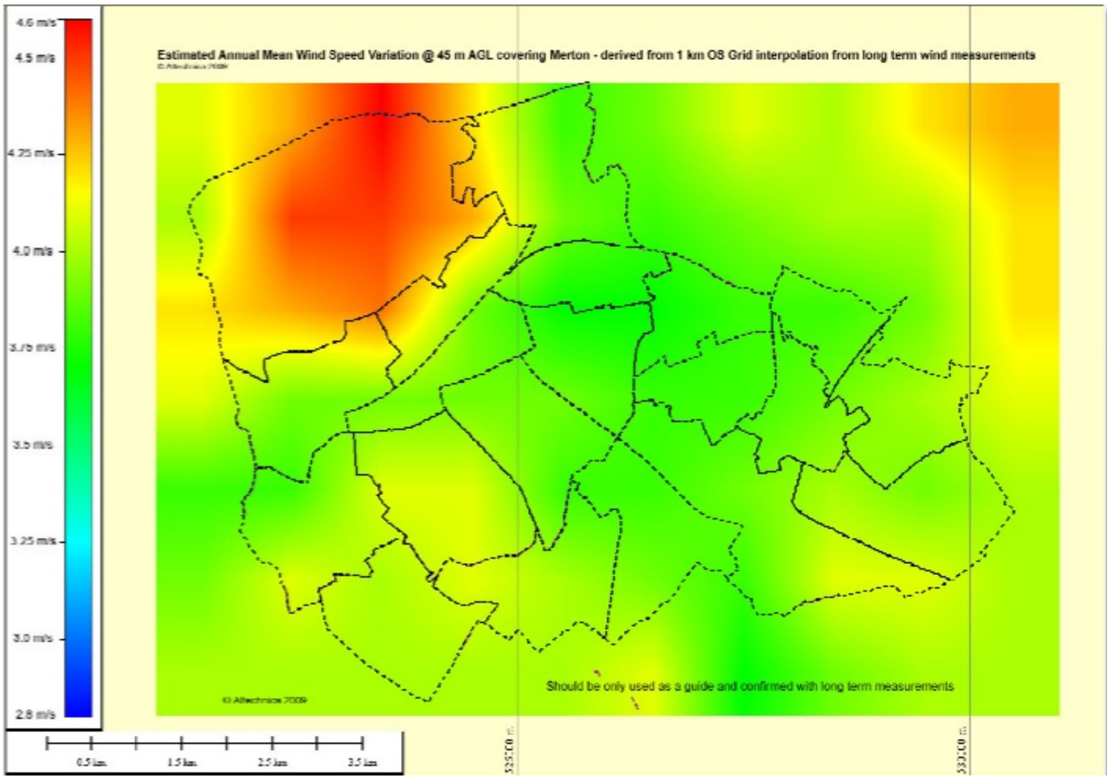

Figure 4.7 Distribution of Average Mean Wind Speeds (AMWS) modelled across the borough at a height of 45 meters above ground level (Altechnica).

Solar Energy

Solar energy can be used to produce renewable heat, electricity or a combination of to both. Passive solar design and passive solar ventilation and cooling can achieve significant emissions and energy reductions but must be considered at the design stage and cannot be achieved retrospectively.

Solar radiation data for London was used to estimate the annual solar radiation at different orientations and panel angle and is shown in Figure 4.8. The orientating and angle of solar collector clearly have a significant impact on the level of solar energy potential. To estimate the solar energy potential in Merton it is necessary to make a number of assumptions to estimate the orientation and angle of roofs available for solar technology installation. It was assumed that that household and roof alignments are at right angles to the approximate street orientation and that buildings have duel pitched roofs with a 40° pitch.

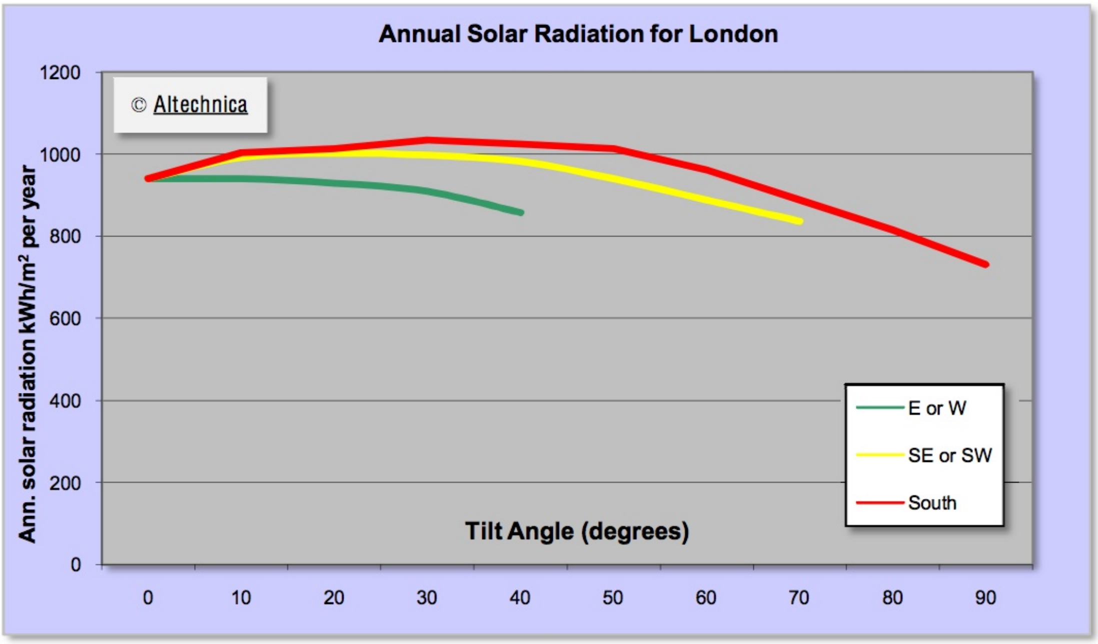

Figure 4.8 Annual solar radiation for London for different panel orientations (Altechnica).

The potential energy production and carbon savings were estimated at different levels of solar hot water penetration across the borough for 3 different types of thermal collector. Estimates were produced for two different types of standard flat panel systems (FP1 and FP2) and an Evacuated Tube System (ET1). Carbon savings were calculated against offsetting the energy use in a standard condensing gas boiler.

On average, solar hot water collectors are estimated to take up between 12.7% (EP1) and 19% (FP2) of the average 'solar' roof areas, this would not exclude the use of solar hot water in conjunction with solar PV.

If a penetration level of 10% of Merton domestic housing stock achieved, the estimated potential of solar hot water production is approximately 9,000 MWh/y (FP1), 9,700 MWh/y (FP2) and 8,500 MWh/y (ET1). This would lead to a carbon saving of 1,900 tCO_2/y (FP1), 2,000 tCO_2/y (FP2), and 1,800 tCO_2/y (ET1). The energy generation and carbon abetment potential increases with the level of penetration across Merton's housing stock.

Solar PV converts sunlight directly into electricity and is relatively easy to retro fit in comparison to solar hot water as there is no need to install specialised secondary equipment such as thermally stratified hot water tank.

Using the same assumptions about roof orientation and angle the potential energy generation capacity for three different roof mounted PV systems has been estimated. The systems considered were, monocrystalline silicon (MCSi) PV, Polycrystalline (PCSi) PV and amorphous triple junction silicon PV shingles (ASi-3JSh). The carbon reductions were estimated assuming the displacement of grid delivered electricity at a grid average emissions factor.

If a penetration level of 10% of Merton domestic housing stock was achieved, the estimated potential of renewable energy from solar PV production is approximately 16,000 MWh/y (MCSI), 13,500 MWh/y (PCSi), and 7,700 MWh/y (ASi-3JSh). This would lead to a carbon saving of 9,000 tCO_2/y (MCSi), 7,700 tCO_2/y (PCSi) and 4,300 tCO_2/y (ASi-3JSh). The energy generation and carbon abetment potential increases with the level of penetration across Merton's housing stock.

Whilst the use of solar hot water and PV in conjunction is possible and the use of one technology does not exclude the other, there may still be conflict for available space in real life situations. When roof design and shading are considered the potential estimates of the solar energy resource within Merton would need to be adjusted.

Heat Pumps

Heat pumps are a low carbon technology that work by extracting useful heat from a low grade heat source and transferring it to a desired location or sink. The carbon saving potential of heat pumps depends on their Coefficient of Performance (COP), which is the amount (kWh_{TH}) of heat produced for every unit of electricity (kWh_e) consumed. Some of the issues surrounding the use of heat pumps and calculating their carbon savings are discussed in chapter 3. Heat pumps can use a number of different heat sources but the most common are Ground Source Heat Pumps (GSHP) and Air Source Heat Pumps (ASHP).

In order to estimate the potential low carbon heat generation across Merton it was assumed that around 30% of the average residential properties land area would be available for Ground Source Heat Pumps instillation. The heat output from Ground Source Heat Pumps with a 100m deep vertical collector in clay soil and a COP of 3.0 would potentially provide a maximum of around $8kW_{TH}$ with and annual yield of 15,000 kWh_{TH} and consume $5{,}000kWh_e$ of electricity. If the carbon savings are calculated against heat produced by a gas condensing boiler and grid derived electricity with an emissions factor of 0.43 kg CO_2 per kWh_e, a Ground Source Heat Pumps will save result in a net carbon saving of 1,000kg CO_2 a year. If the COP is boosted to 4.0 then the potential carbon saving is increased to 1,500 kg CO_2 per yr. The carbon reductions would improve is the electricity used is generated from renewable sources, however, UK government carbon reporting guidelines recommend the use of the Long-term marginal carbon intensity (0.43 kg CO_2 per kWh_e) for calculating emissions reductions based of the avoidance or use grid derived electricity and do not recognise the potential for electricity from Green tariffs or suppliers.

If ground source heat pumps were to achieve a 10% penetration rate across Merton's domestic housing stock the annual carbon abetment potential is around 6,700 tonnes CO_2/yr. If the electricity used to was generated from renewable resources and delivered via a private wire network the carbon saving could be calculated to be 20,900 tonnes CO_2/year.

The performance of air source heat pumps are more prone to seasonal fluctuations than ground source heat pumps as their performance is dependent on air temperatures. To estimate the potential for low carbon heat production from air source heat pumps it is therefore necessary to examine Merton's historical meteorological conditions. When historical temperature data is examined an air source heat pump is estimated to produce 1900 kWh_{TH}/per year for every kW_{TH} of installed capacity. A 5 kW_{TH} air source heat pumps with a COP of 2.5 will produced around 9,800 kWh_{TH} and will consume 3,900 kWh_{E}. Using the same assumptions for calculating the carbon reduction from ground source heat pumps this would produce a carbon saving of approximately 300 kg CO_2/year. If a COP of 3.0 were achieved then the carbon savings would increase to 660 Kg CO_2/year.

Other key findings in Merton's renewable resource report included:

- The capacity for hydro-power within the borough is limited to a number of low head installations in the Wandle river which will offset a maximum of 230 tonnes of CO_2 per annum. There is however, a limited potential to develop the hydro opportunities along the river due to the restrictions on development that arise from the high risk levels.
- There is currently no borough supply of biomass though the greatest potential is provided by grass pellets and woody fuel generated SynGas.
- Biomass Micro-CHP is still undergoing field trials. Gas powered Micro-CHP has not proved as effective at reducing CO_2 emissions as anticipated. The use of biomass could improve the potential emissions savings but there is a long way to go before these technologies reach market maturity.

4.4) **Opportunities for Decentralised energy networks**

There have been a number of feasibility studies undertaken to assess the feasibility of district heating networks in the borough and there are several CHP schemes under development.

Feasibility studies

There have been a number of feasibility studies undertaken to examine the potential for creating CHP networks in the borough. These studies have focused on the Merton Town centre and the south east of the borough in connection with regeneration and redevelopment plans (Annex 1).

The London Development Agency has also created the London Heat Map Tool to aid in planning decisions and local authority decentralised energy strategies. The image from the London Heat Map Tool in Figure 4.9 shows the areas of high heat demand and existing decentralised energy infrastructure. Whilst the London Heat Map Tool is useful for identifying areas with a high heating demand, patterns of heat demand are an important consideration in decentralised energy network feasibility.

