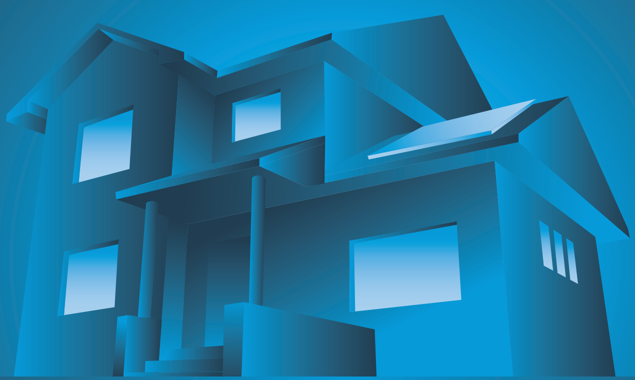
ATKINS

Lewisham Renewables Evidence Base Study

Final Report

February 2010



Lewisham

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1. Introduction

Study purpose

1.1 Atkins was appointed by London Borough of Lewisham in March 2009 to prepare a Renewable Energy evidence base study. The study was jointly commissioned by the Council's Planning Service and Sustainable Resources Group.

1.2 The Council is currently preparing its Local Development Framework (LDF), which includes reviewing its renewable energy, sustainable design and construction and energy efficiency policies. There is a need to examine the impact of renewable energy delivery in the Borough in terms of setting different renewable energy thresholds and CO_2 in both borough-wide and site targets.

1.3 The study will be used by the Council to inform the development of renewable energy, sustainable design and energy efficiency policies and will also contribute to other Local Development Documents (LDDs) under preparation.

1.4 The Renewable Energy Study (RES) will also be used by the Council to inform delivery of its Carbon Reduction and Climate Change Strategy and to shape delivery of our work with citizens and partners in delivering against National Indicator 186 'Per capita CO_2 emissions in the local authority area'.

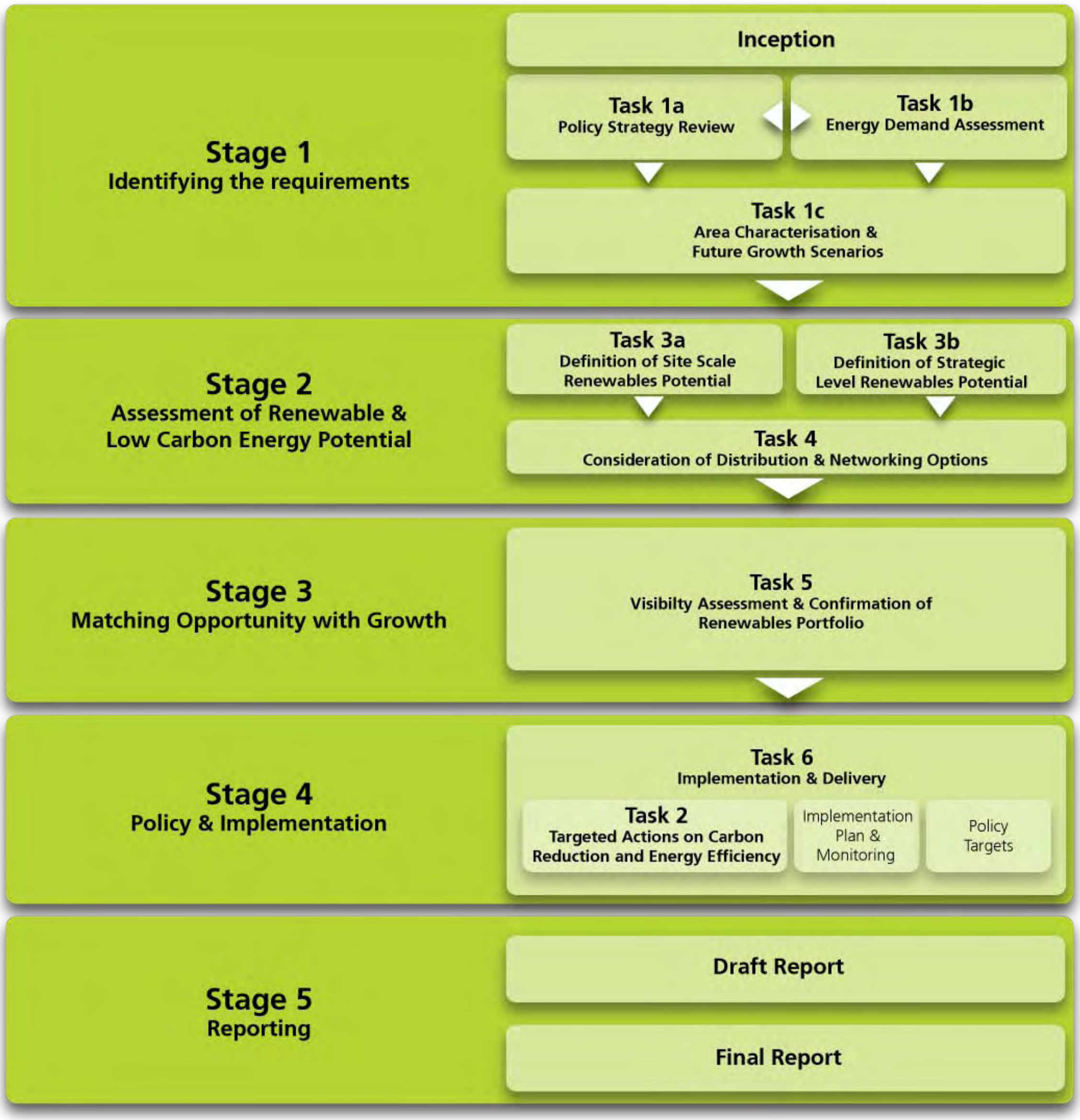
1.5 Other objectives for the study identified within the study brief include.

- Identify the potential for decentralised and renewable and low carbon energy generation within the Borough taking account of potential energy resources and techno-economic viability within the period up to 2025.
- Identify the potential for wider carbon reduction and energy efficiency measures, complementing delivery of renewable energy generation, to reduce energy consumption across the borough within the period to 2025.
- Consider how the energy needs of additional development, and existing infrastructure, in the Borough may be met through decentralised renewable energy and low carbon generation taking account of the level, type and distribution of development to 2025.
- Identify how decentralised and renewable and low and zero carbon energy generation potential would be realised taking account of business and delivery models, potential lead funding (grant, equity, third party, loans, "Invest to Save"), revenue estimates, capital and operating costs estimates, scalability and long-term sustainability. The Consultant would identify how individual developments would contribute to on, near or off site solutions and links to planning obligations.
- Take account of viability of decentralised energy and Code for Sustainable Homes targets considering overall development costs and revenues, other policy requirements and the potential impact on housing delivery including affordable housing.
- Identify policy recommendations and targets for inclusion within DPDs and SPDs, and other strategic frameworks, including area or site renewable energy targets as appropriate.

Approach

1.6 A blended team undertook the study including energy specialists from Atkins Carbon Management team and Town planners from Atkins Planning Team.

1.7 Figure 1.1 sets out the approach which was taken to completing the study including the key study stages and tasks.



1.8

Figure 1.1 – Study Approach

1.9 This report summarises the key findings from the study. The remaining sections of the report follow sequentially through the stages identified above.

- Section 2 provides a review of the legislative background underpinning the study including national planning policy guidance, the requirements of the London Plan, current and emerging local planning policies and other guidance, research reports and consultation documents which are relevant to the study.
- Section 3 identifies a number of high level scenarios which identify a range of assumptions regarding energy demand and CO2 emission reduction over the life of the Core Strategy to 2025. These scenarios help to establish the boundaries for the assessment of area and site level opportunities associated with new development and the scope for other complementary

actions to reduce energy efficiency improve energy efficiency in the domestic, industrial and commercial sector in terms of addressing the existing energy usage.

- Section 4 provides an assessment of the Borough to accommodate renewable energy potential within the Borough in connection with development. The assessment considers the potential for large and medium scale facilities which have the potential to anchor the development of local energy networks. It also considers the approach which should be taken to identify appropriate solutions for smaller sites. The chapter identifies the scale of potential energy generation, distribution and networking options, business and delivery models, project costs, funding and deliverability.
- Section 5 considers the approach which could be taken towards retrofit of the existing residential stock and provides a strategy for targeting future action to reduce CO2 emissions in the Borough.
- Section 6 provides an assessment of the economic viability of renewables options through a series of development case studies. The assessment considers the interaction with other policy goals including affordable housing, planning obligations and the relationship between renewable energy targets and Code for Sustainable Homes targets.
- Section 7 draws together the conclusions of the study. It recommends the approach which should be taken within the Core Strategy and other DPDs with regard to targets for on site and near site renewable energy generation taking into consideration the opportunities for higher area or site level targets where these can be achieved and how the London Plan energy hierarchy should be applied within the context of the Borough. The chapter recommends how the policy requirements should be integrated with the Development Management Process including guidance on how renewables options should be considered at pre-application stage and during the consideration of planning applications. This section also makes recommendations for complementary supporting actions which are needed to support and implement planning policies including other actions to reduce CO2 emissions associated with the existing stock and actions associated with the establishments of Energy Service Companies (ESCOs).

2. Policy Context

Introduction

2.1 This section provides a review of the national, regional and local targets and strategies that impact on Renewable Energy (RE) and low carbon energy generation options. It includes reference to measures to secure CO2 reduction including regulatory and voluntary mechanisms such as Code for Sustainable Homes (CSH) and BREEAM which address in part the thermal efficiency of buildings. A balanced portfolio of actions is needed to encourage sustainable energy use with respect to new development and existing energy users within the Borough.

2.2 The purpose of the policy review is to show what role policy can play in encouraging renewable energy generation in the borough and ensuring that the decision making process reflects, objectives, targets and relevant standards. The Council will draw on baseline evidence and local circumstances to determine options for intervention where they are most appropriate.

2.3 The drafting of future policies should take an integrated approach and should be drawn so they enable measurements to be taken that satisfy both national and local targets (such as Defra National Indicator targets NI 185 etc and the Council's own Carbon Reduction and Climate Change Strategy (March 2009).

Background: legislative, regulatory & other drivers

2.4 At the national level minimum targets are defined in the Climate Change Act 2008 (CCA 2008) and other government policy. The Planning and Energy Act 2008 enables local authorities to exercise a power to adopt the policy in PPS1 Supplement although it is a discretionary.

2.5 Carbon reduction targets are tied to statutory targets and are subject to regular review. There is a duty on the Secretary of State to ensure that legally binding targets are met and this includes green house gas emission reductions through action in the UK and abroad of at least 80% by 2050, and reductions in CO2 emissions of at least 26% by 2020, against a 1990 baseline. This has had an effect on London Plan targets, driving them upwards. Planning authorities should help to achieve the national timetable for reducing carbon emissions from domestic and non-domestic buildings.

2.6 The April 2009 budget the Government promised to cut greenhouse gases by 34% over the next decade with the use of a legally binding 'carbon budget'. Progress in reducing emissions will be measured by the use of indicators in order to understand whether emission reductions are sustainable through the implementation of measures.

National Planning Policy

2.7 The requirement for local authorities to develop low carbon and renewable energy policies in their Development Plan Documents comes from PPS 22 (2004) and the PPS 1 Supplement Planning & Climate Change (2007). Local Planning Authorities should provide a framework to encourage low carbon and renewable energy in development plan documents (DPDs) and can explicitly adopt higher standards than the Building Regulations in policy.

PPS 1 Supplement.

2.8 The PPS Supplement sets out a series of principles for the decision-making framework designed to ensure that new development, its spatial distribution, location and design should be planned to limit carbon dioxide emissions; make good use of opportunities for decentralised and renewable or low carbon energy and ensure new development should be planned to minimise future vulnerability in a changing climate.

2.9 Paragraph 33 states that in testing out local requirements planning authorities should ensure that what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including costs of necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities. The evidence base should be tested before an Inspector. LPAs should set out how they intend to advise potential developers on the implementation of the local requirements and how these will be monitored and enforced.

2.10 Paragraph 18 states planning authorities should consider the opportunities for the core strategy to add to the proposals and policies of the RSS where local circumstances will allow to further progress in achieving the Key Planning Objectives.

2.11 The Key Planning Objectives (Paragraph 9) relate to sustainable development. The broad based criteria can be used to justify reasons for decision making and briefly require LPAs to:

- contribute to delivering the Government's Climate Change Programme and energy policies;
- provide for homes, jobs, services and infrastructure by securing the highest viable resource and energy efficiency and reduction in emissions;
- deliver patterns of urban growth which reduce the need to travel, especially by car;
- secure new development and shape places that minimise vulnerability, and provide resilience to climate change in ways consistent with social cohesion and inclusion;
- conserve and enhance biodiversity;
- reflect the development needs and interests of communities; respond to the concerns of business and encourage competitiveness and technological innovation in mitigating and adapting to climate change.

2.12 If these objectives cannot be met then consideration should be given to how proposals could be amended to make them acceptable, or where this is not practicable, to whether planning permission should be refused. In the context of this Study the first, fourth and sixth Objectives are the most relevant.

2.13 Policies within DPDs should expect a proportion of energy to be supplied from low carbon or renewable sources and policies should promote this through supporting infrastructure (Paragraph 19).

2.14 Strategic targets are also defined in the RSS but they should be used as a strategic tool for shaping policies and for annual monitoring and 'should not be applied directly to individual planning applications' (Paragraph 16), although consistent underperformance by an authority would prompt action by the Secretary of State at the RSS level and with implementation.

2.15 The ability to contribute to targets will vary according to a site's size, resources and the rate and nature of new developments coming forward and judgement may also be partly informed by this evidence base. There are also local requirements for sustainable buildings (Paragraphs 30-32).

Renewable and low-carbon energy generation

2.16 Planning authorities **should** (Paragraphs 19-20):

- not require applicants for energy development to demonstrate either the overall need for renewable energy and its distribution, nor question the energy justification for why a proposal for such development must be sited in a particular location;
- ensure any local approach to protecting landscape and townscape is consistent with PPS22 and does not preclude the supply of any type of renewable energy other than in the most exceptional circumstances;

2.17 Alongside any criteria-based policy developed in line with PPS22, consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, support innovation and expect a proportion of the energy supply of new development to be secured from decentralised and renewable or low-carbon energy sources.

Selecting land for development

2.18 In deciding which areas and sites are suitable, and for what type and intensity of development, planning authorities should take into account:

- the extent to which existing or planned opportunities for decentralised and renewable or low-carbon energy could contribute to the energy supply of development;
- the means to reduce the private car and opportunities to service sites through sustainable transport;
- the capacity of existing and potential infrastructure to reduce carbon dioxide emissions and successfully adapt to likely changes in the local climate;
- the ability to build and sustain socially cohesive communities with appropriate community infrastructure, taking into account local impacts that could arise as a result of likely changes to the climate;
- the effect of development on biodiversity;
- the contribution to be made from existing and new opportunities for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity; and adapt to known constraints on such as flood risk and stability, taking a precautionary approach.

2.19 In deciding on areas and sites to identify for development, priority should be given to those that will perform well against the criteria in paragraph 24 of the PPS (summarised above). Where areas and sites perform poorly, planning authorities should consider whether their performance could be improved.

Local requirements for decentralised energy to supply new development

2.20 Paragraphs 26-29 address local requirements for decentralised energy to supply new development drawing on the evidence-base.

2.21 Authorities should pay attention to opportunities for utilising existing decentralising and renewable or low carbon energy supply systems. Proposed development should connect to an identified system or be designed to connect to be able to connect in the future. A specific requirement to facilitate connection must be fair and reasonable and not unduly restrictive.

2.22 Planning Authorities should set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable and bring forward development area or site specific targets to secure this potential. In bringing forward targets, planning authorities should set out the type and size of development to which the target will be applied and ensure there is a clear rationale for the target and it is properly tested. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured. Planning authorities can set out how the proposed development would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

2.23 New opportunities to supply proposed and existing development could include co-locating potential heat customers and heat suppliers.

2.24 Planning policies should support innovation and investment in sustainable buildings.

2.25 Where appropriate planning authorities can improve upon national policy. Authorities must be able to demonstrate clearly the local circumstances that warrant and allow this and include opportunities for significant use of decentralised and renewable or low carbon energy. Planning authorities should ensure what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities.

2.26 In the case of housing development the proposed approach should be consistent with securing the expected supply and pace of housing development shown in the housing trajectory required by PPS3 and not inhibit the provision of affordable housing. Local authorities should also set out how they intend to advise potential developers on the implementation of the local requirements, and how these will be monitored and enforced.

Monitoring and Review

2.27 Paragraphs 34-37 of PPS1 Supplement state that where monitoring suggests that implementation is not being achieved in line with an agreed strategy or that the strategy is not delivering the expected outcomes, it is essential to respond promptly and effectively and update assumptions on which the spatial strategy is based (which can be tested against the Key Planning Objectives). Annual monitoring reports should describe performance and, as necessary, the action intended to improve implementation or to update the strategy.

PPS 22

2.28 Some of the context for the approach in PPS 22 on Renewable Energy (2004) has changed in the context of more recent policy and legislative drivers. Planning applications for renewable energy projects should be assessed against specific criteria set out in regional spatial strategies (the London Plan) and local development documents. This includes a requirement for a percentage of the energy to be used in new residential, commercial or industrial development to come from on-site renewable energy developments.

2.29 Policies should set out the criteria that will be applied in assessing applications for planning permission for renewable energy projects.

2.30 The wider environmental and economic benefits of all proposals for renewable energy projects, whatever their scale, are material considerations that should be given significant weight in determining whether proposals should be granted planning permission. The Council must determine the degree to which it is reasonable to support a renewable energy scheme in the context of any adverse impact on the local environment or community which may outweigh the local and wider benefits they offer in producing energy or reducing pollution to land, air or water for example.

2.31 Planning applications should not be rejected because output is anticipated to be small. Developers of renewable energy projects should engage in active consultation and discussion with local communities at an early stage and before any planning application is formally submitted.

2.32 Planning authorities should only allocate specific sites for renewable energy in plans where a developer has already indicated an interest in the site, has confirmed that the site is viable, and that it will be brought forward during the plan period. This provision should not be interpreted too restrictively in the light of recent policy changes. However, specific sites that are allocated for RE or Low Carbon generation should realistically be deliverable during the life of the development plan. The issue of viability should be determined on a case by case basis.

Locational considerations

2.33 As most renewable energy resources can only be developed where the resource exists and where economically feasible, planning authorities should not use a sequential approach in the consideration of renewable energy projects.

Small Scale Renewable Energy Developments

2.34 Small scale renewable energy schemes utilising technologies such as solar panels, Biomass heating, small scale wind turbines, photovoltaic cells and combined heat and power schemes can be incorporated both into new developments and some existing buildings and should be encouraged through positively expressed policies in local development documents.

Landscape and Visual Effects of Renewable Energy Developments

2.35 The landscape and visual effects of renewable energy developments vary according to type of development, its location and landscape setting. Some of these effects may be minimised through appropriate siting, design and landscaping schemes. Policies in LDDs should seek to minimise visual effects. Assessing the impact of turbines on the landscape is unlikely to affect LB Lewisham, however, if used for the purpose of micro-generation the Council should consider the need for guidance on the cumulative impact of small turbines on ‘small scale’ development.

Noise

2.36 Renewable energy developments should be located and designed in such a way to minimise increases in ambient noise levels. Plans may include criteria that set out the minimum separation distances between different types of renewable energy projects and existing developments. This is particularly important for housing. Typically ambient noise levels at night time for example are between 35-40 db and can be marginally higher if a neighbour nearby has an interest in the development. LB Lewisham is unlikely to promote wind energy development on anything but a small scale but technical standards should refer to the need to comply with best practice in the ETSU guide 1997.

Odour

2.37 In handling planning applications for anaerobic digestion, local planning authorities should consider carefully the potential impacts of odour and the proposals for its control. In cases where odour would have an impact, such plants should not be located in close proximity to existing residential areas.

Biomass Projects and Energy Crops

2.38 Local planning authorities should make sure that the potential for an increase in traffic effects are minimised by ensuring that generation plants are located in as close proximity as possible to the sources of fuel that have been identified. But in determining planning applications, planning authorities should recognise that other considerations (such as Grid connection and use of heat generated from a development) may influence the choice of the most suitable locations.

Wind Turbines

2.39 LDDs should not include policies in relation to separation distances from power lines, roads, and railways. It is the responsibility of developers to address any potential impacts, and legislative requirements on separation distances, before planning applications are submitted.

Reference to other National Policy Guidance

2.40 There are a number of other national policies that are relevant to the adoption of new policies and their implementation, some of which are particularly relevant from an environmental point of view. They can be summarised as follows:

- PPS 3 Housing;
- PPS 10 Waste;
- PPS 12 Local Spatial Planning 2008 – the approach to good infrastructure planning;

- PPG 13 Transport;
- PPG 15 Heritage – A replacement draft PPS 15 is expected to address in part the balance to be struck between renewable energy and conservation issues;
- PPG 24 Noise; and
- PPG 25 on Development and Flood Risk – flood protection and mitigation measures.

Building Regulations, Standards & Certificates

2.41 The requirements to meet Building Regulations should not be addressed in planning conditions but policy can promote standards that exceed Building Regulations (PPS1) and reference can be made to that. Energy efficiency standards can exceed the energy requirements of building regulations and so lower emissions rates for buildings.

2.42 Part L of the Building Regulations sets the mandatory minimum thresholds of reduction in CO_2 emissions for all types of buildings and requires new residential development's dwelling emission rate (DER) to reduce periodically. Building regulations that cover DER are measured by exceeding Target Emission Rates (TER) in certain percentages, reflecting energy improvements over TER.

Domestic Buildings – Code for Sustainable Homes

2.43 Housing: The requirement to produce new housing at the minimum level of Code level 3 in the standard the Code for Sustainable Homes (2008) (CfSH) is now mandatory for public housing and voluntary for private sector housing. The Government's policy is for all new homes to be zero carbon from 2016 which will be achieved by incorporating the CfSH standards into the Building Regulations. It is proposed to incorporate the energy / carbon standards in three steps. The following Codes will apply to the Building Regulations and the energy improvements over TER relative to the 2002 Building Regulations are:

- 2010 –Code Level 3 – 25% improvement
- 2013 – Code Level 4 – 44% improvement
- 2016 - Code Level 6 – zero carbon

2.44 However, the National 2010 target of 25% carbon emission reduction in Part L of the Building Regulations 2006 is increased significantly by the proposal in the draft London Plan to increase the target to 44% during the period 2010-2013.

2.45 The Government is working on a definition of zero carbon for the purpose of meeting the 2016 target. The Standard Assessment Procedure (SAP) is also being reviewed. These target levels are likely to reduce carbon emissions by a further 10-20% and that reduction should be reviewed post 2016. Non mandatory standards cover other sustainable design issues. Owing to the planned programme of changes to update the CfSH up to 2020 it is unlikely that many developers will want to voluntarily exceed current requirements in terms of targets given the demands, costs and technological challenges satisfying the criteria raises. Guidance on how to comply with the Code can be found in these publications on the DCLG website:

- The Code for Sustainable Homes: Setting the Sustainability Standards for New Homes which sets out the assessment process and the performance standards required for the Code.
- The Code for Sustainable Homes: Technical guide (May 2009 Version 2), sets out the requirements for the Code, and the process by which a Code assessment is reached.

Non-domestic buildings - BREEAM

2.46 The Building Research Establishment Environmental Assessment Standard (BREEAM) addresses similar topics for non residential buildings but the ratings are pass, good, very good, excellent and outstanding. There are some variations in the credits used for different versions of BREEAM although many are the same for all versions. Except for central government estates, agencies and a few others, it is a voluntary standard unlike CfSH. BREEAM is an environmental assessment method used throughout the world for reviewing, assessing and improving the environmental performance of the following types of projects:

- Whole new buildings;
- Major refurbishment of existing buildings;
- New build extensions to existing buildings;
- A combination of new build and existing buildings refurbishment;
- New build or refurbishments which are part of a larger mixed use building; and
- Existing building fit-out.

2.47 The Department for Children, Schools and Families (DCSF) currently requires the following new build and refurbishment projects to achieve at least a BREEAM rating of 'Very Good' for:

- Primary school projects costing £500,000 or more;
- Secondary school projects costing £2 million or more; and
- All projects involving remodelling or complete refurbishment of more than 10% of the total gross internal floor area of a school.

2.48 However, smaller scale projects are also encouraged to achieve a BREEAM rating, where feasible. The BREEAM rating is a way that planning authorities can set targets for sustainable design. BREEAM should be considered for all the projects listed above and adopted where feasible.

2.49 The Government has an ambition to achieve zero carbon for all new public sector buildings by 2018 and non domestic buildings from 2019. Achieving these ambitious targets will require the Council to provide information about financial incentives and support for implementing these. The policy justification for bringing forward any of these targets could be addressed in local policy that expressly refers to the London Plan (currently Policy 4A and Policy 5.2 in the draft London Plan). However, new build stock only provides a very small contribution to carbon emissions produced by the built environment. Policy therefore needs to address measures for retrofitting as existing stock contributes approximately 50% of carbon emissions to the built environment.

Energy Performance Certificates

2.50 The Energy Performance Buildings Directive has seen the final roll- out of Energy Performance Certificates to all building sectors with the introduction of EPCs to rented homes and the extension of EPCs to include all commercial buildings when bought, sold or rented. All large public buildings have to have on public view a Display Energy Certificate showing the building's energy efficiency rating from 1 October 2009. The Directive is due to be revised and the current 1,000 sq metre threshold above which existing buildings undergoing major refurbishment must meet minimum efficiency standards. There may also be penalties for non-compliance. It is too early to say what the measurable achievements of EPCs or DECs will be. They are not linked to a requirement for any specific improvements, so their effect is difficult to measure. However, they may form a consideration for strategy and monitoring purposes.

The Low Carbon Transition Plan

2.51 The Low Carbon Transition Plan sets out a route-map for the UK's transition to a low-carbon economy by 2020. The plan suggests that through the provision of 'carbon budgets', energy will be produced and used more efficiently by all parties. The objective is to make the appropriate changes to a low carbon economy and reduce the dependency on declining resources which make the economy subject to market disturbances. The plan shows the potential emission savings on a sector-by-sector basis, in which the aims are:

- Protecting the public from immediate risk;
- Preparing for the future;
- Limiting the severity of future climate change through a new international climate agreement;
- Building a low carbon UK, through the legally binding 'carbon budgets'; and
- Supporting individuals, communities and businesses to play their part.

Transforming Existing Homes and Communities

2.52 Central government aims to source 15% of energy demand from renewable energy throughout the heat, electricity and transport sectors by 2020. The Transition Plan document states that currently 13% of UK's greenhouse emissions come from heating rooms and the water supply in homes. The plan, along with wider policies, aims to cut emissions from homes by 29% on 2008 levels by producing more heat and electricity through low carbon technologies, such as solar power and heat pumps. Essentially the analysis on least-cost technologies suggests that the delivery of these targets would depend on RE providing around 30% of the electricity supply (including 2% from small-scale sources) and 12% of the heat supply.