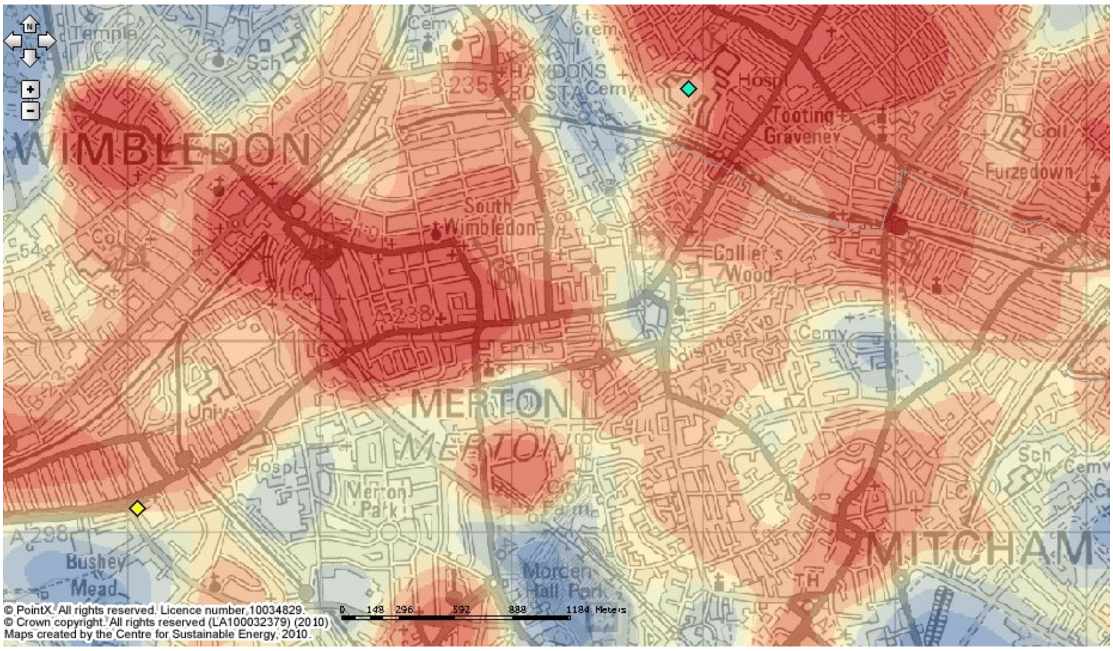

Figure 4.9 Heat demand across the London Borough of Merton, calculated by the London Heat Map project. Red areas show a high level of heat consumption, whist Blue shows areas of lower heat demand.

There are currently no district heating networks in existence in Merton, however, there are plans to install at least two small-scale CHP generators in the borough. One of these proposed schemes is based at the Civic Centre and involves the installation of a 200 kW (electric) gas fired CHP with 200 kW heating and cooling capacity. This size CHP unit is not fit to export heat or electricity, however, there is an additional winter demand for 1MW of additional heat in winter should a district heating system become established in the area.

Morden town centre CHP Plant Option Appraisal

Merton Council commissioned ICE ltd to study the options for establishing a district energy network, suggesting council owned buildings as an energy centre nucleus. The appraisal examined the options for creating a decentralised energy network based around the five buildings (Figure 4.10).

Figure 4.10 Location of buildings for the proposed buildings that would act as the nucleus for the development of a decentralised energy network (ICE ltd).

The appraisal considered 4 possible CHP schemes using the building purposed by Merton. These schemes are outlined in Table 4.11

Table 4.11 Expected performance of different CHP systems for Merton Town Centre. Preferred options have been highlighted in bold (ICE ltd).

CRITERIA	OPTION - 1	OPTION - 2	**OPTION - 3**	**OPTION - 4**
Thermal Connections:	Crown House Northern Line Depot Baitul Futuh Mosque Merton College MPP	Northern Line Depot Baitul Futuh Mosque Merton College MPP	**Merton College MPP**	**Crown House**
Electrical Connections:	Crown House	Merton College MPP	**Merton College MPP**	**Crown House**
CHP size:	270 kWe	200 kWe	**200 kWe**	**130 kWe**
Total Heat from CHP:	35% of demand	34% of demand	**49% of demand**	**62% of demand**
Total Electricity from CHP:	59% of demand	64% of demand	**52% of demand**	**20% of demand**
Total Energy from CHP:	42% of demand	42% of demand	**50% of demand**	**34% of demand**
CHP Running hours:	7,616	7,611	**6,122**	**5,248**
CO2 Savings p.a.:	686 tonnes (20.9%)	491 tonnes (20.5%)	**354 tonnes (21.1%)**	**239 tonnes (13.6%)**
Energy Cost Savings p.a.:	£35,602 (5%)	£25,939 (5%)	**£36,710 (10%)**	**£18,661 (5%)**
Total Capital Costs:	**£2,780,251**	**£1,694,257**	**£723,479**	**£678,517**
ESCO Finance:	£1,763,378 (63.4%)	£1,320,109 (77.9%)	**£641,572 (88.7%)**	**£568,162 (83.7%)**
Connection Charge Contribution:	£290,700 (10.5%)	£290,700 (17.2%)	**£0 (0%)**	**£0 (0%)**
MC Contribution:	£0 (0%)	£0 (0%)	**£0 (0%)**	**£0 (0%)**
Simple Payback:	N/A	N/A	**N/A**	**N/A**
External Grant Sources:	£726,172 (26.1%)	£83,448 (4.9%)	**£81,907 (11.3%)**	**£110,355 (16.3%)**
ESCO Profit p.a.:	£33,866 (5%)	£24,770 (5%)	**£16,585 (5%)**	**£17,727 (5%)**

A comparison the benefits delivered by each of the different options is given can be seen in Table 4.12. The report recommends that Option three be used as the primary CHP model as this delivers the maximum number of potential benefits, with option 4 put forward as the preferable second choice.

Table 4.12 Relative benefits of each of the CHP schemes considered in the option appraisal (ICE ltd).

OPTION - 1	OPTION - 2	OPTION – 3	OPTION - 4
• Largest contribution of heat and electricity by CHP. • Greatest quantity of CO2 savings from all options.	• Largest proportion of electricity demand met. • Smallest proportion of external grant funding required.	• Largest ratio of CO_2 savings to capital cost. • Greatest energy cost savings to MC. • Largest ratio of energy cost savings to capital cost. • Largest proportion of energy demand met. • Highest proportion of ESCO finance of all options. • Smallest contribution of external grant funding required. • Meets CHPQA Good Quality Standard	• Greatest proportion of heat demand met. • Lowest Capital Cost to implement. • Meets CHPQA Good Quality Standard

It is clear from the *Morden town centre CHP Plant Option Appraisal* that establishing a CHP network in Merton is a difficult challenge. Establishing a CHP network will require a large amount of investment infrastructure, and without suitable levels and patterns of energy demand this may prove too risky Energy Service Companies (ESCOs) or other investors.

5) **Viability**

The government has set targets for zero carbon development of 2016 for residential and 2019 for non-domestic development. At the same time there is a strong need to meet the needs of the nations growing number of households with annual household growth predictions indicating the need for 223,000 new households per year. Trying to achieve both those objectives is the challenge facing the planning and development industry over the coming years. The following chapters will detail Merton's response to that challenge.

5.1) **Financial Viability in Zero Carbon Building**

The financial viability of the zero carbon buildings agenda is an issue that continues to be discussed and analysed by all parties in the development sector. The step-phased introduction of higher standards is designed to give the development industry time to innovate so that zero carbon buildings can be built at a lower cost. This strategy depends on a number of variables, some of which, such as technology development and price, are not within the developer's control.

At the same time it is recognised that this is not the only agenda that is having an impact on the cost of development. Planning obligations including affordable housing provision, and transport provision are all factors that can affect the deliverability of a scheme, and with the recent downturn in the property market, there has been a drop in surplus land value from which to absorb the extra cost.

The governments response to this is to state that:

> "*This does not mean that the zero carbon standard that will apply from 2016 should be relaxed to reflect the economic conditions of 2008. But it does mean that we need to place*

> *greater emphasis on signalling a predictable and affordable policy framework for the future*." [43]

5.2) **Financial Viability Appraisal Methodology**

The accepted methodology for undertaking development appraisals is in essence straight forward and can be summarised by the following equation:

Completed Development Value	—	Total Construction Costs*	—	Developers Profit	=	Residual Land Value (RLV)

* Total Construction Costs includes the cost incurred through planning obligations and fees.

The Residual Land Value (RLV) is the money that the landowner will receive if the development is to go ahead and is the key variable in the equation. If the result of the financial viability appraisal is a positive value then the proposed development can be seen as viable. In reality the Residual Land Value will need to be sufficiently positive to ensure that the development risk is acceptable. If the Residual Land Value is insufficient then additional funding will need to be secured to bridge the 'gap' or the proposal will not go ahead.

Whilst this development appraisal methodology is accepted and in common use there is an inescapable flaw relating to this methodology in that all viability assessments are temporally specific and are most accurate at the time of undertaking. Many if not all the variables in the viability assessment will vary depending on economic conditions, political and policy requirements. The variables in the development appraisal must be know with some degree of accuracy in advance of the developments implementation. This means that the accepted convention is to use the current values and costs as the exact cost and values at the time of completion cannot be accurately predicted in most cases.

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[43] *Definition of Zero Carbon Homes and Non-domestic buildings*. 2008.
(Section 3.9 Technical Feasibility)
http://www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinition

Other issues with this approach to viability assessment are:

- The completed development requires that there is sufficient comparable data to provide meaningful and realistic value base. This issue is of particular relevance to the non-domestic sector.
- Whilst development costs are monitored both nationally and locally and can be assessed accurately and with a sufficient degree of confidence under ‘normal’ conditions and circumstances. As recent economic conditions have demonstrated there is still the potential for rapid and significant shifts away from the norm in a relatively short period of time. There are also an increasing number of ‘exceptional’ build costs being experience as developers are increasingly forced to undertake remediation works on contaminated land.
- Development cost and values are directly impacted by local policy and planning obligations that are subject to change. Issues such as the levels of affordable housing and the number and type of planning obligations imposed on a development will impact on viability. These issues will be more important in major developments.
- Developers profit is not disclosed in a viability assessment but is assumed. In reality the developers profit will be correlated to the level of risk associated with a project. Greater rewards will justify greater risks. It has been common practice to assume developer profit to be around 17%. However, recent economic conditions have force this figure to be revised upwards (to around 22%) as banks seek out higher rates of return against which to lend.
- The land value is the critical variable in the viability assessment. The land-owner ultimately has the final decision on the viability of a development. A favourable bottom line will be achieved if the ‘development value’ sufficiently exceeds the ‘existing use value’.

As we can see above, what at first appears to be relatively straightforward approach and simple equation is fraught with complications. Some of these issues are of differing levels of importance from site to site, however, the temporally specific nature of viability assessment’s means that there are inherent issues in undertaking viability studies to accompany and support policies with a long life span such as the Local Development Framework core strategy.

5.3) **Cost Implications of Sustainable Design and Construction**

The Government and the Building Research Establishment (BRE) have commissioned a number of studies into the costs of achieving higher standards of sustainable design and construction in new development. *'A Cost Review of the Code for Sustainable Homes'* conducted in 2007 for English Partnerships and the Housing Corporation looked at the cost of meeting higher levels of Code[44]. More recent studies include work by Cyril Sweett for the *Definition of Zero Carbon Impact Assessment*[45], (2008) and the *'Code for sustainable homes: A cost review'* (2010).

For non-domestic buildings, the '*Report on Carbon Reductions in New Non-Domestic Buildings*[46]*'* commissioned by the UK Green Building Council investigated the cost of moving towards zero for various types of building. The most recent costing data for achieving higher levels of emissions reduction outside of the domestic housing market can be found in '*Zero carbon for new non-domestic buildings*[47]'.