2.53 The UK Renewable Energy Strategy is aspires to make sufficient progress each year to achieve the 2020 target. Under the Renewable Energy Directive, the UK has interim targets to achieve the following shares of renewables:

- 4.0% in 2011-12;
- 5.4% in 2013-14;
- 7.5% in 2015-16;
- 10.2% in 2017-18.

2.54 The most recent analysis suggests the level of RE leading to 2020 will be sufficient to meet these interim targets, if future demand is on the low side of the government projections. However, the government is less confident about meeting the first three interim targets if energy demand is high. In this case the need to generate RE across the UK will be greater, in order to compensate for future energy demands.

2.55 The Transition Plan identifies ways of helping households to make energy savings of 20%, reaching the Carbon Emissions Reduction Target, between April 2008 and March 2011. There is a commitment to insulate six million homes and ensure that energy suppliers are maintained to the end of 2012, through efficient use of the energy and the grid.

2.56 To deliver energy savings in the longer term, the plan aims to install smart readers in every home by the end of 2020 and encourage the provision of smart displays now for existing meters benefiting between two and three million households.

2.57 The Community Energy Saving Programme will deliver treatments to housing in low-income areas in order to raise the overall standards of the housing stock. The Transition Plan also targets the most vulnerable sections of society, e.g. pensioners, and fuel poor households in ensuring that these homes are provided with adequate insulation and that energy costs are reduced.

2.58 The plan is supportive of a local approach to reducing energy consumption, where communities can install RE and low carbon energy generating technologies independently. The Transition Plan will provide an online "How to" guide for communities looking to produce low carbon energy at a community level, as well as unlock greater action by local authorities to identify the best potential for low carbon community scale solutions in their areas.

Regional Spatial Strategy - London Plan Policies

2.59 The Adopted London Plan forms part of the development plan so its policies can both justify Council policies and reasons for planning decisions as local policies must be in conformity with the London Plan. Chapter 4A of the London Plan 2008: Consolidated with Alterations since 2004 (published 2008) addresses climate change and mitigation. It is not necessary to repeat the Policies of the London Plan in the Council's own development plan documentation but it helps to make explicit reference to the policies and to repeat certain aspects of them.

2.60 Policy 4A.1 Tackling Climate Change, states "The Mayor will, and boroughs should, in their DPDs require developments to make the fullest contribution to the mitigation of and adaptation to climate change and to minimise emissions of carbon dioxide.

2.61 The following hierarchy will be used to assess applications:

- Using less energy, in particular by adopting sustainable design and construction measures (Policy 4A.3) ('Be Lean')
- Supplying energy efficiently, in particular by prioritising decentralised energy production (Policy 4A.6), ('Be Clean')
- And using renewable energy (Policy 4A.7) ('Be Green')

Integration of adaptation measures with mitigation to tackle climate change will be sought through the approach set out in Policy 4A.9. These contributions should most effectively reflect the context of each development – for example, its nature, size, location, accessibility and operation. The Mayor will and boroughs should ensure that development is located, designed and built for the climate that it will experience over its intended lifetime.

2.62 Policy 4A.3 refers to sustainable design and construction. Some of its specific requirements are the requirement to design buildings for flexible uses, avoid internal overheating and excessive heat generation, minimise energy use, manage flood risk, avoid creation of adverse local climate conditions, promote sustainable waste behaviour and in new and existing developments, including support for local integrated developments, including support for local integrated recycling schemes, CHP and CCHP schemes and other treatment options.

2.63 The Mayor will and the boroughs should require all applications for major developments to include a statement on the potential implications of the development on sustainable design and construction principles. The statement should address demolition, construction and long-term management. Boroughs should ensure that the same sustainability principles are used to assess other planning applications. Boroughs should ensure that developments minimise the use of new aggregates and do not use insulating and other materials containing substances which contribute to climate change through ozone depletion.

2.64 Policy 4A.4 The Mayor will, and boroughs should, require an assessment of the energy demand and carbon dioxide emissions from proposed major developments, which should demonstrate the expected energy and carbon dioxide emission savings from the energy efficiency and renewable energy measures incorporated in the development, including the feasibility of CHP/CCHP and community heating systems. The assessment should include:

- calculation of baseline energy demand and carbon dioxide emissions;

- proposals for the reduction of energy demand and carbon dioxide;
- emissions from heating, cooling and electrical power (Policy 4A.6);
- proposals for meeting residual energy demands through sustainable energy measures (Policies 4A.7 and 4A.8); and
- calculation of the remaining energy demand and carbon dioxide emissions.

2.65 The assessment should form part of the sustainable design and construction statement (Policy 4A.3). All development should contribute to improving the integration of land use and transport policy (see Policy 3C.1).

2.66 Where land is needed for the provision of renewable energy technologies, such as anaerobic digesters and biomass plants, as part of appropriate developments, boroughs should encourage this provision through their inclusion in development briefs and area development frameworks. The Mayor's forthcoming Renewable Energy SPG will set out broad guidelines to define locations where stand-alone renewable energy schemes would be appropriate and set criteria both for the assessment of such schemes and for their application to individual technologies. Recent technology is able to deal far more efficiently with the risks of odour pollution.

2.67 The Mayor will encourage the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make them feasible. Off-site renewable contributions to developments are only considered acceptable where they are directly connected and supplied by private wire arrangement. Further information will be set out in a forthcoming Renewable Energy SPG.

Decentralised energy: Heating, cooling and power.

2.68 Within London Plan Policy Policy 4A.6 the plan identifies that boroughs should in their DPDs require all developments to demonstrate that their heating, cooling and power systems have been selected to minimise carbon dioxide emissions. The need for active cooling systems should be reduced as far as possible through passive design including ventilation, appropriate use of thermal mass, external summer shading and vegetation on and adjacent to developments. The heating and cooling infrastructure should be designed to allow the use of decentralised energy (including renewable generation) and for it to be maximised in the future.

2.69 Developments should evaluate combined cooling, heat, and power (CCHP) and combined heat and power (CHP) systems and where a new CCHP/CHP system is installed as part of a new development examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

2.70 The Mayor expects all major developments to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:

- connection to existing CCHP/CHP distribution networks;
- site-wide CCHP/CHP powered by renewable energy;
- gas-fired CCHP/CHP or hydrogen fuel cells, both accompanied by renewables; and
- communal heating and cooling fuelled by renewable sources of energy gas fired communal heating and cooling.

2.71 Where possible, the opportunity to link a new development to an existing CCHP/CHP system may be the most resource efficient option, allowing more effective use to be made of heat, power and cooling. If it is not possible to link to an existing system, the provision of CCHP/CHP needs to be considered on a site-wide basis that connects different uses and/or groups of buildings. If a site-wide approach is not possible, CHP/CCHP should still be investigated. This should include renewables where it is technically feasible. Electrical heating and cooling systems cause significant carbon dioxide emissions and the Mayor wishes to discourage these.

2.72 Policy 4A.7 Renewable Energy, incorporates what is known as the Merton Rule. The London Plan now requires development to achieve a 20% reduction in emissions through the generation of on site renewable energy unless it can be demonstrated that it is not feasible. When such provision is not feasible regard should be had to the Mayor's energy efficiency measures in the energy hierarchy set out in Policy 4A.1. The policy does not distinguish between major and smaller scale development. Thus development can be interpreted in its wider sense and would include alterations to existing developments as well as new stock.

2.73 It also states that boroughs in their DPDs should identify broad areas where the development of specific renewable energy technologies is appropriate. These should encourage the fullest realisation of the potential for renewable energy having regard to the environmental and transport policies of the London Plan. These should:

- Identify sites for zero carbon development;
- Identify suitable locations for wind turbines in developments;
- Encourage at least one large wind power scheme in London; and
- Encourage applications for new street appliances (such as bus shelters, bus stops, parking ticket machines and road signs) to incorporate off-grid solar power and other renewable energy sources where feasible.' Reduction of carbon dioxide and other greenhouse gas emissions from new developments will be achieved in particular by Policy 4A.7.

Design principles

2.74 Policy 4B.1 addresses design principles – developments should contribute to adaptation to, and mitigation of, the effects of climate change.

2.75 Existing residential stock: Chapter 3 on Housing. Includes Policy 3A.4 Efficient Use of Stock: 'Boroughs should promote the efficient use of the existing stock by reducing the number of vacant, unfit and unsatisfactory dwellings.' The policy has implications for retrofitting for old stock requiring rehabilitation. Policy 4B.4 London's buildings: Retrofitting states that the Mayor will and boroughs should support measures to produce a lower environmental impact from the existing stock of buildings by supporting policies and programmes for refurbishment of buildings which will reduce carbon dioxide emissions, increase thermal efficiency, reduce waste and noise impacts, conserve water, materials and other resources (see Chapter 4A).

2.76 Monitoring of London Plan policy - AMR reporting: Key Performance Indicator 22 in the Annual Monitoring Report is the basis for calculating the figures this year and the Council should note that the approach to the calculation is different to previous years.

2.77 The Mayor's SPG on Sustainable Design and Construction sets out a variety of standards recommended by the Mayor for incorporation into new development. It is a material planning consideration in the decision making process and is referred to in the options for the Council's Core Strategy. The Council should note that this SPG is due to be updated in the next 12 to 18 months and more exacting standards are likely to be advocated.

London Plan – Emerging Policy

2.78 A draft London Plan was published in October 2009. An Examination in Public is due to take place between May and October 2010. The replacement London Plan is not likely to not be published until late 2010 or early 2011. Therefore changes to emerging policy should be taken into account for purposes of the Council's long term planning with respect to policies for climate change adaptation and mitigation. At the time of writing the Mayor's proposed Climate Change Adaptation and Mitigation Strategies have not been published but are due out before the end of 2009. Where applicable reference has already been made to some of the emerging policies.

2.79 Policy 5.2 of the draft London Plan 2009 retains the 'lean' clean' and 'green' hierarchy in Chapter 4A of the London Plan 2008. Integration of adaptation measures with mitigation to tackle climate change as a policy approach will continue. However, Policy 5.2 introduces new stringent targets for carbon dioxide emission reductions in both residential and non-domestic buildings, albeit that these are addressed in the context of 'major development'. The definition of 'major development' remains the same – for dwellings where 10 or more are to be constructed and in other uses where floor space will be 1000 sq metres or more (or the site area is 1 hectare of more). The new targets are ambitious. [The National 2010 target of 25% carbon emission reduction in Part L of the Building Regulations 2006 is also increased for non-domestic buildings by the draft target of 44% up to 2013, 55% 2012-2016 before defaulting to the regulation requirements].

Policy formulation and the required degree of conformity with the London Plan

2.80 All local development plan documents must be in general conformity with the London Plan. Guidance on the extent to which there can be any variation of London Plan policy is given in Circular 1/2008 which sets out the test of general conformity. A development plan document can be inconsistent with one or more policies in the London Plan, either directly or through the omission of a policy or proposal, but that does not, in itself, mean that the document is not in general conformity. Rather, the test is how significant the inconsistency is from the point of view of delivery of the spatial development strategy. Option 23 of the Council's proposed Core Strategy indicates the intention of the Council to remain in line with Mayoral policy by mirroring London Plan policy. However, should the Council so choose it can approve a policy that may in substantive terms, be either more expansive than the remit of the London Plan or it may vary it to reflect local circumstances.

Related Mayor of London Strategies

The Mayor's Energy Strategy (2004)

2.81 The Mayor's Energy Strategy concentrates on the period up to 2010 and beyond and provides the policy context for action plans. It sets out various targets for a range of renewable energy schemes. The Mayor requests boroughs to set targets for the generation of RE and to include them in DPDs. The Energy Strategy established criteria for a small number of Energy Action Areas none of which are within LB Lewisham.

The Climate Change Action Plan 2006 and Low Carbon Zones

2.82 The Climate Change Action Plan is a useful resource document with some case studies but its policy approach is now a little out of date in the context of recent policy developments. More recently the GLA and LDA have been participating in a new initiative which is an exercise in London Energy Heat Mapping which is examining the potential for decentralised heating systems where it is appropriate to create energy heat networks. This exercise will lead to energy masterplanning where existing heat networks, areas of high heat demand and sources of waste heat are analysed.

2.83 By identifying sites for the location of dedicated energy centres or other sources of low cost heat, such as energy from waste, it is hoped that the energy masterplan would build into a project brief, or series of briefs, within a borough. Opportunities for cross borough co-operation could be co-ordinated by a new organisation called Energy for London. Within the borough energy masterplan, 'decentralised energy project areas' could be defined. These could tie in with the proposed Low Carbon Zones, already established by the GLA, and other areas. Within these project areas new buildings should be required to commit to connecting to the decentralised energy scheme. In return connecting to the heat network would satisfy the 'on-site' renewable energy requirement, even where the heat network was not yet established. Developers would pay a connection charge to connect to existing schemes, or contribute to their development via a Green Energy Fund.

London Heat Map

2.84 The London Heat Map Project as been initiated by the London Development Agency (LDA), the Greater London Authority (GLA) and the London Councils to provide a comprehensive support package to local authorities, which promotes the delivery of decentralised energy (DE) throughout London. The LDA and London Councils have allocated funds for the programme.

2.85 The implementation of DE opportunities in the London Boroughs is integral to local, regional and national climate change mitigation targets as defined by National Indicators 185 and 186, Carbon Reduction Commitment, PPS 1 on climate change, the London Plan and the Government's Heat and Energy Saving Strategy, in order to achieve the Mayor's target of supplying 25% of London's energy from decentralised sources by 2025.