Domestic Buildings and Code for Sustainable Homes

The cost of building to a level of Code is dependent on a number of site-specific factors, as the 2009 DCLG paper '*The Code for Sustainable Homes: Case Studies*[48]' indicates:

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[44] *A Cost Review of the Code for Sustainable Homes Report for English Partnerships and the Housing Corporation.* 2007
http://www.englishpartnerships.co.uk/docdownload.aspx?doc=Code%20for%20sustainable%20homes%20cost%20analysis%20160207.pdf

[45] *Definition of Zero Carbon Homes: Impact Assessment*. 2009
http://www.communities.gov.uk/documents/planningandbuilding/pdf/1284609.pdf

[46] *Report on carbon reduction in new non-domestic buildings*. 2007
http://www.communities.gov.uk/documents/planningandbuilding/pdf/carbonreductionsreport.pdf

[47] *Zero carbon for new non-domestic buildings: Consultancy on policy*. 2009
http://www.communities.gov.uk/documents/planningandbuilding/pdf/1391110.pdf

[48] *The Code for Sustainable Homes: Case Studies.* 2009
http://www.communities.gov.uk/documents/planningandbuilding/pdf/1161997.pdf

> "The build costs, excluding land costs and fees, ranged from £950 to £1,850 per square meter. It is very difficult to find a benchmark figure against which these can be compared, as the costs vary so much by building type, the standard of finish, the target market etc. However, the developers who had similar schemes with which to compare estimated that this equated to an uplift of about 15% over standard build costs."

A number of consultants have been commissioned over recent year to undertake a number of Code costing estimation studies, firstly by the Housing Corporation and English Partnerships in 2007[49], secondly by DCLG as part of the *Cost Analysis of The Code for Sustainable Homes*[50] and the *Definition of Zero Carbon Homes* consultation paper[51] in 2008, and most recently in the report *Code for Sustainable Homes: A Cost Review*[52]. These reports demonstrate that the cost of meeting all Code levels above 2 is very dependent on:

- Home type;
- Site conditions;
- Cost of meeting achieving required energy credits and targets.

The second of these studies indicated that, even given technology learning rates over the intervening years causing a drop in costs, the cost of attaining Code level 6 in the designated timescale may well be prohibitive if the proposed requirement for all energy needs to be met through onsite generation. Indeed, certain sites would find it physically impossible to achieve Code level 6. This has led to the proposed changes to the zero carbon target as detailed in '*Definition of Zero Carbon*'.

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49 *A Cost Review of the Code for Sustainable Homes Report for English Partnerships and the Housing Corporation.* 2007 http://www.englishpartnerships.co.uk/docdownload.aspx?doc=Code%20for%20sustainable%20homes%20cost%20analysis%20160207.pdf

50 *Cost Analysis of The Code for Sustainable Homes: Final Report.* 2008 http://www.communities.gov.uk/publications/planningandbuilding/codecostanalysis

51 *Definition of Zero Carbon Homes: Impact Assessment*. 2009 http://www.communities.gov.uk/documents/planningandbuilding/pdf/1284609.pdf

52 *Code for Sustainable Homes: A Cost Review*. 2010 http://www.communities.gov.uk/publication/planningandbuilding/codecostreview

BREEAM

There have been fewer published studies on the cost implications of meeting BREEAM standards. This may be attributed to the wider range of building types and uses (including mixed use developments), come under this set of standards resulting in a far larger set of variables than in the domestic sector.

A report by Cyril Sweett titled '*Putting a price on sustainability*' looked at the costs associated with meeting BREEAM standards from Good to Excellent. One worked example of a naturally ventilated office building put the extra cost of achieving "Very Good' at between 1% and 2% of capital costs.

Renewable Energy Targets

Prescriptive renewable energy policies, "Merton Rules" have become a standard feature of the planning landscape. The exact percentage requirement varies as do the methods for calculating the baseline figure from which that percentage is determined. Indeed there is even divergence between calculating the requirement in terms of CO_2 or energy.

The original justification for the policy used a figure of a 3% increase in capital costs. However an in-depth study into the cost implications of such policies has not been undertaken. The current *London Plan* (2008) includes policy 4A.7, which expects all new development to reduce 20% of their baseline emissions through onsite renewable energy generation. There are, however, no prescriptive renewable energy targets in the proposed successor to the *London Plan*.

Literary Review of the cost Implications of Sustainable Design and Construction

There have been a number of investigations into the cost implication of sustainable design and construction. These offer a foundation on which to strengthen and widen our understanding of the financial implications of the proposed step changes in building standards.

The non-domestic sector

Putting a price on sustainability[53]*:* This is one of the earliest investigations into the cost implications of building to higher environmental standards. Published by the Building Research Establishment (BRE) and Cyril Sweett in 2005 this report examines the cost of achieving different levels of environmental performance as defined by BREEAM and EcoHomes standards. The report examines the percentage increase in capital cost associated with four different buildings types in different locations. The building types modelled were:

- A house
- A naturally ventilated office
- An air-conditioned office
- A PFI healthcare centre

The effect of different locations on the uplift costs associated with meeting different BREEAM standards was calculated based on a location's ability to deliver on a number of BREEAM credits that are location specific. The credits that were included in the study were:

- the location of public transport;
- proximity to local amenities;
- existing ecological value of the land.

The BRE define the different location used in this study as:

Poor location = Where no location credits are achievable

Typical location = Where a selection of credits are achievable such as brownfield site with some access to local amenities and public transport.

Good location = where all location credits are achievable.

[53] *Putting a price on sustainability*. 2005. http://www.bre.co.uk/

Some location specific credits were not assessed because they were deemed to be too site-specific, these included improving the ecological value of a site, planning for the long-term impact of climate change and the use of recycled aggregate. As these credits were excluded, more innovative and expensive technologies such as rainwater harvesting, renewable energy technologies and fabric measures were used to achieve a higher BREEAM score. These technologies may not represent the most cost-effective method of achieving BREEAM Excellent, therefore development in the BREEAM Poor areas represents the worst case implications for meeting higher levels of BREEAM.

Report on carbon reductions in new non-domestic buildings[54]*:* In 2007 the UK Green Building Council carried out a further research into the cost reduced and zero carbon non-domestic buildings in the UK. The report sets out to examine four questions:

- What is the total energy use in non-domestic buildings?
- Is it feasible to reduce the carbon emissions resulting from this energy use down to zero?
- What would be the estimated cost of these carbon emissions reductions?
- Over what timescales could zero carbon new non-domestic buildings be achieved?

This report has help to shape the recent *Zero Carbon for New Non-domestic Buildings: Consultation on policy options.*

The wide variety of non-domestic building types and uses means that the issue of achieving zero carbon and investigating the potential cost such aspirations in this sector are more complex than in the domestic sector. The complexity of the non-domestic sector is one reason why the policy in this area has made slow progress in comparison to the domestic sector.

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[54] *Zero Carbon for New Non-domestic Buildings: Consultation on policy options*. 2009 http://www.communities.gov.uk/documents/planningandbuilding/pdf/1391110.pdf

The domestic sector

Two separate reviews into the cost of the Code were published in February 2007. The Construction and Property Consultants Cyril Sweett published *A Cost Review of the Code For Sustainable Homes* on behalf of English Partnerships and the Housing Corporation. The report examined the cost of moving from compliance with EcoHomes Very Good to the Code.

The move from EcoHomes to Code has been driven by the more stringent emissions and water targets in Code level 3 compared to EcoHomes Very Good. The minimum performance standard in Code level 3 is a 25% reduction in CO_2 compared to the Target Emissions Rate set out in Building regulations 2006 Part L, together with a potable water consumption levels of 105 litres per person per day. To determine the uplift costs for achieving the higher standards in Code level 3 took four different scenarios for achieving the required emissions reductions in four different dwelling types. The four scenarios used are outlined below:

Scenario 1. Initial energy efficiency measures followed by use of solar thermal technologies and then photovoltaic and biomass systems.

Scenario 2. Initial energy efficiency measures initially followed by use of small scale wind turbines and then biomass systems.

Scenario 3. Development with shared energy services, such as combined heat and power (CHP). For this scenario cost per unit are averaged for different infrastructure options for a theoretical 200 unit development.

Scenario 4. Achievement of Code level 3 without resource to renewable energies through the use of a whole house mechanical ventilation system with heat recovery and by assuming the use of proprietary details.

The DCLG built on the work of Cyril Sweett in 2008 when they released their *Cost Analysis of the Code for Sustainable Homes: Final report*. Earlier work needed revisiting as changes were made to the detail of credit requirements arising from the publication of the Code technical guidance and the inclusion of a formal definition of zero carbon housing enabling the costs associated with Code level 6 to be estimated. In addition to updating the work by Cyril Sweett it builds upon it by taking account of the different approaches to addressing issues with the developments location (e.g. flood risk, ecological value).

The report aims to:

- Update the cost analysis undertaken by Cyril Sweett for English Partnerships and the Housing Corporation in light of the finalised technical guidance on the Code.
- Provide greater confidence in the analysis of the cost implications of achieving the energy standards in Code levels 4, 5 and 6.
- Provide analysis of the overall cost implications of achieving Code level 6.
- Assess the potential for reductions in the cost of meeting different Code levels arising from increased uptake of the key technologies.
- Provide overarching cost information on achieving each level of the Code together with a semi-quantitative evaluation of likely trends in cost.

The baseline build costs are the same as those used by Cyril Sweett and are taken to be the cost of constructing a dwelling to Building Regulations 2006 Part L. The four different development scenarios are:

- Small scale
- City infill
- Market town
- Urban regeneration

In order to provide guidance on the different policy options and the possible contribution that offsite measures could make towards meeting the Zero

Carbon target for housing. The results of the research are based on the analysis of five different policy options that consider:

- The phased implementation of the policy at key stages in 2010, 2013 and 2016.
- The permitting of contributions from offsite renewable energy schemes to offset the carbon emissions from proposed developments
- The setting of mandatory minimum levels of energy efficiency prior to the selection of renewable technologies

Each policy was modelled twice, once optimising on capital costs alone and secondly taking both the initial capital cost and the expected running costs in to consideration.

The method of calculating the uplift cost in earlier Code costing work has been improved. The four set technology scenarios have been replaced by a dynamic cost benefit model that calculates the smallest uplift costs possible based on capital cost and capital and running cost. The information in this report was then used in the national cost benefit analysis published in the *Definition of zero carbon homes: Impact assessment* released in 2008.

Definition of Zero Carbon Homes

As the policy has developed it has become necessary to update the research into the expected cost implications on sustainable design and construction. In light of work by the UK Green Building Council and the realisation that zero carbon is unachievable in many development without a contribution being made from offsite 'Allowable Solutions', Cyril Sweet were asked to undertake a *Cost and Benefit of alternative definitions of Zero Carbon Homes* (2009). This research built on the original by:

- Acknowledging the need to capture a variety of definitions of a zero carbon home, involving specified performance standards for:
    - Energy efficiency
    - Carbon reduced onsite
    - Carbon reduced off-site

- Including the likely changes to the SAP methodology, by which home energy consumption and carbon emissions are modelled, and its use to within Part L of the Building Regulations
- Including the new approach for the appraisal of the impacts of Greenhouse Gas policies set out by the Inter-Departmental Analysis Group (IAG).
- Findings of work undertaken by the UK GBC's Zero Carbon Task Group.

The methodology and assumptions were the same as in the earlier research with figures being updated where possible (e.g. energy price projections). This then lead to an updated version of the *Definition of zero carbon homes: Impact assessment* being released in December 2009. This updated impact assessment was similar in approach to the 2008 version but takes account of the changes to SAP that represent the latest guidance on grid decarbonisation. There were also some alterations made to the biomass price assumptions to respond to issues arising from the assumptions on biomass fuel costs used in the first impact assessment.

5.4) **Alternative Approaches to Viability**

Viability in PPS22

Local authorities are required to be mindful that planning policies do not negatively impact on the delivery of new development.

Planning Policy Statement (PPS) 22: Renewable energy highlights the question of 'undue burden' on developers in respect of planning related renewable energy requirements. The PPS specifically states that in preparing policies in relation to onsite generation, local planning authorities should take into account the following considerations:

- Policies should not place undue burden on developers;
- Local authorities should be mindful of the level of development pressure in their area in setting generation targets.