2.86 The London Heat Maps will contain detailed information on heat demands of major consumers, energy supply plants, community heat networks and the potential routes for new networks in a particular area. This information is portrayed as an accurate and up-to-date spatial intelligence, which stakeholders interested in DE development can use.

2.87 The London Heat Map Project promotes the partnership of local authorities, regional bodies and private sector stakeholders to develop, co-ordinate and deliver DE projects. Direct services and support will be made available to Borough's according to their requirements, level of commitment and their readiness in terms of policy or project development. Selected boroughs including Lewisham will be provided with funding at the DE project level to support the procurement of technical consultancy expertise for specific projects and develop DE opportunities. The first phase of the heat mapping programme is to identify locations for DE opportunities. The LDA then continues its support through the development of option appraisals, high level business and financial issues and guidance on procurement strategies and delivery partnerships. Subsequently, guidance and advice is provided in the third phase by the LDA when a specific project is identified as technically viable and with the potential to secure finance. The LDA will provide expertise and work alongside the borough to facilitate a market offer for the DE project.

Emerging Lewisham Local Development Framework

2.88 Local planning authorities have a power to include energy policies in the Core Strategy and other development plan documents (DPDs). SPDs can address further detail. These policy documents should impose reasonable requirements for a proportion of energy used in development to be low carbon energy and for the production of energy to come from renewable resources within their locality. Regulation on permitted development rights and building standards also has implications for local policy.

2.89 The Council is currently in the process of developing a Local Development Framework (LDF) which is scheduled for adoption in 2011. The Core Strategy Options (2009) contains proposals for renewable energy, sustainable design and construction, energy efficiency, and air quality. Options 22 and 23 are referred to in the Study Brief. Option 22 is a general climate change provision but does not explicitly include a requirement that climate change adaptation should extend to decision making in planning consents as expressed.

Box 1 - Option 23: Sustainable design and construction and energy efficiency

"The option is to explore opportunities to improve the energy standards and other sustainability aspects involved in new developments. The council would expect all new developments to reduce CO2 emissions through:

Compliance with other Core Strategy policies on sustainable movement, local air quality, waterways and flooding, sustainable design and waste management and

Application of London Plan policies relevant to climate change, air quality, energy efficiency, and sustainable design and construction. This would include the use of living roofs.

This option would require *applications for all new major developments (with a floor space of 1,000m^2 or more residential units) to:*

- Submit a sustainability statement according to the requirements of London Plan Policy 4A.3 and the London Plan SPG on Sustainable Design and Construction to demonstrate how sustainability issues have been taken into account at all levels through a lean, clean and green strategy;
- Maximise the opportunity of supplying energy efficiently by prioritizing decentralised energy generation (clean) for any existing or new developments according to the requirements of London Plan Policies 4A.5 and 4A.6, and promoting the use of SELCHP (South East London Combined Heat and Power Plant) as an energy source for the mixed use sites in the Deptford New Cross area;
- Meet at least 20% of the total energy demand through on-site renewable energy (green) according to the requirements of London Plan Policy 4A.7;
- Comply with the Code for Sustainable Homes standards by achieving:

  Level 3 by 2008

  Level 4 by 2010

  Level 5 by 2012; and

  Level 6 by 2016 (or the equivalent standards of BREEAM if non-residential development is proposed).

Option 23 will support and encourage the retrofitting of existing housing and other development according to the requirements of the London Plan Policy 4B.4, particularly estate renewal, which would contribute to achieving the objectives and standards for sustainable design and construction and energy efficiency." But it may be possible to do a variation of this depending on what expectations are targets to be achieved.

2.90 The Saved UDP Policies updated in 2007 supersede many of the Council's former energy policies. However those policies included within the London Plan remain relevant.

Conservation Areas

2.91 The Council should distinguish the approach to development in and outside its Conservation areas. There are now 25 conservation areas in Lewisham which are referred to as being very different in character and style. Conservation areas are unlikely to accommodate major industrial plant. The South East London Combined Heat and Power (SELCHP) plant in Lewisham is outside the Conservation area as is most of Deptford for example. There is a limitation on the exercise of permitted development rights in Conservation Areas and more explicitly in terms of installing renewable energy equipment in as a result of the GPDO 2008. There is no presumption in favour of Permitted Development Rights (PDR) in Conservation areas for many renewable energy technologies. The Conservation areas in the borough are primarily concentrated in the north of the borough with smaller areas around Catford (Culverley Green), Sydenham and Beckenham Place Park.

2.92 These stricter controls mean that all new buildings must preserve or enhance the character of the conservation area by using the highest quality design to complement the surrounding buildings and urban form. A development control policy will reflect that requirement. The character and appearance of conservation areas should be respected. Planning proposals that have an adverse effect on the historic environment should not be granted. However, the justification should refer to the balance that should be struck with the need to reach low carbon and renewable energy targets and include reference to best practice in renewables and integrating their design into the built fabric.

2.93 Permitted development rights are not extended to Listed Buildings which are covered by other planning regulations. The Council has produced Conservation Area Guidance for a number of Conservation Areas, some of which are due to be updated and which could usefully refer to new policy on low carbon and renewable energy.

Area Action Plans

2.94 Area Action Plan proposals have been published for Lewisham Town Centre and Catford which have been subject to separate consultation processes which are now closed. The consultation AAPs and their Sustainability Appraisals do not focus on energy efficiency and renewable energy although wider Borough policies are referred to. There is an opportunity to include area and site specific renewables targets within AAPs prior to submission.

SPDs

2.95 The Residential Development Standards Supplementary Planning Document (SPD) 2006 provides detailed guidance on:

- standards for new residential development;
- standards for conversions of existing houses into flats;
- residential extensions; and
- roof extensions.

2.96 The Council will also encourage in all new developments the inclusion of energy efficient and renewable energy technology and design, including passive solar design, natural ventilation, combined heat and power, community heating, photovoltaics, solar water heating, wind fuel cells, biomass fuelled electricity and heat generating plants. These issues will have consequences for the design of new development. Creative solutions will need to be found that meet the general design requirements of this guidance in order to accommodate this technology in a way that causes the least visual intrusion to the environment.

2.97 In the case of the larger schemes it is expected that schemes should demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:

- Passive design;
- Solar water heating;
- Combined heat and power for heating and cooling preferably fuelled by renewables;
- Community heating for heating and cooling;
- Heat pumps;
- Gas condensing boilers; and
- Gas central heating.

2.98 These developments will be required to generate a proportion of the site's electricity or heat needs from renewable sources, wherever feasible. The SPD provides a useful basis for requiring LDF documents to incorporate the approach that energy efficiency should not only apply to new build but existing stock and extensions to it.

2.99 The Council is currently preparing a Planning Obligations SPD. This document will establish the approach the Council will take to identifying the appropriate planning obligations in connection with development. This study will inform the final approach to planning obligations for renewable energy infrastructure and connections.

Council Strategies

2.100 The Council's Carbon Management Programme sets a target of a 50% reduction in CO_2 emissions from Council operations underpinned by a set of quantified projects.

2.101 The Council's Carbon Reduction and Climate Change Strategy 'is designed to ensure the Council leads by example on energy efficiency and is the starting point for working with its strategic partners and with citizens to deliver a wide range of programmes and projects'. It is project focused and spans a number of actions on 'softer targets'. New projects planned for the borough include:

- Green Schools initiative.
- Tackling fuel poverty: Ensuring that those most affected by the increasing cost of energy bills are able to heat their homes effectively by improving insulation have access to benefits and grants, and advice on low-cost energy efficiency measures.
- Low-carbon business hub: Using new technology and other building improvements to create a low-carbon business centre, attracting 'green collar' workers and environmentally aware social entrepreneurs.
- New Energy Action Zone: Extending Lewisham's successful Energy Action Zone, providing door-to-door advice and information on energy efficiency and access to grants.
- A pilot 'Green Street' initiative: street-wide package of improvements designed to make a significant reduction in CO2 emissions.
- Local Authority Carbon Management Programme (March 2009): Working with the Carbon Trust to ensure the Council leads by example in energy efficiency and provide the basis for delivering targets for reducing carbon dioxide emissions from Council activity including heating and lighting buildings, street lighting and transportation with a target set of a 50% reduction. The programme will extend to support for refurbishment of older buildings and reductions of energy consumption in buildings.
- New finance for Mayor of London Low Carbon Zones. The Zones are expected to include a range of carbon-cutting measures in homes, neighbourhoods, businesses and public

buildings such as:
- Home insulation;
- Smart meters to help people regulate their energy use;
- Retrofit packages for public and commercial buildings;
- Decentralised energy plants to produce heat and electricity locally;
- Renewable energy sources such as solar panels; and
- State of the art facilities to use waste as a clean fuel source.

2.102 The Low Carbon Zones could be as small as a couple of streets, or encompass areas of 1000 buildings.

Conclusions

2.103 This policy review provides the context for defining the scope of Sections 3-5 of this report and the approach taken towards policy recommendations set out in Section 7.

3. Energy Baseline and Requirements

3.1 This section identifies the energy requirements for the Borough in terms of demand for electricity, gas and energy from renewable energy sources. It establishes existing requirements and then outlines a series of other scenarios for future energy consumption which are described below.

3.2 The high level Borough level scenarios help to define the boundaries of what may be possible for renewable energy generation at a more local level and help provide a benchmark to measure performance of alternative renewable energy options.

Existing energy requirements

3.3 The table below lists the most pertinent Census data and energy consumption data for the Borough of Lewisham for 2007. It can be deduced that the energy consumption for electricity is 28.5 kWh/m^2 and 93.3 kWh/m^2 for gas. It can also be estimated that the average energy consumed per household in Lewisham in 2007 was 3029 kWh and 11593 kWh of gas.

Table 3.1 - Energy consumption 2007

2001 Census data	**Lewisham**	Population	248,922
		Area (hectares)	2,164
		Households	145,931
Breakdown of Energy Consumption (kWh)	**Electricity**	Ordinary domestic	377,375,304
		Economy domestic	64,721,188
		Industrial/Commercial	174,065,458
	Gas	Domestic	1,691,852,112
		Industrial/Commercial	327,963,642
Total energy consumption (electricity and gas)	**Consumption (kWh)**	Electricity	616,161,950
		Gas	2,019,815,754
	Number of meters	Electricity	127,156
		Gas	107,454
	Consumption (kWh)	Domestic	2,133,948,604
		Industrial/Commercial	502,029,100
		Total	1,344,365,170

Existing renewable energy capacity in Lewisham

3.4 A review of the Ofgem Renewables and CHP Register[1], which is a database of all renewable energy and CHP facilities claiming Renewables Obligation Certificates (ROCs) or CHP LECs, was undertaken. There are over 2000 facilities registered on the Ofgem database and none appear in the London Borough of Lewisham. Thus, although there may be some standalone renewable energy installations (e.g. solar thermal panels, solar PV, etc.) there are no major renewable energy installations within the borough at present.

3.5 On the north-western border of the borough, SELCHP operates a waste incineration business. The incinerated waste, of which over 100,000 tonnes per annum is collected from London Borough of Lewisham, fuels an onsite Combined Heat and Power facility which exports electricity to the London grid. The peak power produced by this unit is 35MWe and over 40MW of thermal energy is also generated. At present this thermal energy is available for use by other consumers, such as industrial, commercial or domestic properties. The Lewisham neighbourhoods in close proximity to SELCHP include Deptford and New Cross.

Spatial distribution of demand

3.6 Figure 3.1 graphically displays the spatial distribution of energy demand including domestic, industrial and commercial electricity and gas consumption (represented by the pie charts). The map shows how energy consumption in the Borough varies at lower super output area (LSOA) level.

3.7 Those areas with the most significant concentrations of existing energy consumption are around Lewisham town centre, close to the A2 Corridor in Deptford and New Cross and at Catford Town Centre. These areas accommodate the greatest concentrations of commercial/industrial development which has a large influence on overall consumption.

3.8 Elsewhere existing consumption is predominantly domestic and has lower energy density although those LSOAs with greater concentrations of commercial uses and community facilities tend to have greater consumption.

3.9 Existing concentrations of energy consumption provide a guide to the density of energy consumption and therefore a guide to the suitability of areas to be retrofitted to be served by area CHP networks. However, other factors including the scale of new development are also important and considered further in section 4.

[1] Ofgem, “Ofgem Renewables and CHP Register”, http://www.ofgem.gov.uk/Sustainability/Environment/RCHPreg/Pages/RCHPreg.aspx, Website cited May-2009

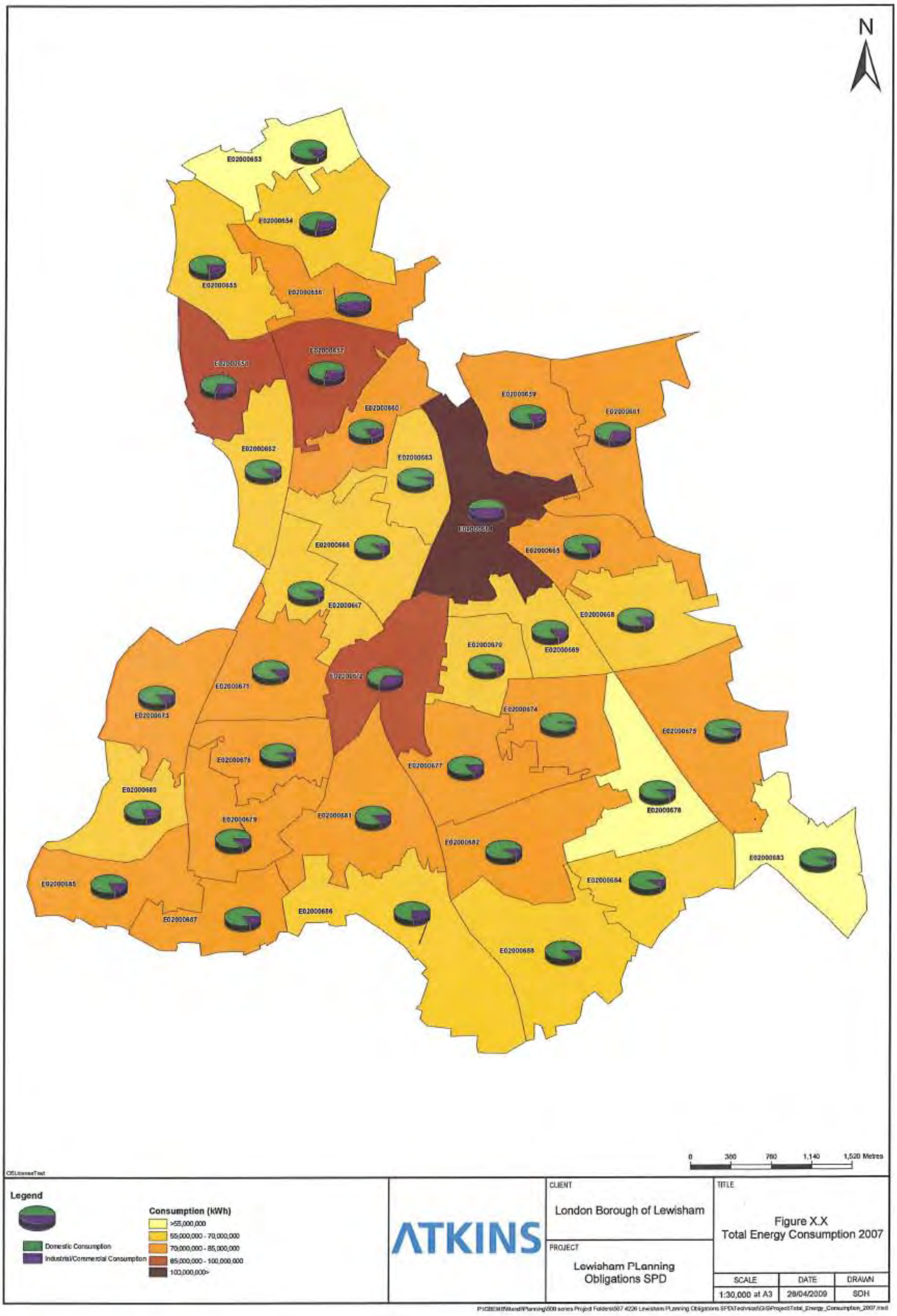


Figure 3.1 - Spatial distribution of energy demand.

Source: DECC MLSOA Electricity and gas estimates 2007.

Comparison with other London Borough's

3.10 This section briefly discusses and comments on Lewisham's electricity and gas consumption in comparison to the other 32 London boroughs.

3.11 In order to compare the gas and electricity consumption for the borough, domestic and industrial/commercial consumptions have been split out and all the London boroughs ranked in order of highest consumption. This information provides an understanding of how consumption in Lewisham compares with other London Borough's. Figure 3.2 and Figure 3.3 display the electricity consumption in the Domestic and Industrial/Commercial sectors respectively. Figure 3.4 and Figure 3.5 display the Domestic and Industrial/Commercial gas consumption.

Electricity sales at regional and local authority level, 2007			
	Domestic consumers	Sales per household	All consumers
NUTS4 Area	Sales 2007 - GWh	Average domestic consumption kWh	Sales 2007 - GWh
Camden	370.5	3,563	1,929.80
Islington	323.2	3,759	1,246.50
Hammersmith and Fulham	298.5	3,827	1,030.30
Lambeth	462.3	3,852	1,140.70
Newham	379.9	3,916	1,242.90
Hackney	345	3,920	776.1
Greenwich	395.6	3,996	818.6
Lewisham	**442.1**	**4,019**	**870.3**
Southwark	465.2	4,045	1,783.00
Merton	335.9	4,047	665.7
Waltham Forest	381.4	4,191	741.4
Wandsworth	516.6	4,200	1,160.40
Tower Hamlets	377.6	4,290	3,090.40
Kensington and Chelsea	383.6	4,310	1,487.90
Ealing	519.2	4,326	1,435.40
Westminster	505	4,353	4,118.90
Haringey	415.5	4,374	759.8
Barking and Dagenham	299.2	4,400	784.8
Croydon	638.7	4,405	1,375.30
Redbridge	430.2	4,435	728.9
Brent	463.4	4,499	1,219.00
Kingston upon Thames	294.5	4,531	634.6
Bexley	418.1	4,544	850.8
Sutton	363.6	4,602	672.5
Richmond upon Thames	363.9	4,606	785.3
Hillingdon	458.6	4,633	1,684.30
Hounslow	405.3	4,713	1,374.50
Bromley	608.7	4,719	1,083.60
Harrow	391.6	4,776	662.2
Havering	456.4	4,856	863.9
Enfield	561.4	4,881	1,407.30
City of London	25.1	5,016	2,555.10
Barnet	678.1	5,099	1,216.80
	1,264.60	**469**	**5,179.20**

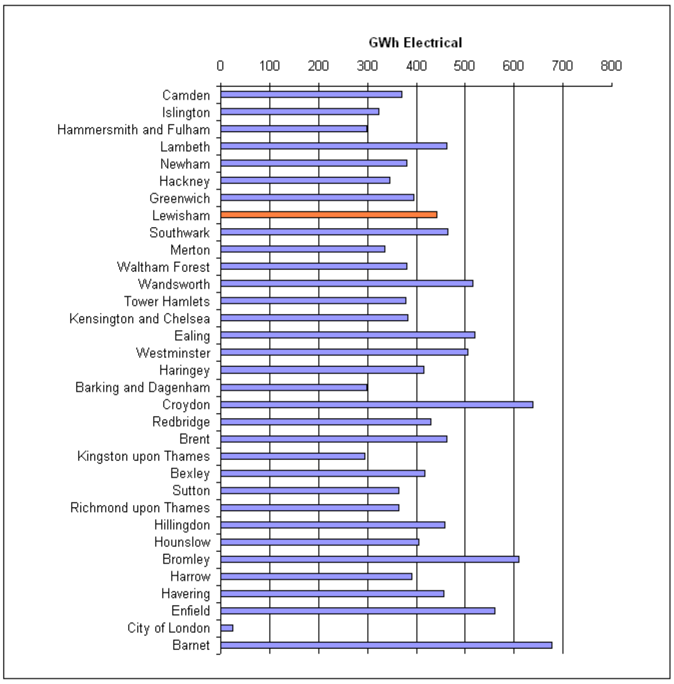


Figure 3.2 - Domestic electricity consumption for all London boroughs 2007 Source: DECC MLSOA Electricity and gas estimates 2007.

3.12 From Figure 3.2 it can be seen that Lewisham is ranked 13th/33 for total domestic consumption of electricity (ranked from lowest to highest). A review of the population levels of the London boroughs[2] and a ranking of the 'Average domestic consumption' shows that Lewisham performs well compared with other Borough's for domestic electrical efficiency (25th/33). This is partly a reflection of the type of residential stock in the Borough which is dominated by smaller terraced properties.

3.13 In Figure 3.3 it can be seen that electrical consumption for commercial and industrial users puts Lewisham at the lower end of the table being eleventh from bottom in terms of highest consumers with 2% of London's commercial electrical consumption. When ranked in order of average consumption Lewisham is third lowest in the league table. This indicates that the commercial and industrial activity in the Borough is lower compared with most other Boroughs and that there are relatively few energy intensive commercial and industrial users.

[2] Source: http://www.london.gov.uk/gla/publications/factsandfigures/DMAG-briefing2009-02-round-projections.pdf on 28/05/09

Electricity sales at regional and local authority level, 2007			
	Commercial and industrial consumers	Sales per consumer	All consumers
NUTS4 Area	Sales 2007 - GWh	Average commercial and industrial consumption kWh	Sales 2007 - GWh
Hackney	431.1	25,441	776.1
Haringey	344.3	36,502	759.8
Lewisham	**428.2**	**37,156**	**870.3**
Redbridge	298.7	37,694	728.9
Lambeth	678.4	37,796	1,140.70
Wandsworth	643.8	39,894	1,160.40
Waltham Forest	360	39,974	741.4
Bromley	474.9	43,397	1,083.60
Merton	329.8	44,269	665.7
Barnet	538.7	45,674	1,216.80
Harrow	270.6	45,722	662.2
Greenwich	423	47,480	818.6
Richmond upon Thames	421.5	48,266	785.3
Sutton	308.9	49,358	672.5
Islington	923.3	50,213	1,246.50
Kingston upon Thames	340.1	52,225	634.6
Hammersmith and Fulham	731.8	52,789	1,030.30
Brent	755.6	55,045	1,219.00
Camden	1,559.30	56,439	1,929.80
Havering	407.5	56,885	863.9
Kensington and Chelsea	1,104.40	58,082	1,487.90
Croydon	736.6	60,110	1,375.30
Bexley	432.7	64,736	850.8
Southwark	1,317.80	72,411	1,783.00
Ealing	916.2	78,296	1,435.40
Westminster	3,614.00	81,297	4,118.90
Newham	863	83,982	1,242.90
Barking and Dagenham	485.6	88,681	784.8
Enfield	845.9	96,921	1,407.30
Hounslow	969.2	118,559	1,374.50
Hillingdon	1,225.70	157,156	1,684.30
Tower Hamlets	2,712.80	172,175	3,090.40
City of London	2,530.00	324,363	2,555.10
TOTAL GREATER LONDON	**28,423.40**	**73,718**	**42,197.00**

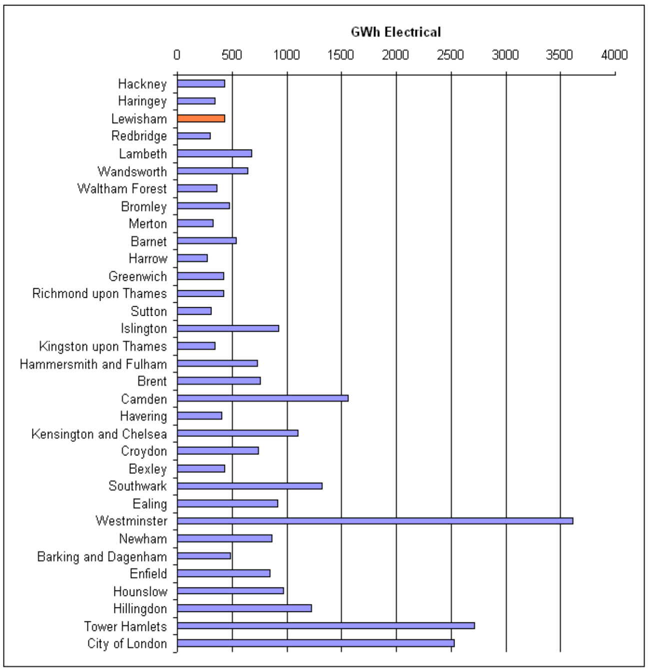


Figure 3.4 - Industrial/Commercial electricity consumption for all London boroughs 2007 Source: DECC MLSOA Electricity and gas estimates 2007.

3.14 Figure 3.5 displays the table and graphs containing the comparison data for domestic gas usage in the Borough.

Gas sales at local authority level, 2007			
	Domestic consumers (1)	Sales per consumer	All consumers
NUTS4 Area (2)	Sales 2007 - GWh	Average domestic consumption, kWh	Sales 2007 - GWh
Tower Hamlets	902.9	12,065	1,630.80
Southwark	1,331.40	13,037	2,360.60
Westminster	1,196.80	13,447	4,083.70
Islington	1,181.70	13,700	1,897.20
City of London	36.7	13,901	963.5
Hackney	1,252.70	14,119	1,567.90
Barking and Dagenham	930.7	14,232	1,178.00
Camden	1,172.70	14,914	2,715.40
Hammersmith and Fulham	1,110.10	15,010	1,708.10
Kensington and Chelsea	1,067.50	15,028	2,030.80
Lambeth	1,775.40	15,178	2,578.90
Newham	1,389.10	15,263	2,677.30
Greenwich	1,437.40	15,614	2,416.40
Lewisham	**1,691.90**	**15,921**	**2,019.80**
Wandsworth	1,886.20	16,093	2,624.40
Waltham Forest	1,492.90	16,589	1,834.90
Haringey	1,613.20	17,174	2,010.60
Merton	1,297.90	17,440	1,699.00
Hounslow	1,429.20	17,518	2,208.90
Bexley	1,541.10	17,552	2,351.00
Ealing	2,084.40	17,867	2,856.40
Havering	1,679.50	17,931	1,935.90
Enfield	1,922.80	18,315	2,617.80
Sutton	1,264.40	18,336	1,605.20
Hillingdon	1,752.70	18,439	3,230.70
Kingston upon Thames	1,080.20	18,649	1,379.50
Croydon	2,497.10	18,762	3,051.50
Richmond upon Thames	1,449.40	18,984	1,909.20
Brent	1,918.50	19,040	2,473.70
Redbridge	1,739.20	19,075	2,058.20
Bromley	2,475.70	19,654	2,980.20
Harrow	1,696.10	21,168	2,374.40
Barnet	2,623.20	21,252	3,319.20
TOTAL GREATER LONDON	**49,920.60**	**16,911**	**74,349.30**

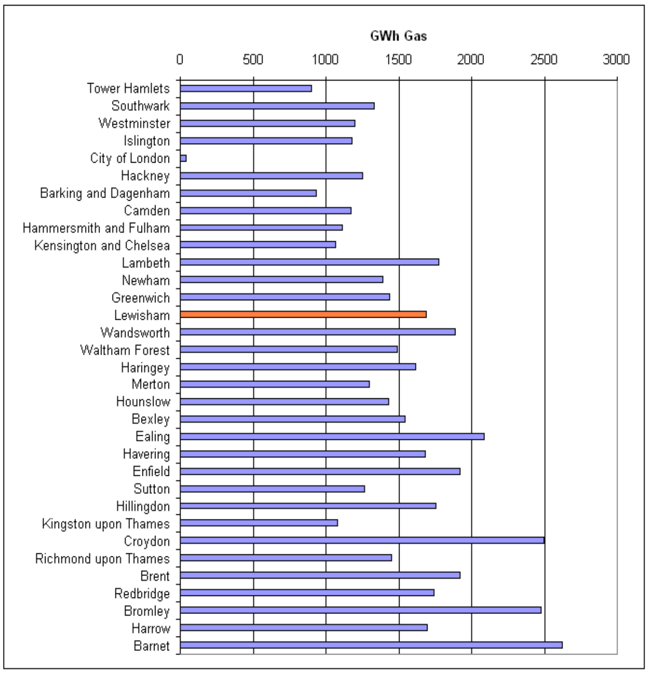


Figure 3.5 - Domestic gas consumption for all London boroughs 2007 Source: DECC MLSOA Electricity and gas estimates 2007.