In order to demonstrate compliance with the requirements of PPS22 Merton embarked on an in-depth study into the impact of sustainable design and construction related costs on development viability. The aims of the study were threefold:

- Establish a definition for ‘undue burden’.
- Generate accurate cost data for Code and BREEAM for developments in Merton.
- Design a policy that could quickly respond to changes in the development landscape

Defining ‘Undue Burden’

Before it could be demonstrated that the any proposed policies would not result in an ‘undue burden’, this term required definition. There were two potential metrics for doing this:

- As a percentage of build cost
- As a percentage of Gross Development Value

All costing studies to date have used the former metric, however this fails to take into account the effect that the final sale price of the development has on the impact of the extra costs on the business model of the development. This can be demonstrated by a simple case study.

Table 5.1 shows the cost implications of requiring two identical developments built in different parts of Merton to achieve Code level 4.

Table 5.1 Comparison of the uplift costs to reach Code level 4 as a percentage of the total build costs in two developments in different locations within Merton.

Development	**A**	**B**
Address	Wimbledon	Mitcham
Details	10 x 2 bed flats	10 x 2 bed flats
Build Cost	£ 750,000	£ 750,000
Sale Price	£300k per unit	£150k per unit
Gross Development Value	£3 million	£1.5 million
Uplift cost to Code 4	£60K	£60K
Percentage of GDV	2%	4%

To establish an accurate picture of the cost of achieving levels of Code, the London Borough of Merton employed Carbon Plan Limited to construct a sophisticated and flexible Code Cost Calculator (MC^3) that could take into account a wide variety of factors in determining the probable uplift in cost required to meet Code level 3 and 4.
These include:

- Dwelling type
- Development type
- Access to low cost Low, Zero Carbon resource
- Developer type (i.e. small, medium, large)
- Ecological value of site

The MC^3 was designed to take an initiative approach to calculating the viability of different level of Code, defining viability not as a positive residual land value but rather by examining the uplift costs to higher levels of Code as a percentage of the Gross Development Value. The level of viability chosen for the MC^3 model was 3% of Gross Development Value as it was felt that this mirrored the work done prior to the implementation of the Merton Rule.

The work on the MC^3 calculator provided some interesting insights into the viability of different levels of Code across the borough, and potentially offers a new approach to calculating the highest possible level of sustainable design and construction standard in specific locations.

The London Borough of Merton recognise the importance and potential of this research but feel strongly that a regional or national body would be better place to take on this work and provide innovative approaches to assessing viability. This is because a regional or national body would be better placed to gain access to data, including a wide variety of development scenarios and variables to provide the data required to make a viability approach based on Gross Development Value suitably robust to be implemented.

6) **The Viability of Code for Sustainable Homes in Merton**

Merton council undertook a *Local Development Framework: Affordable Housing Viability Study*[55] for the borough in order to assess the affect of planning policy on development viability. The viability of building to Code for Sustainable Homes (Code) level 4 was measured directly using the uplift costs (the increase in building costs for meeting a higher level of Code) and through the base assumption of compliance with Code level 3 plus a 20% reduction in CO_2 from the use of onsite renewables.

Viability was tested using Code level 4 under a number of different affordable housing scenarios, over a range of development obligation costs and in a range of development sizes. The results for this viability modelling are given in the Appendices IIL, IIm and IIn of the *Affordable Housing Viability Study*. The results show that building to Code level 4 is viable across the borough under the tested conditions for developments of 25, 50 and 80 dwellings. Adams Integra were asked to present the viability modelling undertaken in terms of Code level 4.

The base scenario for sustainable design and construction used is the uplift cost for a 20% reduction in CO_2 through onsite renewable energy measures, over and above the Code Level allowances made for the base assumption (*Affordable Housing Viability Study* 3.11.1 p66.)

The *Affordable Housing Viability Study* has used a high value for the provision of the 20% CO_2 reductions from renewables to model for the worst case scenario even though it is acknowledged that this figure is higher than will be experienced under normal conditions. This also helps to take account of the fact that smaller infill developments of the type typical to Merton often spend a

55 *Local Development Framework: Affordable Housing Viability Study.* 2010 www.merton.gov.uk/living/planning/ldf/planningresearch.htm

higher proportion of their costs achieving sustainable design and construction standards than larger new build schemes due to economies of scale and the more limited range of measures feasible on smaller sites.

> “. . .we acknowledged that the additional allowance made alongside our Code Level 3 base assumption may be in excess of actual amounts, but that we considered it appropriate to make sure there was at least adequate allowance for this cost area which can be highly variable from site to site.”

This cautious approach to the inclusion of a 20% emissions reduction from the use of onsite renewables means that the estimated uplift costs of achieving Code level 3 plus a 20% emissions reduction form the use of onsite renewable exceeds that of achieving Code level 4 (Table 6.1).

It is therefore reasonable to assume that the introduction of Code level 4 and the exclusion of a prescriptive renewable energy target will be viable in all situations that were viable under the base assumptions of Code level 3 plus a 20% CO_2 reduction from onsite renewable energy.

Table 6.1 The Residual Land Value (RLV) for different levels of affordable housing and for different levels of sustainable design and construction standard. The base case is taken to be Code level 3 plus the inclusion of a commitment to achieve a 20% reduction in CO_2 in the London Plan. Value Point 3 only - 70/30 Tenure Mix (Affordable Housing Viability Study p.67).

Appraisal Type	25 Unit Mixed Scheme (VP3)			
	RLV (£) CfSH Level 3 (Base)	RLV (£) CfSH Level 4	RLV (£ per Ha) CfSH Level 3 (Base)	RLV (£ per Ha) CfSH Level 4
30% Affordable	£1,405,465	£1,485,478	£4,258,985	£4,501,448
40% Affordable	£1,151,115	£1,231,127	£3,488,226	£3,730,689
50% Affordable	£795,829	£875,842	£2,411,604	£2,654,067

In recognition of the long-term nature of the Local Development Framework and the need for viability evidence to take into consideration the limitations of the accepted viability assessment, contingencies were built into the Adams Integra methodology. To create a improve longevity of the results from the *Affordable Housing Viability Study* the method included the use of 9 different 'Value Points' (VP) chosen to represent the clustering of land values within the borough with a Lower (VP1) and higher (VP9) Value Points to represent changing market conditions. The inclusion of VP1 and VP9 in the modelling of housing viability protects ensures that the housing policies can be shown to be theoretically viable in changing market conditions.

7) **The Viability of BREEAM in Merton**

It is not possible to assess the viability of BREEAM in the same detail as the analysis of Code for Sustainable Homes as outlined in Chapter 5. A detailed analysis of BREEAM for the purpose of a broad-level level viability assessment to inform policy for non-domestic buildings is hampered by a number of factors:

- The increased complexity of non-domestic building analysis due the wider range of building types and building uses.
- Insufficient comparable data to create meaningful Value Points that would allow change market conditions to be considered.
- Limited published academic research into cost implications of reaching different levels of BREEAM.

There is insufficient available data on the full range of commercial properties and mixed use developments to use the standard viability assessment approach, therefore it is not possible to establish the viability for different levels of BREEAM across all schemes. The key barrier to any broad level approach to BREEAM viability is in calculating the uplift cost for a number of BREEAM credits and categories, e.g. Energy and Water. There are however, a number of credits that can be met at little or no cost. Some credits are awarded on location-specific conditions e.g. Transport, Flooding and Ecology.

To gain a better understanding of BREEAM credits affected by location within Merton it is necessary to firsts examine past trends in non-domestic building and proposed future developments (from planning permissions or pre-application discussions) that are likely to take place within the borough. These development trends can then be examined against the criteria of the location-dependent credits to examine the potential number of BREEAM credits that will be awarded to a scheme simply by virtue of its location. This information can them be used to classify Merton's suitability as a BREEAM development location. Once Merton has been classified as either a poor, typical or good location the 2005 BRE investigation into the uplift cost associated with meeting different levels of BREEAM can be used to estimate the potential impact of different levels of BREEAM on viability.

7.1) **Development trends in Merton**

Assessing Historic non-domestic Development trends in Merton

A database of all non-domestic developments across the borough was compiled using building records for the last 10 years. The data was selected to capture all construction works undertaken as part of new build development or refurbishment works. The data included construction from mixed-use schemes, provided the construction works was undertaken in relation to the non-domestic element of the scheme. This database was then examined to ascertain the relationship between the number of schemes and their size or area of the development. Traditionally development classification based on size has separated developments into major (over 1,000m^2) and minor sites (under 1,000m^2).

In order to gain a better understanding of the relationship between the number of planning applications and the area of development, the standard development sizes were subdivided into small categories. Minor developments have been subdivided into classes with boundaries set at 250m^2 and major developments have been separated with boundaries set at 1,000m^2. The results are set out below.

Table 7.1 Number and size of development applications over the last ten years in Merton.

	Number of units	Total floor space	% of units	% floor space
0 - 249	21	1943	32	2
250 - 499	13	4820	20	5
500 - 749	4	2430	6	3
750 - 999	4	3481	6	4
1000 - 1999	5	7748	7	7
2000 - 2999	6	14707	8	14
3000 - 3999	6	20559	8	19
4000 - 4999	1	4480	1	4
5000 - 5999	0	0	0	0
6000 - 6999	4	25961	6	24
> 7000	1	19659	1	18

Table 7.1. shows that around 50% of non-domestic developments are smaller than 500m^2 and account for only 7% of Merton's total non-domestic development. Over 90% of Merton's non-domestic development occurs in developments over 500m^2 in size. By excluding those developments under 500m^2, the number of development site can be reduced by 50% whilst ensuring that the majority of Merton's development area is included.

The historic developments over 500m^2 were then mapped according to their classification in the Use Classes Order and ward (Table 7.2) to gain a greater understanding of the types and locations of developments that have occurred in Merton over the last 10 years.

Table 7.2 Business use class and location of developments in Merton over the last 10 years.

Ward	Number of sites	Minor sites	Major sites	Planning use class								
				A1	A3	B1	B2	B8	C2	D1	D2	SG
Abbey	5	1	4			7358	3048	2709		863		
Colliers Wood	3	0	3			1962			3225		3900	
Cricket Green	2	0	2					4480			2570	
Hillside	6	2	4			7575	880		3991		2070	2512
Lavender Fields	2	1	1			928		1576				
Longthornton	3	1	2	1766		7582						
Lower Morden	1	0	1				6200					
Merton Park	1	0	1			1100						
Raynes Park	2	1	1		875				2130			
Village	1	0	1								2716	
West Barnes	1	0	1	19659								
Wimbledon Park	4	2	2			4372						3210
LBM Total	31	8	23	21425	2674	29078	10128	8765	11858	863	11256	5722

Table 7.3 Area of development by use class for Merton over the last 10 years.

Description	**Class**	**Aream (m2)**	**Area (%)**
Shops	A1	21425	22
Restaurants and cafés -	A3	875	1
Business	B1	30877	31
General industrial	B2	10128	10
Storage or distribution	B8	8765	9
Residential institutions	C2	9346	9
Non-residential institutions	D1	863	1
Assembly and leisure	D2	11256	11
Sui Generis*	SG	5722	6

The most common development is B1 (Business) in terms of both the total floor space developed and the number of schemes. There were 12 developments throughout Merton classed as B1:

- five occurring as part of a mixed used scheme alongside residential,
- two mixed use developments in which there was no residential with
- the remaining five developments not built as part of a mixed used scheme.

The schemes ranged from 52m^2 to 6,970m^2 with an average B1 development of 2,573m^2.

The second largest development by business use class is A1 (retail) (Table 7.3). However, there are only two developments that have been classed as A1, with the large A1 development in West Barnes accounting for the majority of this. Most other business use classes saw between two and four developments within D1 (non-residential institutions) and A3 (restaurants) and cafes) making the smallest contribution to the levels of development.

Table 7.4 Area of development by ward for Merton over the last 10 years.

Ward	Area (m2)	Area %
Abbey	13978	14
Colliers Wood	9087	9
Cricket Green	7050	7
Hillside	17028	17
Lavender Fields	2504	3
Longthornton	9348	9
Lower Morden	6200	6
Merton Park	1100	1
Raynes Park	3005	3
Village	2716	3
West Barnes	19659	20
Wimbledon Park	7582	8

When development trends are examined by ward (Table 7.4) we see that West Barnes is the most developed ward in terms of floor area (20%) thanks to the contribution from the large retail unit that is situated here. The most developed ward in terms of the number of developments is Hillside with six developments closely followed by Abbey with five. Hillside and Abbey are the second and third most developed wards accounting for 17% and 14% of the total floor spaced developed.

There are eight wards within the borough that have not witnessed any of the historic development and are not expected to see any significant non-residential development in the near future.

Assessing Future non-domestic Development trends in Merton

Planning applications were examined again, this time to gauge the trend in future development. A database of major sites (over 1,000m^2) that are expected to come forward in the coming years is compiled from planning discussions and is updated fortnightly[56]. Future sites have been mapped according to their location only (Table 7.5).

Table 7.5 Number of major future development sites proposed in different wards within Merton**.**

Ward	Number of sites
Abbey	3
Colliers Wood	2
Cricket Green	1
Dundonald	2
Figge's Marsh	1
Hillside	1
Lavender Fields	3
Longthornton	1
Merton Park	1
Pollards Hill	1
Raynes Park	6
St Helier	1
Village	2
West Barnes	1
Wimbledon Park	2
LBM Total	28

There will be a total of twenty-eight major sites that will be likely to undergo development over the next few years, identified though planning discussions. Only the location of the future developments has been examined as the exact

[56] Database used for analysis Dated 03 Aug 2010

development type (by Use Class Order) at different locations may be subject to change.

By examining the location of major sites for non-domestic development within Merton we can see that the majority of potential development is planned for Raynes Park, with six major sites identified in this ward alone. The number of sites in other wards is lower with an average of two sites being located in each of the other wards.

Summary of Merton's development trends

When the past development trends within Merton over the last ten years and the major sites identified for development over the next few years are examined it can be seen that:

- The level of development within Merton has been relatively low.
- Historic patterns do not necessarily dictate future trends. Raynes Park has not seen significant levels of historic development but will account for a more significant level of development in future.

7.2) **Establishing a viable minimum BREEAM standard**

To set developments within the context of BREEAM it is first necessary to establish the most relevant BREEAM scheme that would be used to assess each of the historical development sites. A background is given in Chapter 3 and explains that there are a number of BREEAM schemes (e.g. Offices, Data-centres, Industrial etc.) and BREEAM Bespoke scheme allows the full range of non-domestic building types to be assessed. Within each BREEAM *Scheme Document* section 2.0 outlines the which type of BREEAM scheme should be implemented and now different developments should be classified.

There is a good correlation between most non-residential Use Classes and the different BREEAM schemes, however, some non-residential Use Classes are more difficult to classify directly with a particular BREEAM scheme. Where a clear correlation between the non-residential Use Class and the most appropriate BREEAM scheme was not obvious, schemes were placed in the most appropriate scheme by examining the detail in the project description according to the information provided in section 2.0 of the BREEAM scheme handbooks.

Where the information provided in the project description was not detailed enough (e.g. insufficient information on floorspace) to be able to undertake a precise classification procedure, , the classification of some projects has been undertaken on a qualitative assessment of the available information.

The non-domestic Use Classes and the most appropriate BREEAM scheme are listed below. The classification of the non-domestic Use Classes that do not correlate well BREEAM and the justification for each BREEAM scheme chosen are also given. The poorest collection between the non-domestic Use Classes and BREEAM is associated with Use Classes D1 and D2. The classification of development classed as D1 (non-residential institutions) and D2 (Assembly and leisure) have been assigned the most appropriate BREEAM scheme based on the development description, with developments classed as D1 and D2 being split between the BREEAM offices and BREEAM Retail schemes (Annex 2). The number of historic developments by most applicable BREEAM scheme are shown in Table 7.6.

Table 7.6 Number of historic development by most appropriate BREEAM scheme.

Scheme	Area (m2)	Area (%)
Industrial	18013	18
Multi-residental	9346	9
Office	39772	40
Retail	32126	32

The effect of location on achieving BREEAM standards

A developments location will have an important influence on its BREEAM assessment. The relationship between BREEAM and location is straightforward in a few cases and more complicated in others. In terms of cost, and therefore in terms of viability, one of the most crucial factors associated with a specific location will be the availability of renewable energy resources. Compliance with the energy credit requirements of the different BREEAM levels will be the main contribution to the uplift cost from one level of BREEAM to the next. Whilst it has been possible to untaken a review of the available renewable energy resources in Merton it not possible to translate this research into a comprehensive assessment of the uplift costs of meeting different levels of BREEAM in the different building types within Merton.

When looking at the variation in number of location-specific credits that will be achieved at different sites across Merton it is important to choose those credits in which location is the only/major determinant. This has lead to the assessment of the availability of the following credits:

- Tra1: Provision of Public Transport
- Tra2: Proximity to local amenities
- Pol5: Flood Risk
- LE1: Reuse of Land

BREEAM credit Tra1: Provision of Public Transport

Access to public transport is assessed in the Tra 1 with five credits available in the retail scheme and three credits in all other schemes included in this investigation. It is possible to undertake a broad level assessment of the potential number of Tra 1 credits that will be achieved in different parts of Merton by mapping the historic and future sites against a Public Transport Accessibility Level (PTAL) map.

Whilst PTAL is not appropriate for use in an individual BREEAM assessment undertaken by a trained assessor, it is suitable for use to get general trends. For the purpose of accreditation, a site would have to measure the exact distance to public transport nodes from the front entrance of the building and the credits awarded would be based on the Accessibility Index. The BREEAM scheme handbooks include a table giving the approximate read across from different PTAL scores that correlate to different ranges within the Accessibility Index, which in turn can be used to estimate the number of Tra 1 credits that will be available in different locations (Table 7.7 and 7.8).

The BREEAM Retail scheme places a greater level of importance on Tra 1 than any of the relevant Merton schemes, with five credits available in Retail Tra 1, whilst only three are available in other schemes.

Table 7.7 BREEAM credits awarded according to the level of the Accessibility Index that is achieved.

Accessibility Index	BREEAM Credits
≥2	1
≥4	2
≥8	3
≥12	4
≥18	5

Table 7.8 Accessibility Index equivalents to the Public Transport Accessibility Level (PTAL).

PTAL	Accessibility Index
1	0.00 - 5.00
2	5.01 - 10.00
3	10.01 - 15.00
4	15.01 - 20.00
5	20.01 - 25.00
6	≥ 25.01

Results for Tra1

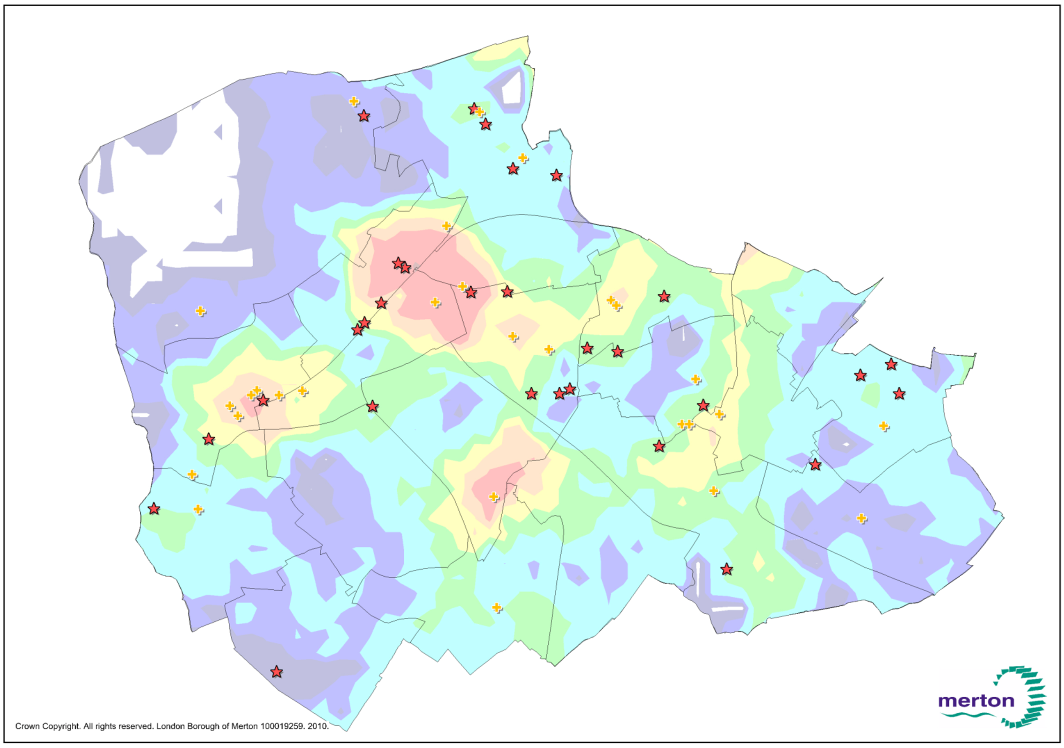

Figure 7.9 Distribution of historic and future development sites across Merton mapped against the Public Transport Accessibility Level (PTAL). Red indicates a high PTAL score, whilst Blue indicates lower PTAL scores.

Table 7.10 Number of development sites receiving different levels the location specific Tra1 Credits (Excluding historic retail sites).

Tra1 Credits achievable	Number of Developments
All	34
Some, possibly all	15
Some	4

Table 7.11 Number of Tra1 credits under BREEAM Retail for historic Retail sites and Future development sites

Tra1 Credits achievable	Number of Developments
All	11
Some, possibly all	5
Some	18

BREEAM credit Tra2: Proximity to amenities

The second location-dependent BREEAM transport credit is awarded based on the proximity to following amenities:

- Grocery shop and or food outlet
- Post box
- Cash Machine

A development must be situated within 500m of all three of these different amenities in order to receive the credit available for Tra 2. The distance to each of these amenities is not measured in a straight line but rather by the distance via a safe pedestrian route.

As with Tra1 it is not practical to undertake a detailed site-specific BREEAM assessment for each of the development sites in this investigation. Therefore to get an overview of the achievability of Tra2 in Merton the development sites were mapped against the known location of post boxes, retail units and neighbourhood parades, local centres, district centres and regional centres – using the assumption that all of these areas would contain a convenience store and cash machine. The biggest limitation to this approach was the lack of reliable location specific data on cash points. However, by mapping the known retail areas and post boxes it is possible to ascertain how many developments have a low or no possibility of receiving a credit under Tra2.

There is a strong correlation between the location of retail areas and cash points and whilst the presence of retail does not guarantee retail area are a suitable proxy for purpose of this investigation. The location of post boxes are not strongly correlated with the location of retail or local, regional and district centres. Post box location could therefore be seen as the limiting factor in the achievability of the Tra2 credit.

Results for Tra2

Table 7.11 Number of development sites within a 500m radius of the amenities required to receive the location specific credits awarded under Tra2.

Located near post box	Located near Retail	Number of Developments
No	No	4
Yes	No	21
Yes	Yes	34

BREEAM credit Pol5: Flood Risk

Within the Pollution category of all BREEAM schemes there are location-specific credits available that relate to food risk. Two credits are automatically awarded under the Pol 5 if the development can be shown to have a low annual probability of flooding and that the a site-specific Flood Risk Assessment confirms that there is a low risk of flooding from all sources.

The Strategic Flood Risk Assessment undertaken by Scott Wilson on behalf of four south London boroughs including Merton undertook a detailed analysis of the potential risks of flooding in Merton from all sources. The development sites can be mapped against the hazard maps showing the probability of:

- Ground water flooding
- Tidal flooding
- Surface water flooding
- Sewer Flooding

Issues relating to Sewer Flooding and BREEAM

There are a number flaws with the data collection for sewer flooding that should be taken into account when examining the BREEAM credits available for Pol5. The first is the issue of the relatively short period of time over which data collection on sewer flooding has been collected (> 10 years). The second issue relates to the way in which this data has been mapped.

The data collection has been mapped according to the postcode area from which the data has been collected. Mapping the data in this way does not provide the level of resolution required to accurately examine the effect of sewer flooding on development sites within Merton.

There is also no commonly recognised definition of the boundaries for different hazard zones for sewer flooding. The Strategic Flood Risk Assessment establishes the following boundaries for hazard boundary definitions:

- High Probability – > 5 properties affected within the previous 10 year period
- Medium Probability – between 3 and 5 properties affected within the previous 10 year period
- Low Probability – < 3 properties affected within the previous 10-year period

The problem with this approach is that when data collected over a short period of time is separated in to the hazard boundaries above and mapped at post-code a resolution it creates an unrealistic interpretation of the potential risk from sewer flooding. This is because the short time scales of data collection gives a poor sample of the range and scale of sewer flooding events. The hazard boundaries have therefore been based on a data collected over a short time scale, and over a limited geographical range that is not represent the range and scale of events that would be expected to emerge from a data set that had been collected as part of a long-term study rather than a decade. The high probability category does not therefore necessarily represent a “high” probability of sewer flooding is simply shows a higher probability of sewer flooding than the other areas in the borough.