3.15 Lewisham consumes approximately 3% of London's total domestic gas consumption which ranks it as the thirteenth largest consuming borough. Lewisham is placed 14/33 for lowest average domestic gas consumption. This compares poorly to the position for domestic electrical consumption (8^{th}). This places the Borough in the upper half of the table and indicates that there is likely for potential improvement. With the tenth largest population this indicates that it is still performing better than the majority of the other boroughs.

3.16 A review of the commercial gas usage in the Borough is shown in Figure 3.6. In terms of average commercial gas consumption Lewisham ranks well, being placed fifth. This reflects the fact that Lewisham has less commercial and industrial activity bourn out by the fact that it only consumes 1% of London's commercial gas consumption placing it 27th in terms of total consumption.

Gas sales at local authority level, 2007

NUTS4 Area (2)	Commercial and industrial consumers Sales 2007 - GWh	Sales per consumer commercial and industrial consumption, kWh	All consumers Sales 2007 - GWh
Barnet	696	218,111	3,319.20
Havering	256.4	249,950	1,935.90
Haringey	397.4	261,797	2,010.60
Hackney	315.1	273,564	1,567.90
Lewisham	**328**	**276,296**	**2,019.80**
Bromley	504.5	279,349	2,980.20
Croydon	554.4	280,403	3,051.50
Kingston upon Thames	299.3	281,274	1,379.50
Redbridge	319	291,368	2,058.20
Richmond upon Thames	459.8	316,253	1,909.20
Merton	401.1	323,483	1,699.00
Waltham Forest	342	330,085	1,834.90
Brent	555.2	334,653	2,473.70
Kensington and Chelsea	963.4	338,500	2,030.80
Sutton	340.8	350,258	1,605.20
Wandsworth	738.2	400,753	2,624.40
Ealing	772	403,330	2,856.40
Barking and Dagenham	247.3	414,241	1,178.00
Lambeth	803.5	461,014	2,578.90
Enfield	695	461,505	2,617.80
Islington	715.5	471,018	1,897.20
Camden	1,542.60	478,190	2,715.40
Westminster	2,886.90	511,869	4,083.70
Hammersmith and Fulham	598	512,454	1,708.10
Harrow	678.3	535,763	2,374.40
Southwark	1,029.30	562,763	2,360.60
Tower Hamlets	727.9	565,140	1,630.80
Hounslow	779.7	585,391	2,208.90
City of London	926.9	871,130	963.5
Greenwich	978.9	886,726	2,416.40
Bexley	810	924,653	2,351.00
Hillingdon	1,477.90	997,267	3,230.70
Newham	1,288.20	1,276,720	2,677.30
TOTAL GREATER LONDON	**24,428.70**	**455,522**	**74,349.30**

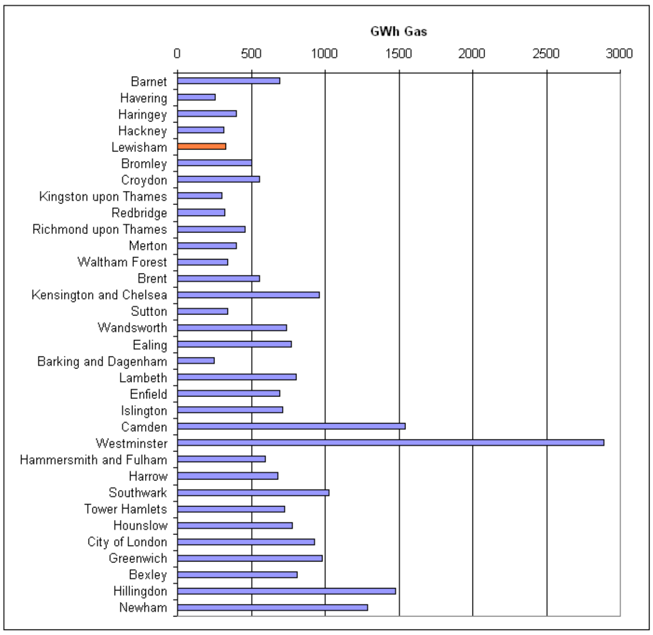


Figure 3.6 - Industrial/Commercial gas consumption for all London boroughs 2007 Source: DECC MLSOA Electricity and gas estimates 2007.

3.17 In summary, Lewisham compares well in terms of average consumption of domestic and commercial gas when compared against the other London boroughs.

Assessing future energy requirements

Approach

3.18 In order to evaluate the proposed policy targets, Atkins have modelled the future energy requirements of existing and proposed development for the period to 2025. Reducing carbon emissions are key elements of UK policy, consequently there are many assumptions and corresponding future scenarios that could affect the proposed future energy requirements for the Borough. However, to enable a planned energy and CO_2 emission trajectory to 2025, key assumptions have to be defined.

3.19 The assumptions made are based on the Government's recent Heat and Energy Saving Strategy Consultation (existing building stock) and reflect the targets set out in Option 23 of the Council's Core Strategy Preferred Options report (2009) which includes the proposed Code for Sustainable Homes trajectory. These assumptions take into account the impact of sustainable construction, energy efficiency and low and zero carbon technology energy sources but not the specific opportunities relating to renewable energy generation linked with new development in the Borough.

3.20 Two key reports have also been reviewed to determine other possible future energy scenarios that may affect the energy trajectory assumptions used in this document, these are:

- Powering London Into the 21st Century[3], March 2006;
- Updated Energy and Carbon Emissions Projections[4], November 2008.

Powering London into the 21st Century

3.21 The report investigates how London can source energy for its buildings and meet the Government's **previous** CO_2 reduction figure of 60% by 2050. The foundation of the report is to use a decentralised energy strategy, in preference to a centralised energy system incorporating nuclear power.

3.22 The report provides four scenarios for CO_2 reductions, these are as follows:

- Centralised low nuclear option: 19% CO_2 reduction by 2025
- Centralised high nuclear option: 23% CO_2 reduction by 2025
- Low decentralised energy option: 27% CO_2 reduction by 2025
- High decentralised energy option: 33% CO_2 reduction by 2025

3.23 All of the above scenarios assume a 20% contribution of large-scale renewable energy development; energy demand as projected in the Mayor's London Plan; limited improvements in gas boiler and building energy efficiency (in both new and existing buildings).

3.24 The study concludes that a 27.6% CO_2 reduction figure (from 2005 data) could be achieved by 2025 through a low decentralised energy option, without assuming the introduction of considerable energy efficiency improvements.

DECC – Updated Energy and Carbon Emissions Projections

3.25 The report provides robust updated emission projections up to 2020, where data has been updated to reflect changes in the key assumptions of: fossil fuel prices; economic growth; population; and energy data. The projections are regarded to be of a high standard and used by government to develop policy.

3.26 The report states that, taking into account current policy at the time of the report, UK carbon emissions are projected to fall to about 26% below 1990 levels by 2020. The report also details that emissions from the residential sector are estimated to be reduced by 28%, from 74 Mt CO_2 to 53 Mt CO_2.

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[3] Mayor of London & Greenpeace, "Powering London into the 21st Century", March 2006, PBPower, London
[4] Department of Energy and Climate Change, "Updated Energy and Carbon Emissions Projections", November 2008, DECC

3.27 The report also provides a renewed projection of the composition of UK electricity generation by fuel, where the main changes that will affect emissions are: a 27.5% reduction in the proportion of coal generation; a 16% increase in the use of gas; a 50% reduction in the proportion of nuclear generated electricity; and a 70% increase in the use of renewables.

Conclusions

3.28 Analysis of the two reports above show that there are many contributing factors that can affect future energy demand and carbon emission projections. Specific assumptions have been made for domestic and commercial electrical and gas sectors and the assumptions used in the chosen energy trajectory scenario are deemed to be satisfactory, when taking into account the scenarios discussed in the reports studied, particularly when considering the proposed higher CO_2 reduction figure of 80% by 2050. The specific assumptions are outlined in the following sections.

Energy Assumptions associated with new developments

New Dwellings

3.29 For the purposes of the scenario it is assumed that between 2006 and 2007 all new dwellings were built in line with Part L1A of Building Regulations (Conservation of fuel and power in new dwellings). Thereafter, relevant Code for Sustainable Homes levels, as defined by the Lewisham's proposed LDF Core Strategy are applied. These are detailed in Table 3.2. Code Level 3 (same CO_2 emission reduction as planned changes to Part L of Building regulations in 2010) can typically be achieved through energy efficiency improvements.

Table 3.2 Code for Sustainable Homes

Mandatory Building Standard	Date	$C0_2$ emissions reduction
2006 Part L1A	2006-2007	"Baseline"
CfSH Level 3	2008-2009	-25%
CfSH Level 4	2010-2011	-44%
CfSH Level 5	2012-2015	-100%
CfSH Level 6	2016-2025	-100% (Zero Carbon)

3.30 The trajectory of CO_2 emissions reduction outlined in the table above is the percentage improvement of Dwelling Emission Rate (DER) over Target Emission Rate (TER). For Code levels 3, 4 and 5 the emission rates are calculated from space heating, domestic hot water heating, and lighting for a building. Code level 6 emission rates are calculated from space heating, domestic hot water heating, lighting, cooking, and appliances.

3.31 It was assumed that the reduction in kWh consumption from the "Baseline" follows the Code for Sustainable Homes Levels 3 and 4. In other words, for Code levels 3 and 4 a reduction in energy consumption equal to 25% and 44% respectively was assumed for new development.

3.32 For Code level 5 it was assumed that the maximum reduction in energy consumption through building efficiency measures is a further 20% on Code level 4, i.e. 64%. Thus, although CO_2 emissions are 100% below the baseline, it is assumed that new development will have an energy demand but that the carbon emissions will be offset by on-site renewable energy technologies. In the case of Code level 6, the building is regarded as a 'Zero Carbon Home' and thus has no net energy consumption.

3.33 An illustrative example of the assumptions for new dwellings is tabulated in Table 3.3. The "Baseline" energy consumption is for a typical 3 bedroom house built to current (2006) building regulations. This data was sourced from the Energy Saving Trust[5].

Table 3.3 Energy assumptions for new build dwellings

Building Standard	Electrical kWh/yr	Electrical Kg CO2/yr	Gas kWh/yr	Gas Kg CO2/yr	Total kWh/yr	Total Kg CO2/yr
"Baseline"	4440	2522	7820	1517	12260	4039
CfSH Level 3	4285	2434	5865	1138	10150	3571
CfSH Level 4	4166	2366	4379	850	8546	3216
CfSH Level 5	4042	2296	2815	546	6857	2842
CfSH Level 6	0	0	0	0	0	0

3.34 Please note that the energy consumption figures quoted above (kWh/yr) include the consumption of electrical cooking and appliances but the CO_2 and consumption reductions exclude these parameters, as per Code for Sustainable Homes guidance[6]

Non residential development

3.35 At the time of writing, the Code for Sustainable Buildings had not been finalised. It is anticipated this Code, like the Code for Sustainable Homes, will assign points scores (and therefore the Level attained) for percentage emissions reductions beyond the 2006 baseline. In the absence of a timetable to work from, certain assumptions have been made. The Government's Heat and Energy Saving Strategy Consultation has stated that all buildings other than dwellings will be zero carbon by 2019[7]. It has been assumed that a 25% reduction from 2010 (due to proposed changes to Part L2A of Building Regulations), a phased interpolation to 2019 will result in a sliding scale of emissions reductions. The eventual reductions to be laid out in the Code for Sustainable Buildings is likely to follow the format of the Code for Sustainable Homes, but in the absence of suitable guidance, Table 3.4 has been used in our calculations.