When this issue is combined with the poor resolution of post-code mapping the result is that the sewer flooding risk map is not ideally suited for use in a strategic assessment such as this. However, it would not be appropriate to disregard flood risk from sewers entirely. The inclusion of sewer flooding based on the hazard map described above will provide a cautious approach with respect to sewer flood risk and consequently a developments ability to qualify form the maximum number of credits available under Pol5.

Results for Pol5

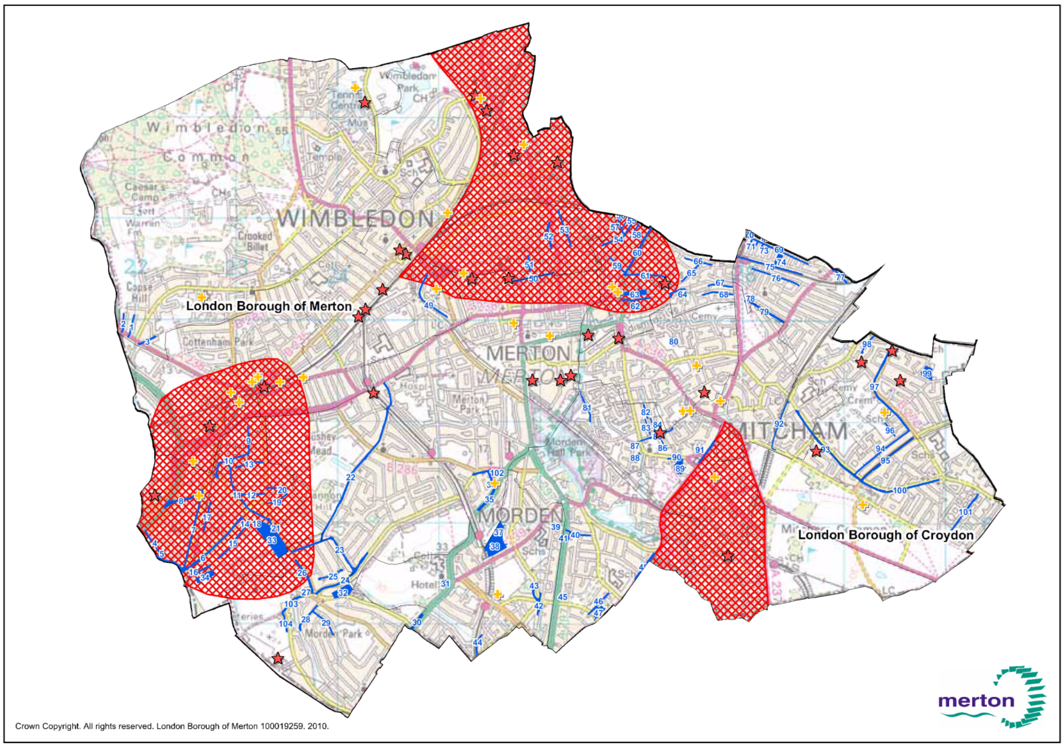

Figure 7.12 Distribution of historic and future development sites across Merton mapped against surface water flooding.

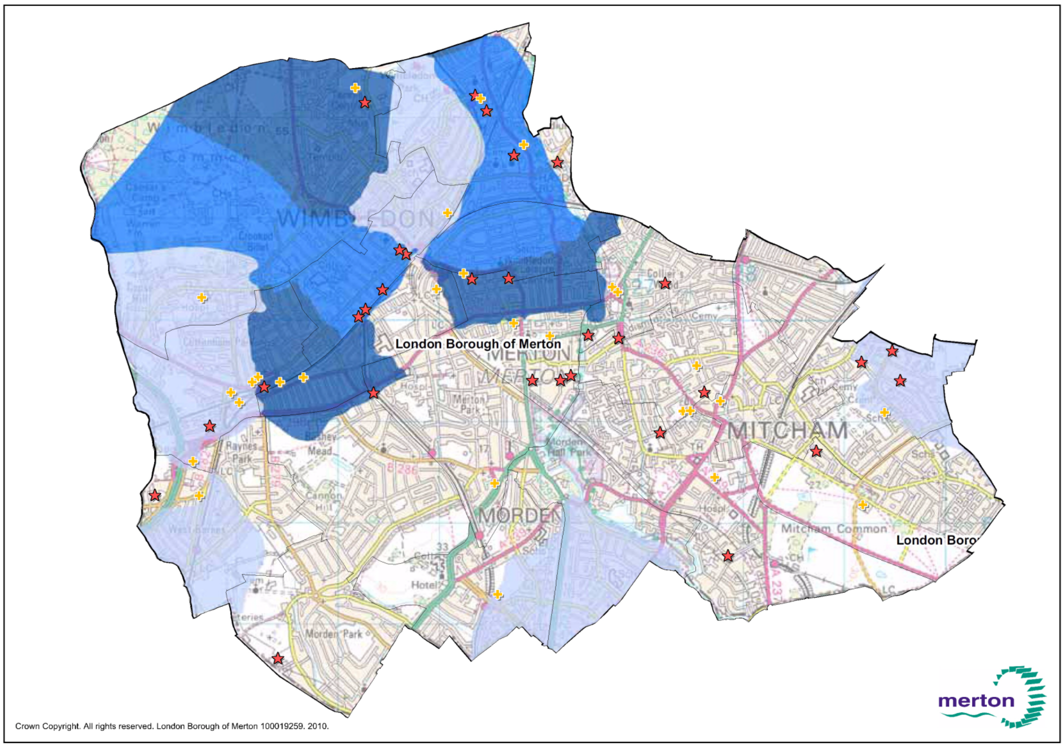

Figure 7.13 Distribution of historic and future development sites across Merton mapped against sewer flooding

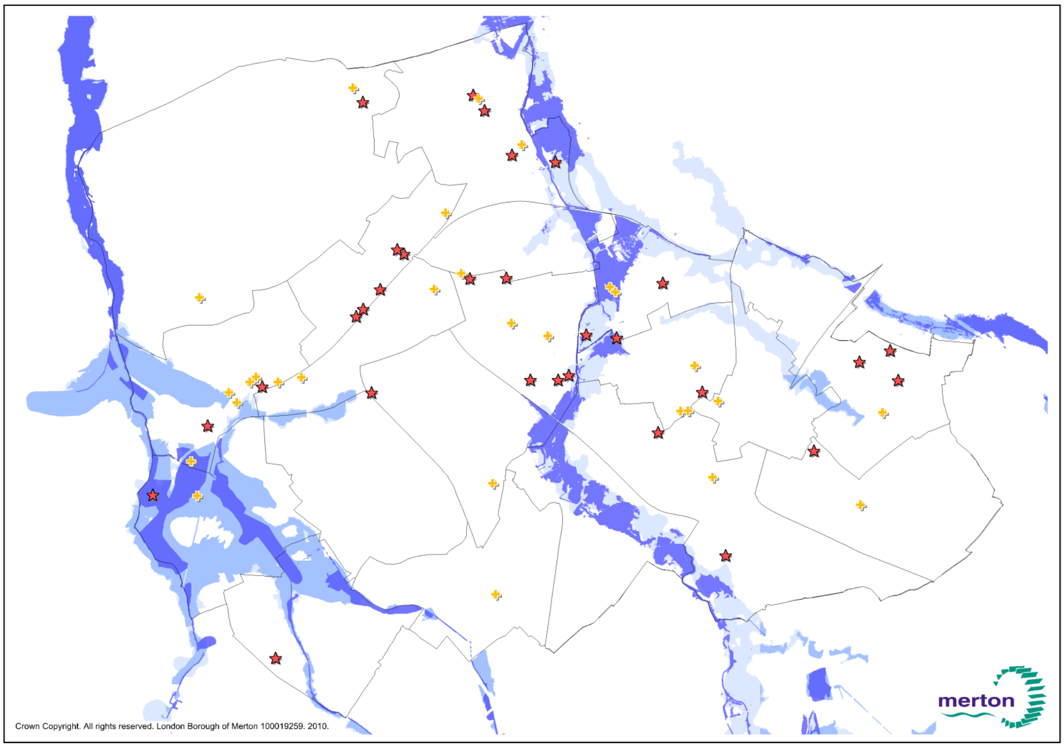

Figure 7.13 Distribution of historic and future development sites across Merton mapped against the Environment Agencies tidal and fluvial flood risk areas.

Table 7.14 Number of historic and future development sites at risk of surface water flooding

Surface water flood risk	Number of Developments
None	31
Yes	28

Table 7.15 Number of historic and future development sites at different levels of risk from sewer flooding

Sewer water flood risk	Number of Developments
High	10
Medium	10
Low	12
None	27

Table 7.16 Number of historic and future development sites in the different Environment Agencies Fluvial and Tidal flooding risk zones.

Flood Zone	Tidal flood risk	Number of Developments
Flood Zone 1	Low	49
Flood Zone 2	Medium	3
Flood Zone 3a	High	3
Flood Zone 3b	Functioning Floodplain	4

Only one site showed potential flood risk form ground water flooding

Table 7.17 Number of locations receiving different levels of the location specific Pol5 credits.

Pol5 Credits achievable	Number of Developments
All	32
Some	9
None	18

BREEAM credit LE1: Reuse of Land

Under LE1 there is one credit available for the reuse of previously developed land. In order to achieve this credit a development must site at least 75% of the buildings footprint on land that has previously been developed for industrial, commercial or domestic purposes in the last 50 years.

Merton has policies in place to safeguard existing open space and the reuse of previously developed land. It would be an acceptable assumption to suggest that all developments within Merton will comply with the requirements of this credit.

To ensure that none of the historical or proposed developments are to be built on land that has not previously developed the sites were mapped against their identifiable land type.

Results for Pol5

Table 7.18 Number of developments on different land types.

Land status	Number of Developments
Industrial Land	10
Urban centre	17
Previously developed land	32
Undeveloped land, Green space	0

Assessment of Merton as a BREEAM development location

When the potential number of location-specific credits are totalled for BREEAM Offices, Industrial and Multi Residential schemes, there are maximum of seven credits available, with a maximum of nine available of BREEAM Retail. The upper and lower range of location specific credits have been calculated for each development and shown in the table 7.19.

Table 7.19 Number and percentage of potential location specific BREEAM credits available to developments.

	Numver of credits		% of credits	
	Maxium	**Minimum**	**Maxium**	**Minimum**
Historical	6	4	84	59
Future	6	4	85	63
Historical Retail	5	3	60	38
Future Retail	7	5	79	58

From this we can see that Merton could be classed as a typical / average *location for achieving BREEAM location-specific credits* BREEAM development area as it is always possible to achieves some, but not all of the location-specific credits.

The effect of BREEAM location on the percentage increase in capital cost is investigated in the 2005 BRE paper described in Chapter 5. The percentage increase in capital cost for the three different case studies building scenarios covered in this investigation are shown below (Tables 7.20, 7.22 and 7.24.). These results show that the uplift cost are close to zero, between Pass and Very Good. However, when the cost curve for meeting increased levels of BREEAM are examined it can clearly be seen that the uplift cost start to rise more steeply between BREEAM Very Good and Excellent (Figures 7.21, 7.23, 7.25). Developers can take advantage Merton in terms of Merton as an area for BREEAM development. Whilst 100% of the location specific credits might not be available on the whole a development can be expected to gain some credits simply by virtue of its location.

Table 7.20 Increase in the capital costs to achieve different BREEAM ratings in different locations for a naturally ventilated office.