Table 3.4 Assumed CO_2 reductions for new non-domestic buildings

Assumed Code Level	Year	C02 emissions reduction
Level 3	2010 - 2012	-25%
Level 4	2013 - 2015	-44%
Level 5	2016 - 2018	-100%
Level 6	2019 - 2025	-100% (Zero Carbon)

3.36 The assumed reductions CO_2 and energy consumption are the same as those set out in section 3.3 for domestic new builds. Buildings other than dwellings were divided into two types, offices and industrial. The projected energy consumption and CO_2 emissions per square metre of floor area for each was estimated. For estimating future floor space demand the latest (2006) GLA borough employment projections by land use sector were used. The forecast demand shows that office space will increase in the period up to 2025 whilst it is assumed there will be a reduction in

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[5] Energy Saving Trust, Personal communication to Atkins CM&R team, 23-Mar-2009
[6] Communities & Local Government, "Code for Sustainable Homes: Technical Guide", October 2008, Dept. for Communities and Local Government
[7] Department of Energy & Climate Change, "Heat and Energy Saving Strategy Consultation", 11th February 2009

industrial floor space. The energy benchmark assumptions were sourced from CIBSE[8]. The assumptions are tabulated in Table 3.5.

Table 3.5 Energy assumptions for new buildings other than dwellings

Application	Building Standard	Electrical kWh/m^2yr	Electrical $KgCO2/m^2yr$	Gas kWh/m^2yr	Gas $KgCO2/m^2yr$	Total kWh/m^2yr	Total $KgCO2/m^2yr$
Office	"Baseline"	95	54	120	23	215	77
	Level 3	71	40	90	17	161	58
	Level 4	53	30	67	13	120	43
	Level 5	34	19	43	8	77	28
	Level 6	0	0	0	0	0	0
Industrial	"Baseline"	35	20	180	35	215	55
	Level 3	26	15	135	26	161	41
	Level 4	20	11	101	20	120	31
	Level 5	13	7	65	13	77	20
	Level 6	0	0	0	0	0	0

Energy Assumptions associated with existing building stock

3.37 As part of the Government ambitious target of cutting CO_2 below 1990 levels by 80% by 2050, the Government's aim is for all existing buildings to be approaching zero carbon by 2050, as defined in the consultation document, the Heat and Energy Saving Strategy (launched February 2009).

3.38 The energy demand of the existing building stock represents a significant proportion of energy use in comparison with the future energy demands of new development. Consequently, energy efficiency improvements to existing buildings is seen as major opportunity to reduce carbon emissions, whilst also being regarded as a more cost-effective means of making savings. The Government has highlighted the requirement for low and zero carbon energy sources to be introduced, following the completion of more cost effective energy efficiency measures, such as heating system (boiler) upgrades and solid wall insulation, to make further contributions.

Existing Dwellings

3.39 The Government's Heat and Energy Saving Strategy Consultation suggests an equivalent of a 30% reduction in CO_2 from households by 2020 compared to 2006 Refer to Table 3.6, which would reduce annual emissions by up to 44 MtCO2 by 2020.

3.40 To enable this target it is proposed that all cavity walls and lofts will be insulated, where practical by 2015. Further to this it is suggested that more substantial improvements will be needed, incorporating small-scale energy generation and solid wall insulation, with an aim of delivering these substantial changes to seven million homes by 2020. It is also proposed that all homes are to receive a 'whole house' package incorporating cost-effective energy saving measures by 2030.

3.41 The Government has indicated that new policies will be required to deliver these ambitious targets. It is proposed that the Carbon Emissions Reduction Target (CERT) programme may run to December 2012 and from this point, new community based schemes will be required. The Government is currently piloting a programme entitled the Community Energy Savings Programme (CESP) to trial this approach.

3.42 Table 3.6 illustrates the interpolated emissions reductions to 2025 commensurate with the 30% by 2020 target for existing housing.

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[8] CIBSE, "Energy Benchmarks TM46", 2008

Table 3.6 CO_2 reductions of existing housing stock

Year	$C0_2$ emissions reduction
2009	0%
2010	3%
2011	5%
2012	8%
2013	11%
2014	14%
2015	16%
2016	19%
2017	22%
2018	25%
2019	27%
2020	**30%**
2021	33%
2022	35%
2023	38%
2024	41%
2025	44%

Existing Buildings other than dwellings

3.43 Information sourced from The Carbon Trust suggests that a reasonable scenario for reductions in CO_2 levels in commercial buildings is 20% by 2020. To support the delivery of these savings the Government's Heat and Energy Saving Strategy Consultation sets out the objective that all dwellings and other buildings will receive a package incorporating all of the cost-effective energy saving measures by 2030. Similar to Table 3.6, the assumed CO2 reductions have been interpolated for existing buildings other than dwellings, shown in Table 3.7.

Table 3.7 CO2 reductions of existing buildings other than dwellings

Year	$C0_2$ emissions reduction
2009	0%
2010	2%
2011	4%
2012	6%
2013	8%
2014	10%
2015	12%
2016	14%
2017	16%
2018	18%
2019	**20%**
2020	22%
2021	24%
2022	26%
2023	28%
2024	30%
2025	32%

3.44 The reductions outlined above were also applied to the energy consumption of the existing stock. The results of the energy and CO2 trajectories are given in the next section.

Energy demand trajectory

3.45 Table 3.8 summarises the projected energy consumed and CO_2 emissions up to and including 2025 for the London Borough of Lewisham. Detailed tables are included in Appendix A and these provide a breakdown of energy consumption and CO_2 emissions for gas and electricity for domestic and industrial/commercial buildings.

Table 3.8 Projected LBL Energy Consumption and CO2 Emissions to 2025

Year	Domestic		Industrial/Commercial		Total	
	GWh	kt CO_2	GWh	kt CO_2	GWh	kt CO_2
2007	2134	579	502	162	2636	742
2008	2140	581	503	163	2643	744
2009	2143	583	503	163	2647	746
2010	2086	567	493	160	2579	727
2011	2030	552	483	156	2513	709
2012	1975	539	473	153	2448	692
2013	1918	523	462	150	2380	673
2014	1862	508	452	146	2315	655
2015	1799	491	442	143	2242	634
2016	1727	469	432	140	2159	609
2017	1668	453	422	137	2090	590
2018	1610	437	412	133	2022	571
2019	1552	421	401	130	1953	551
2020	1494	406	391	127	1885	532
2021	1436	390	381	123	1817	513
2022	1377	374	371	120	1749	494
2023	1319	358	361	117	1680	475
2024	1261	342	351	114	1612	456
2025	1203	327	341	110	1544	437

3.46 Projections were based on Middle Layer Super Output Area (MLSOA) 2007 electricity and gas estimates[9]. This data has been used as the starting point and the declared adjustments and assumptions have been derived from this data. From Figures 3.6-3.9 it can be seen that the overall projected energy consumption and CO_2 emissions for the Borough follow a downward trend based on the reduction targets previously discussed. The figures on the next page provide a graphical representation of the reduction in energy consumption and CO_2 emissions.

3.47 It should be noted that the reductions in electricity and gas consumption shown are contingent on some existing energy consumption from the national grid being displaced by decentralised renewable sources in the Borough and energy efficiency savings being realised.

3.48 The figures above display a general downward trend in energy consumption and CO_2 emissions in both domestic and industrial/commercial sectors. These downward trends are achievable based on the assumptions made previously (i.e. implementation of Code for Sustainable Homes and the future proposed Code for Sustainable Buildings).

3.49 Realisation of these energy consumption reductions assumes that CfSH measures are fully implemented within new development and that funding and incentives referred to in Government strategies are implemented.

[9] Dept. of Energy & Climate Change, "Middle Layer Super Output Area (MLSOA) electricity and gas estimates 2007: London Government Office Region", 2007, BERR

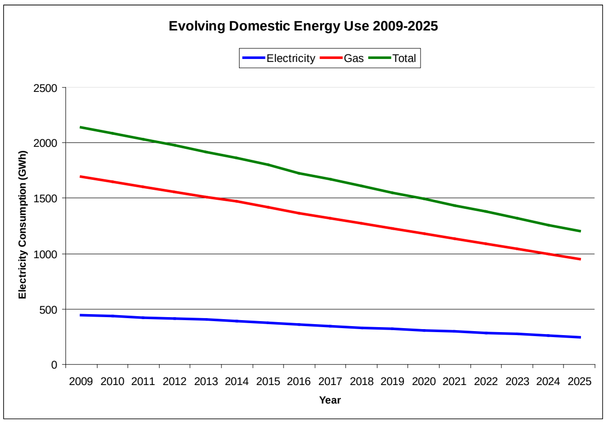

Figure 3.6 Evolving domestic energy consumption

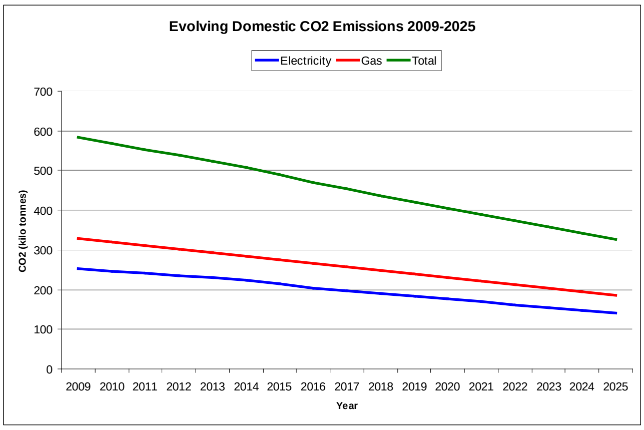

Figure 3.7 Evolving domestic CO2 emissions

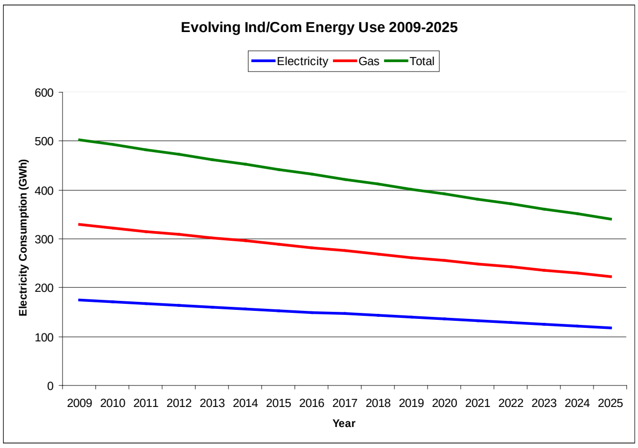

Figure 3.8 Evolving Industrial/Commercial energy consumption

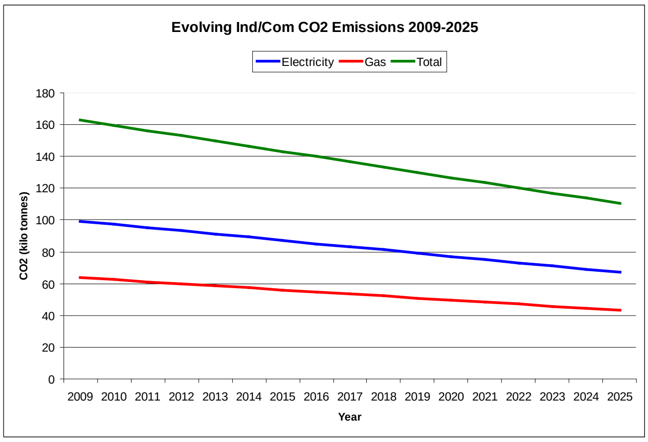

Figure 3.9 Evolving Industrial/Commercial CO2 emissions

4. Renewable and low Carbon energy potential linked to new development

Approach

4.1 This section summarises the approach the consultants have taken to assessing renewable energy potential in the Borough. The greatest potential to embed new medium and large scale renewable energy facilities in an existing urban area such as Lewisham is in association with new development.

4.2 This section considers the development pipeline which influences the scale and type of renewable energy opportunities which will exist in conjunction with new development, the scale of the resource available in the Borough and the feasibility of realising this resource. The potential for local energy networks is considered first, followed by the feasibility of other renewable resources (see paras 4.101-4.114).

4.3 The study sought to establish the potential for renewable potential linked to new development through the following approach:

- Step 1 – Review of development trajectory and development locations and definition of development typologies to identify those areas which may have potential for local energy networks;
- Step 2 - Review of major large scale renewable energy opportunities and their fit with new development;
- Step 3 – Establish technical feasibility and cost of larger scale facilities; and
- Step 4 – Establish smaller scale opportunities and technical feasibility and costs.

4.4 A summary of key findings of the assessment is set out below.

4.5 Although this study focuses on the potential for renewable and low carbon energy, consistent with the London Plan, the Council's approach should be to maximise renewable energy opportunities in conjunction with:

- seeking to reduce overall CO_2 emissions through reducing energy consumption;
- improving energy efficiency in new development through application of the Code for Sustainable Homes (CfSH); and
- deployment of other low and zero carbon technologies.

4.6 The costs of meeting CfSH and BREEAM targets have featured in the assessment of viability in Section 6.

Review of development trajectory and locations

4.7 The Council has already undertaken a number of strands of research to establish an evidence base of development requirements in the Borough up to 2025. These include:

- Strategic Housing Land Availability Assessment (SHLAA) and establishment of the 5 year housing trajectory which establishes the likely scale, location and phasing of residential development within the Borough.
- Employment Land Study (ELS) which establishes the potential scale of employment development (B Class uses) including those employment sites where there is potential for redevelopment for mixed uses.

- Deptford and New Cross Masterplan (DNX Masterplan) which further examines the development potential of the north of the Borough.
- Draft Area Action Plan (AAP) Documents for Lewisham and Catford Town Centres which identify development opportunities linked to these town centres.

Residential development

4.8 The SHLAA provides an assessment of development capacity at sites within the Borough which will come forward for development between 2007 and 2025. Overall, potential for around some 25,577 dwellings has been identified this is comprised of the following sources of supply:

- Completions from small sites of 5,688 dwellings based on an assumptions of 316 dwellings per annum;
- Completions from non self contained housing of 720 dwellings based on an average of 45 dwellings per annum;
- Vacant housing brought back into use of 1,458 dwellings based on an average provision of 73 dwellings per annum; and
- Large sites comprising of 17,711 dwellings. The breakdown of large sites is identified in Table 4.1 below.