Location[2]	BREEAM score and rating for the base case naturally ventilated office	% increase in capital cost to achieve a Pass/Good/Very Good/Excellent			
		Pass	Good	Very Good	Excellent
Poor	25.4 (Pass)	–0.4	–0.3	2.0	—
Typical	39.7 (Pass)	—	–0.4	–0.3	3.4
Good	42.2 (Good)	—	—	–0.4	2.5

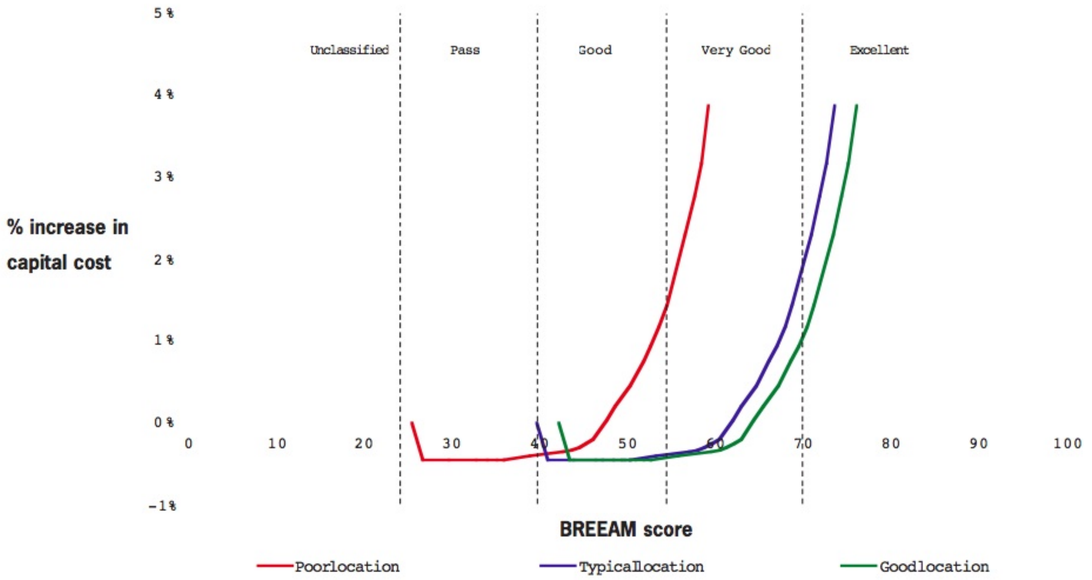

Figure 7.21 Cost of achieve different BREEAM ratings in a naturally ventilated office for different BREEAM location types.

Table 7.22 Increase in the capital costs to achieve different BREEAM ratings in different locations for an air-conditioned office.

Location[2]	BREEAM score and rating for the base case air-conditioned office	% increase in capital cost to achieve a Pass/Good/Very Good/Excellent			
		Pass	Good	Very Good	Excellent
Poor	20.3 (Unclassified)	0	0.2	5.7	—
Typical	34.6 (Pass)	—	0	0.2	7.0
Good	37.1 (Pass)	—	0	0.1	3.3

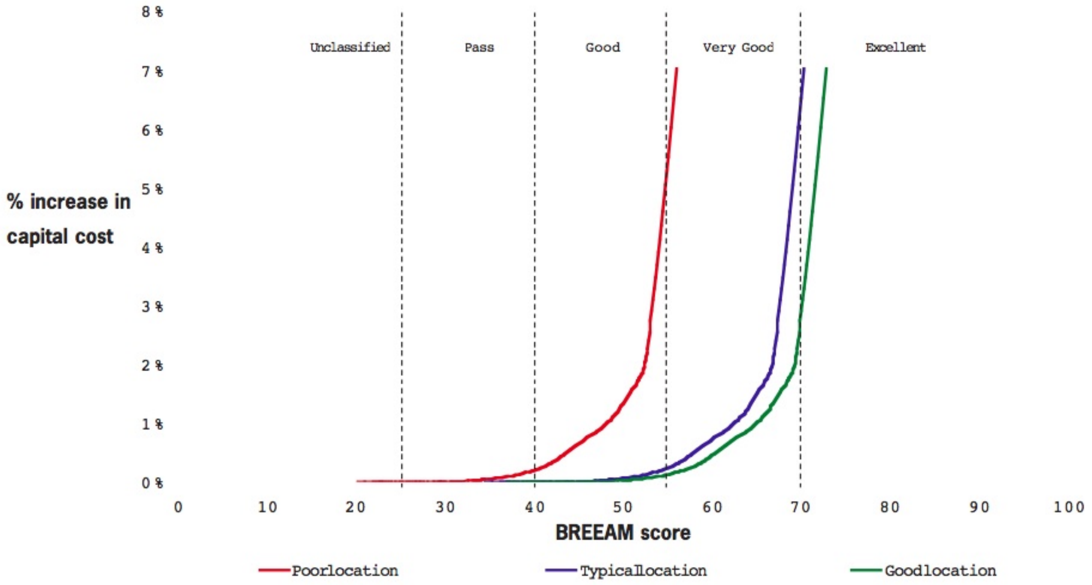

Figure 7.23 Cost of achieve different BREEAM ratings in an air-conditioned office for different BREEAM location types.

Table 7.24 Increase in the capital costs to achieve different BREEAM ratings in different locations for a PFI health centre.

Location[2]	BREEAM score and rating for the base case healthcare facility	% increase in capital cost to achieve a Pass/Good/Very Good/Excellent			
		Pass	Good	Very Good	Excellent
Typical	44.3 (Good)	—	—	0	1.9
Good	48.4 (Good)	—	—	0	0.6

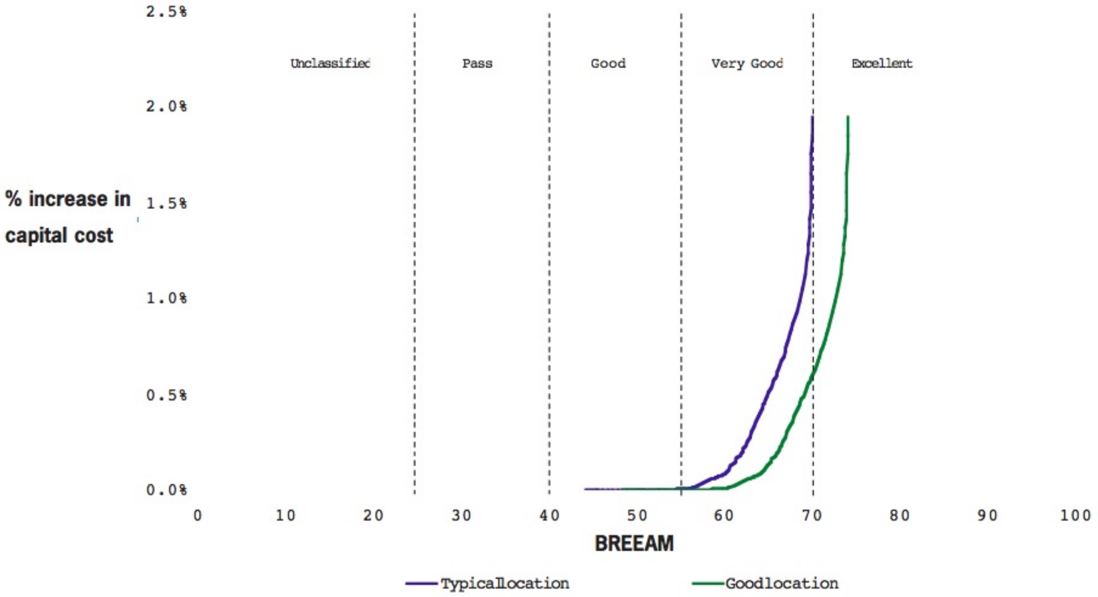

Figure 7.25 Cost of achieve different BREEAM ratings in a PFI health centre for different BREEAM location types.

8) **Conclusions & Recommendations**

8.1) **Recommendation 1**

The LDF core strategy must be flexible and adaptable in its original conception and incorporate methods of updating and advising on policies, to recognise that policy and practice on climate change and energy issues are evolving quickly.

The long-term economic consequences of climate change[57], energy security and projected energy price trends[58] create a strong business case for ensuring that greenhouse gas emissions are reduced, energy efficiency improvements are made where ever possible and that energy generation sources are diversified. These long-term imperatives are recognised and supported through a wide range of policies operating at different levels and focusing on different aspects of the sustainable development and energy security agenda. National policies such the *Climate Change Act 2008*[59]*,* provide a long-term legislative driver to addressing environmental and energy issues, however, policies that support and govern different technologies, sectors and national, regional and local strategies create a continually shifting policy landscape through which to navigate. There are complex interactions between different aspects of sustainability and policy that create financial risks in the construction and energy sectors. Careful policy consideration can help to reduce this risk by providing consistent policy drivers, however, poorly considered and outdated policy can increase this risk.

Research and development and the markets for Low or Zero Carbon technologies will play an important role in the development of future policies. As the markets for energy efficiency and low and zero carbon technologies

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57 *Stern Review: The Economics of Climate Change*. 2006, www.hm-treasury.gov.uk/stern_review_report.htm

58 *Annex F: Fosse Fuel and Retail Price Assumptions*. 2010. http://www.decc.gov.uk/en/content/cms/statistics/projections/projections.aspx

59 *Climate Change Act 2008*, The Stationary Office, 2008 http://www.decc.gov.uk/en/content/cms/legislation/cc_act_08/cc_act_08.aspx

progress they will have pressure exerted on them by policy but will also in turn help to shape future policy. The local development framework must be able to adapt to these market and policy changes.

In order to cope with and adjust to changes in the policy landscape climate change policies, the LDF must provide a secure base from which to tailor national and regional policies and incentives at a local scale. Policies must be holistic in approach and attempt to address all aspects of sustainable development, covering not only CO_2 emissions but also addressing wider sustainability issues such as the effective use of resources and material and the use and treatment of water. Changes in national policy or local circumstances will require policies in the LDF are supported and built upon through the carefully considered Supplementary Planning Guidance to help update and focus the policies in the LDF. Good examples of the need for a LDF policy that is flexible and updatable will be the future incorporation of measures such as the Allowable Solutions to help in achieving zero carbon development. Or updating local policies in response to changes in the national policies, such as the phased step changes to the emissions reduction targets in Part L.

8.2) **Recommendation 2**

The need for a prescriptive onsite renewable policy at the local planning policy level is no longer necessary. Removing the Merton rule will increase developer flexibility without reducing the environmental performance of buildings, and by prioritising the fabric measures will improve the situation.

The two main options for controlling energy and emissions in the built environment are energy efficiency measures to manage energy demand and the production of low and zero carbon energy. When the Merton Rule was conceived and introduced there were no energy efficiency backstops included in building regulations and the requirement to produce 10% of the developments energy from onsite sources encouraged developers to address both energy efficiency and renewable energy generation in the design and construction process. The introduction of SAP (and SBEM), the introduction of Part L, increasing emissions reduction targets in building regulations and the Zero Carbon Building program now ensure that energy efficiency must be incorporated as a fundamental part of design, to enable energy reductions through the whole life of the development. The introduction of the Clean Energy Cashback schemes means that there is now national policy to support microgeneration, and this support does not need replicated at a local level through the imposition of prescriptive onsite renewable energy targets.

8.3) **Recommendation 3**

Ensure the energy efficiency is prioritised in new developments

There is little benefit to be gained from placing prescriptive renewable energy generation targets locally over challenging national energy efficiency backstops unless there are large potentially viable renewable energy resources going unutilised. Renewable energy will contribute towards meeting CO_2 reduction targets where it is cost effective to implement but it is critical to ensure that energy efficiency becomes a central consideration in the design process. The removal of prescriptive renewable energy targets within Merton will provide developers flexibility in balancing fabric measures and renewable energy production, without reducing support for either approach. This will enable the most effective site-specific and cost effective solutions to be realised.

The removal of the prescriptive renewable energy targets will also aid in ensuring that the emissions reductions are examined in order of preference according to the London Plan energy hierarchy.

8.4) **Recommendation 4**

Maximise the potential for addressing emissions from existing buildings through the planning system.

There is a pressing need to find methods of substantially reducing emissions from existing buildings, in particular the domestic housing stock. Planning policy has only a limited ability to tackle emissions from existing buildings unless they are being developed or renovated in a way that requires that they enter into the planning system. It is important that planning policies are able to ensure that all the feasible emissions reductions opportunities are undertaken. For this reason it is of critical importance that both new developments and refurbishment that enter the planning system are covered by sustainable design and construction policies.

This can be done by ensuring that policies relating to the development of non-residential include building renovation. Sustainable design and construction policies can be applied to redevelopments for non-domestic buildings through the use and separation of the 'Shell and Core' or 'Fit out only' approach to a given BREEAM scheme.

BRE are currently developing a BREEAM scheme to cover the refubishment and renovation of domestic properties. Once the BREEAM Refurbishment standard is launched Supplementary Planning Guidance should be published to outline its possible contribution towards meeting the Climate Change policies in the Core Strategy.

Merton council originally consulted on the possible introduction of a 'Merton Carbon Fund' that would have taken contributions towards emissions saving projects. It was intended to help address emissions from existing buildings by getting developers to contribute towards offsite retro-fit or refurbishment work. Whilst the idea of a 'Merton Carbon Fund' did not progress beyond the consultation phase the introduction of the Allowable Solutions will help to direct funds from development towards cost effective emissions reductions in existing buildings.

Merton should explore and prepare to take advantage of new national and regional policies that might help to accelerate carbon cuts from existing buildings.

8.5) **Recommendation 5**

Establish Decentralised Energy Networks where the opportunities arise

Merton faces challenges with regards to a number of low and zero carbon technologies. There is limited potential within the borough for the wide scale deployment of hydro, wind or biomass technologies and there is limited potential rapid deployment of a large decentralised energy network. The best potential for establishing renewable energy networks within the borough is through the co-ordination of climate change and sustainable design with other approaches such as regeneration proposals and energy from waste technologies.

Some developments and areas of regeneration will be able to achieve the required critical mass required to make the implementation of a CHP network feasible. Where it is viable for a developer to invest in decentralised energy network infrastructure in order to help towards achieving required emissions reductions target, this would be expected. In situations where it is not viable for the developer fully support community scale CHP infrastructure alternative arrangements should be sought to take advantage of regeneration and development opportunities. There is an increased cost in retrospectively installing decentralised energy networks compared to incorporating them alongside other utility provisions therefore it is important not to miss taking advantage of such opportunities at the most cost effective stage.

Developers should contribute towards the networks by contributing to networks where possible (to achieve BREEAM or Code Credits) and co-operating with other interested parties in order to establish or build on decentralised energy networks. The Council, or other third parties such as ESCO's may be able to work with developers to find alternative arrangements to take advantage of the potential long-term benefits from the deployment of decentralised energy infrastructure at the time of construction.

8.6) **Recommendation 6**

Sustainable design and construction policies must be viability lead.

A critical challenge for the LDF will be to implement climate change policy that is able to push up the standards of sustainable design and construction without placing an undue burden on developers. If unrealistically high targets are put in place for sustainable design and construction then the level of development in Merton may be affected, however, if climate change policies are not challenging then they will not provide a strong drive to reduce emissions and drive up standards.

In striking a balance between improved environmental performance and negative impacts on development viability, it is important to have a good understanding of the flaws of the standard viability appraisal methodology for informing policy. The standard viability assessment methodology has a limited ability to provide a long-term assessment of financial feasibility, unless a good range of comparable data is available to provide a realistic value base. The wide variety of the non-domestic building types and uses and the consequent issues with compiling sufficient comparable data make a long-term viability assessment of the effect of sustainable design and construction standards for non-domestic buildings extremely challenging. It is not possible to demonstrate the viability of different levels of BREEAM across an area in the same way that it is possible to assess the viability of Code.

The problems with synthesising data to assess the level of viability associated with deferent levels over a long time period using the standard viability assessment methodology means that alternative methods of balancing environmental and economic concerns must be found. A viability clause should be added stating that unless a developer cannot robustly justify why local sustainable design and construction standards targets and climate change policy are not viable, then the council would expect developments to comply with all the relevant local sustainable development and climate change policies.

Increased availability of nationally recognised academic data around viability in the non-domestic sector will help to inform future policy. However, in the absence of suitable academic research establishing a local target for BREEAM must be based on a sound methodology and judgment and include a viability clause to prevent unintentional negative impacts on the level of development within Merton.

The use of challenging yet achievable BREEAM target in conjunction with a viability clause will ensure that where possible standards advance beyond the national norm, however, building that are developed to the highest viable sustainable design and construction standards are not made unfeasible because they fail to satisfy local policy.

8.7) **Recommendation 7**

Merton must make the most effective use of its resources. Therefore policy should focus on delivering the maximum climate benefits whilst managing resource pressure on the council.

Careful consideration must be taken into the impact of sustainable design and construction policies not only on the industrial sector but also the resources that will be required to implement and enforce these policies. In setting levels and boundaries of sustainable design and construction policies that go beyond national requirements both the increased burden on the public and private sector and must be considered. An effective policy will set the policy boundaries in such a way so as to capture the maximum possible carbon saving that is covered by policy whilst minimising the burden on the public sector by reducing the number of smaller sites that are likely to come forward.

By examining Merton's historic development trends it can be seen that 90% of the non-domestic development area in the borough occurs in 50% of planning applications over 500m^2. Once non-domestic development exceeds the 1,000m^2 and qualifies as a major development we can see that the ratio of percentage of Merton's total non-domestic development area to the percentage of planning permissions applications becomes positive. This means that 1% of Merton's planning permissions over 1,000m^2 will account for more than 1% of Merton's total non-domestic development area. This demonstrates the benefit of challenging major development sites to achieve a higher level of emissions reductions, than sites between 500m^2 and 1,000m^2.

8.8) **Recommendation 8**

BREEAM and Code (or other recognised sustainable design and construction standard) should be used to tailor sustainable development policies to local needs and requirements

Establishing a set of nationally and internationally recognised sustainable design and construction standards that are flexible enough to deal with the huge variety of development types provides a valuable tool for driving up standards and tailoring design criteria towards local conditions and circumstances. The holistic nature of BREEAM and Code and their use of a range of weighted credit categories provides planners with a tool through which to raise the standards of different elements of sustainable design and construction. BREEAM schemes have the ability to address a wider range of development scenarios as the ability to choose a 'shell and core' or a 'fit out only' assessment that can be used to address sustainability issues in refurbishments. The BRE are currently developing the BREEAM Refurbishment standard and once this is launch should be incorporated into LDF policy to drive up sustainable design and construction standards in domestic refurbishments.

8.9) **Recommendation 9**

Developments should be able to clearly demonstrate how they have been designed and constructed to withstand the long-term impacts of climate change

BREEAM and Code include measures for the adaptation to the effects of climate change and support good design principles that will contribute towards adaptation without distracting from the potential of a development to mitigate against the effects of climate change. However, support for climate change adaptation through an over reliance on sustainable design and construction standards may not be sufficiently encourage adaptation measures in a strategic way at a local level. As understanding of the effects of climate and on local conditions and circumstances grows additional policies and policy guidance may need to be introduced to target local adaptation needs and circumstances.

8.10) **Recommendation 10**

The sustainable design and construction requirement for domestic developments within the borough should be set at Code level 4.

The greater availability of academic research and a sound value base complied from the available comparable data on land values and development cost. This has enabled a detailed viability assessment to be undertaken for domestic properties. Merton's *Local Development Framework: Affordable*

Housing Viability Study[60] provides a broad-based approach to proving the viability of developing domestic units in the borough under a range of policy assumptions. The inclusion of the Code level 4 as the assumption for the sustainability criteria in this modelling shows that according to the standard viability assessment methodology it is viable to achieve Code level 4 in almost all circumstances and location across the borough. There is therefore sufficient quantitative evidence to support the introduction of a minimum standard of sustainable design and construction requiring all domestic development to achieve a minimum of Code for Sustainable Homes Level 4. The Code for Sustainable homes is not yet adaptable to be of use in connection to domestic refurbishment. Once the BREEAM Refurbishment standard has been released action should be taken to establish a minimum stainable design and construction standard for domestic refurbishment.

8.11) **Recommendation 11**

The sustainable design and construction requirement for non-domestic developments should require all developments over 500m^2 within the borough should achieve BREEAM Very good and all major developments must achieve the minimum energy requirements for BREEAM Excellent.

As discussed throughout this document there are a number of issues relating to the use of the standard viability assessment methodology in relation to non-domestic developments and BREEAM. It has therefore been necessary to investigate the issue of viability in relation to different BREEAM standards using the available academic research coupled with an investigation into local circumstances. The 2005 BRE research paper[61] into the associated uplift cost as a percentage of total build cost gives one possible method of assessing the relative effect on viability different BREEAM levels. In order to use the results

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60 *Local Development Framework: Affordable Housing Viability Study.* 2010 www.merton.gov.uk/living/planning/ldf/planningresearch.htm

61 *Putting a price on sustainability*. 2005. http://www.bre.co.uk/

of *Putting a price on sustainability* research, it was first necessary to establish Merton as a location for using BREEAM in accordance with the methodology and terminology used in the BRE paper.

After examining historic building trends and expected future development sites and potential of these developments to achieve a number of location dependant credits. This exercise demonstrated that Merton can be seen as a typical location for BREEAM developments with some location specific credits being available but not all in the vast majority of development sites, and no sites were not able to theoretically receive at least some location dependant credits.

The uplift cost[62] associated with meeting BREEAM Very Good in a 'typical' BREEAM area range between -0.3% and 0.2%, Whilst the uplift cost for meeting BREEAM Excellent in the same situation range between 1.9% and 7.0%. This would suggest that there is that it would be viable to achieve BREEAM Very Good in a large number of circumstances and locations and viable to achieve BREEAM Excellent in other location and circumstances. However, recent case studies from Europe have shown that it is possible to achieve BREEAM Excellent without a significant uplift costs if sustainability is incorporated and focused on at an early stage of the developments design. It is therefore essential that planning policies encourage the incorporation and consideration of sustainable design and construction features and standards at the earliest possible stage of the design process.

Setting the sustainable design and construction standards with these boundaries and standards will ensure that Merton is working effectively to tackle emissions from the borough. The use of BREEAM Very Good as a minimum standard for buildings over 500m^2 is unlikely to have any significant impact on building viability as there are no minimum energy efficiency requirements to be achieved.

[62] As a percentage of total build costs.

The inclusion of the minimum energy requirements for BREEAM Excellent in conjunction with achieving an overall level of BREEAM Very Good is reasonable and justifiable for major developments. The uplift cost for achieving BREEAM excellent range between 2% and 7% of total build costs. Whilst the energy and emissions reduction credits are acknowledged as being the most arduous to achieve, restricting local policies to the inclusion of the energy credits only should not dramatically affect viability. Setting minimum requirements for emissions through the use of the mandatory energy credit requirements will ensure that climate change mitigation is addressed without adversely impacting on development. It is, however, understood that because of the wide variation in building types and uses that this policy is not a 'one size fits all' solution. Providing developments can demonstrate that they have satisfied the majority of the sustainable design and construction policies and that it is not viable to achieve the specified levels of Code or BREEAM in the LDF, the development should be allowed to proceed.

Annex 1: Merton's CHP feasibility studies

Title	Authors	Date
Town Centre, Morden CHP Plant Option Appraisal	ICE ltd	Jan-10
Feasibility study for district heat and power network in S-E Merton	PB Power	Jan-06
Energy Management and opportunities assessment	Carbon Trust	Mar-05
South-East Merton district heat and power network technical feasibility study	ESD ltd	Aug-05

Annex 1: Draw across from business use classes to BREEAM Schemes.

BREEAM Multi residential:
- C2

BREEAM Industrial:
- B2 (if operational areas are >50%)
- B8 (if operational areas are >50%)

BREEAM Offices:
- B1
- B2 (If office space is >50%)
- B8 (If office space is >50%)
- D1 (05/P1613) (The development in question consists mainly of a church hall and meeting rooms)
- D2 (00/P2436) (The development in question is contain office or a Doctors surgery which would be most appropriately assessed under this scheme)
- D2 (03/P2777) (The development includes a doctors surgery and offices classed as use class B1)
- SG (04/P1854) (The development has can be examined under BREEAM Office due to the dominance of B1 use)

BREEAM Retail:
- A1
- A2
- A3
- D2 (00/P1882) (As health and fitness centre is a service provider and the presence of restaurants)

- D2 (02/P0124) (As the development is to include a Bank, Shop and ticketing office.
- SG (02/P0713) (Car showroom has been assessed under BREEAM retail)