4.9 There is potential for around 7,000 dwellings to be delivered up to 2013 with the balance provided after this period. However, due to the recent downturn in the housing market the exact timing of new development is uncertain.

Table 4.1 – Estimated Housing Potential 2007 - 2025

Map Ref.	Plan Ref.	SOURCES OF HOUSING SUPPLY		TOTAL
		NON IDENTIFIED SOURCES		
		Completions from the small sites component		**5688**
		Completions from non-self contained housing		**810**
		Vacant housing brought back into use		**1314**
		Sub-total		**7378**
		IDENTIFIED LARGE SITES		
		CATFORD		
1	CAAP1	Catford Shopping Centre	600	**1989**
2	CAAP3	Plassy Road Island	500	
3	CAAP4	Catford Greyhound Stadium	589	
4	CAAP5	Wicks Catford	300	
		DEPTFORD and NEW CROSS		
5	DC03	New Cross Hospital Site	40	**1392**
6	DC09	Seager	192	
7	DC12	Comet Street Site (part)	26	
8	DC13	Giffin Street	238	
9	DC15	Octavius Street / Deptford Station	115	
10	DC22	New Cross Gate Station Sites	285	
12	DC27	Tanners Hill	62	
13	DC30	Rival Envelop Company (Trundleys Rd)	88	
14	06/63352	Thanet Wharf	226	
15		Brockley Cross Sites	120	
		SOUTH OF THE BOROUGH		
16	DC17.1	Sites at Forest Hill (Forest Hill Station)	24	**767**
17	DC17.2	Sites at Forest Hill (Finches Site on Perry Vale)	71	
18	DC17.3	Sites at Forest Hill (Clyde Terrace)	52	

19	DC20	Rear of Christian Fellowship Centre	87	
20	DC25	Sites in Nightingale Grove	57	
21	DC26	9 Staplehurst Road	57	
22	DC28	O'Rourke/Sivyer Transport	29	
23	DC29	113-157 Sydenham Road	49	
24	DC04	Former United Dairies	44	
25	DC06	Bell Green Gasworks	156	
26	07/67480	Courts	141	
		MIXED USE SITES		
27	DCE12	Childers St/Arklow Rd	200	
28	DCE13	Oxestalls Rd	950	
29	DCE14	Plough Way (Cannon Wharf)	750	
30	DCE15	Surrey Canal Rd	2700	**8020**
31	DCE16	Grinstead Rd	160	
32	DCE17	Convoys Wharf	3500	
33	DCE18	Sun & Kent Wharf	300	
		ESTATE RENEWAL / RSL		
34	DC23	New Cross Gate NDC Centre	173	
35	DC23	Kender Estate	239	
36		Excalibur Estate	274	
37	04/58432	Honor Oak Estate (Ipswich House)	19	**1803**
38	05/59110	Silwood Estate	258	
39		Heathside and Lethbridge Estate	768	
40	08/68063	2-36 Plassy Road	60	
		LEWISHAM		
41	LAAP01	Lewisham Gateway	800	
42	LAAP05	Loampit Vale - W of Elmira	350	
43	LAAP06	Lee High Rd Eastern Side	53	
44	LAAP08	Loampit Vale - E of Elmira	400	
45	LAAP10	Loampit Vale - W of Jerrard	290	**3446**
46	LAAP11	Loampit Vale Sites	350	
47	LAAP12	Loampit Vale Railway Strip	60	
48	LAAP13	Connington Road (North-Link)	430	
49	LAAP14	Connington Road (Tesco)	628	
		Total new dwellings (small sites + allocated)		**23399**
		Total vacant housing brought back into use		**1458**
		Total non-self contained dwellings		**720**
		GRAND TOTAL		**25577**

Source: LB Lewisham 5 Year Housing Trajectory (Spring 2009)

Establishing renewables portfolios and development typologies

4.10 An analysis of the development trajectory was undertaken in order to identify the likely size and type of developments which are likely to come forward up to 2025. As identified in Table 4.1 in terms of the number of planning applications received, it is notable that a significant number relate to applications for single dwellings and housing conversions and small developments up to 10 dwellings as well as the medium and larger sized schemes outlined above.

4.11 In addition to the scale of development identified in the development pipeline another significant determinant is the scale and density of development and the relationship with the threshold sizes for different types of renewable and low carbon energy provision.

4.12 Some technologies are scalable on a continuum whilst the technical feasibility of other technologies are 'staircased' with thresholds between different scales of technology. These are summarised below:

- Easily scalable: Photovoltaic, Solar Water Heating, Small Hydro, Biomass Boiler, Ground Source Heat Pump (2 main technologies with choice dependent on density and land available), Air Source Heat Pump.
- Staircased: Combined Heat and Power and Biomass Combine Heat and Power, Wind (although range of sizes and capacities available provides flexibility).

4.13 Taking into account these considerations the following typology of developments was derived to capture the development pipeline and both key technological thresholds:

- Individual dwelling Detached/Semi detached;
- Individual dwelling terrace;
- Individual house conversion;
- Small scale development between 10 and 50 dwellings (within the Lewisham context these tend to be flatted developments;
- Housing led mixed use 50-200 dwellings;
- Housing led mixed use 200-500 dwellings; and
- Housing led mixed use 500 units+.

4.14 These development categories have been specifically tailored to reflect the nature of development coming forward within Lewisham.

4.15 In certain parts of the Borough where several larger scale development proposals are planned including a larger component of non residential uses including Deptford and New Cross, Lewisham and Catford town centres. Here a more bespoke approach is appropriate to consider the opportunities linked with these developments.

Employment land and premises

4.16 The Council has prepared an Employment Land Study to underpin its evidence base regarding the scale and type of B Class premises required in the Borough up to 2025. The conclusions of the study identify that there is a need for an increase in the amount of B-Class floorspace for light industrial, offices and other B-Class premises for small businesses.

4.17 The majority of the floorspace required will be located at existing employment sites within the Borough and in connection with town centre opportunities at Lewisham and Catford. New floorspace will be achieved through the intensification and redevelopment of existing employment sites where the current type and quality of premises is not well matched to future needs. In many cases it is envisaged that employment premises will be delivered through new mixed use developments where housing represents the enabler for an improvement in the amount and quality of premises provision.

4.18 Whilst the employment floorspace capacity of major mixed use sites is identified in the Employment Land Study the use of that space for different sectors and activities (which would be useful in estimating energy requirements) has not been identified. Energy requirements are strongly linked to the level of plant and equipment and its consumption rather than the size of the premises which means that it is only possible to undertake a high level assessment of requirements.

4.19 The re-provision of employment floorspace will lead to a significant improvement in energy efficiency as a significant proportion of the existing industrial and commercial stock is in poor condition compared with BREEAM energy efficiency standards.

4.20 The approach this study has taken to considering B-Class energy requirements has been to consider major commercial and industrial activities to be located within Deptford and New Cross, Lewisham and Catford which represent almost all new B-Class premises likely to come forward in quantitative and percentage terms. Within these areas we have taken a bespoke approach to assessing energy needs and renewable energy potential. For smaller scale employment development within other parts of the Borough we have also provided estimates of the potential for renewable energy for non residential uses which may be integrated within smaller residential development as part of a wider mixed use concept.

Other land uses

4.21 Within the scope of this study we have not identified the renewables potential associated with other types of development which may come forward within the Borough up to 2025. At present the location and scale of development and energy requirements are not known. Furthermore, such development which includes A-Class retail uses not combined with mixed use schemes, residential and non residential Institutions such as schools, hospitals and leisure uses also have highly specific energy consumption profiles which it is difficult to derive assumptions.

4.22 Although the scale of opportunity cannot be determined there are several programmes where there are significant opportunities for integrating renewable energy generation such as:

- Building Schools for the Future programme to upgrade secondary schools;
- New and refurbished Primary School provision;
- New Further and higher education facilities such as Goldsmiths College and Lewisham College;
- Proposed Leisure Centre at Forest Hill; and
- Improvements to University Hospital Lewisham and provision of additional Primary Healthcare facilities.

4.23 An approach to assessing the requirements associated with other uses is described in Chapter 7 in order that the opportunities linked with such developments can be maximised.

Identification of potential opportunities for Local Energy Networks

4.24 To establish the potential for the establishment of local energy networks in the Borough (extending beyond a single land ownership) an assessment was made of those sites which had the potential to either host a medium or large scale CHP facility or where it was possible to link sites to form a network either served by a single central facility or a small number of “seedpod” facilities.

4.25 District wide systems are constituted by one or several centralised plants, normally comprising of cogeneration plants (CHP) and high efficiency boilers which feed a piped hot water network. This approach reduces the air pollutant emissions and resource depletion with respect to private thermal generation. Heat and power is distributed within each building as normal, but buildings are served by an underground insulated pipe network. This ensures the distribution water and electrical circuit (primary circuits) are isolated from the consumer’s internal network (secondary circuits).

4.26 There are a number of parameters that should be considered to assist the achievement of sound and cost-effective district wide energy networks. Densely populated areas optimise the efficiency of these networks in terms of thermal losses and minimize the initial capital investment, for economy of scale reasons.

4.27 The Energy Saving Trust Guide (CE55 Community Heating) specifically states 'Most new build will be constructed by private developers, and assuming a project lifetime of 20 years with a discount rate of 12 per cent, new developments of 55 or more dwellings per hectare are, prima facie, likely to be cost effective'.

4.28 While this is a general rule of thumb there are several other criteria which are also important in establishing potential. A suitable model needs to exist or can be established exists for long term funding, management and maintenance. In addition sufficient critical mass is needed to underpin a business case especially given that under EU competition rules future occupiers cannot be tied in to taking energy suppliers from any particular supplier.

4.29 A number of criteria were used to identify those facilities which had the greatest potential for a wider CHP network these were:

- Scale of development and associated energy demand;
- Phasing of development in order that there is potential for close alignment between the development of the heat network and development in order to overcome cashflow and payback limitations;
- Presence of anchor facilities such as institutional or commercial uses which are larger heat users and could underpin demand for heat especially during the summer months when demand is low for domestic users;
- Proximity of developments to maximise efficiency and reduce the need for pumping;
- Presence of suitable heat corridors and routes which do not require major works to railway or strategic road corridors;
- There is potential to influence the shape of proposals through the planning process (Planning permission has not yet been granted or S106 agreement signed, or outstanding conditions relating to renewable energy strategy not yet discharged);

4.30 It should also be noted that district energy networks are normally to be designed with a degree of redundancy in the sizing of pipes and equipment to provide a degree of future proofing to take account of future extension and intensification of use and revision of construction coefficients. These considerations are reflected within the specification of pipelines and cables which are installed from the outset.

4.31 To optimise the network routing should also be minimised, i.e. the distributed generation station (heat and/or power) should be sited as close as possible to the thermal consumers. The generation plant should function over long annual periods with a thermal load close to the technical nominated one, for increased energy efficiency to be achieved.

4.32 An extensive programme of consultations took place with potential users who could represent anchors for local energy networks this included discussions with:

- LBL Estates Department;
- LBL Housing Department;
- LBL BSF Programme Manager;
- University Hospital Lewisham;
- The Council's Waste Management Department;

- Lewisham College;
- Goldsmiths College; and
- LBL Deptford and New Cross Area Manager.

4.33 The purpose of the discussions was to establish existing energy requirements confirm future plans and proposals relating to redevelopment/refurbishment of the building stock and upgraded heating and energy systems.

4.34 A systematic analysis was also undertaken of the distribution of the pattern of new development within the Borough to identify whether sufficient critical mass existed to underpin the demand of medium and large scale CHP facilities.

4.35 Figure 4.1 shows that the greatest concentrations of development sites are located in 3 main areas Deptford and New Cross in the North of the Borough (9,412 dwellings), around Lewisham Town Centre (3,446 dwellings) and Catford Town Centre (1,989 dwellings) together these represent 63% of allocated and small sites in the Borough.

4.36 The other larger development sites in the Borough representing significant sources of new dwellings included Estate Renewal and RSL sites and several relatively small sites in the south of the Borough which have a more dispersed pattern of development and not likely to be sufficiently clustered to merit the development of a local energy network encompassing multiple land owners. Instead CHP has been considered within the development typologies outlined below where CHP has been identified as a possible on site option for schemes with more than 10 dwellings.

4.37 Other opportunities for local energy networks requiring a bespoke renewable energy strategy such as the refurbishment of stock through Estate Renewal programmes were not considered as part of the study. Many of these schemes have already received planning permission and incorporate proposals to improve energy efficiency to Decent Homes standards. It is unclear what the contribution renewable energy makes to reducing overall energy consumption, further proposals should be considered with the guidelines for assessing proposals for development set out in Chapter 7.

4.38 This report has not considered the opportunities for retrofit of existing residential or commercial properties in identifying potential heat networks other than in connection with development or redevelopment.

4.39 At present the costs of adapting and connecting existing properties would be prohibitive due to the costs involved. Inclusion of such properties would undermine the potential business case of a local energy network if it was dependent on retrofitting existing properties.

4.40 Despite this once a network is established there is potential for it to serve existing properties as they are developed or refurbished. In addition an Energy Service Company (ESCO) could be tasked with social and regeneration objectives which may use the profits generated from its energy generation and distribution activities to fund energy efficiency improvements to the existing stock. This is discussed further in Appendix D.

4.41 A strategy for the development of each of the three area wide energy networks is described below.

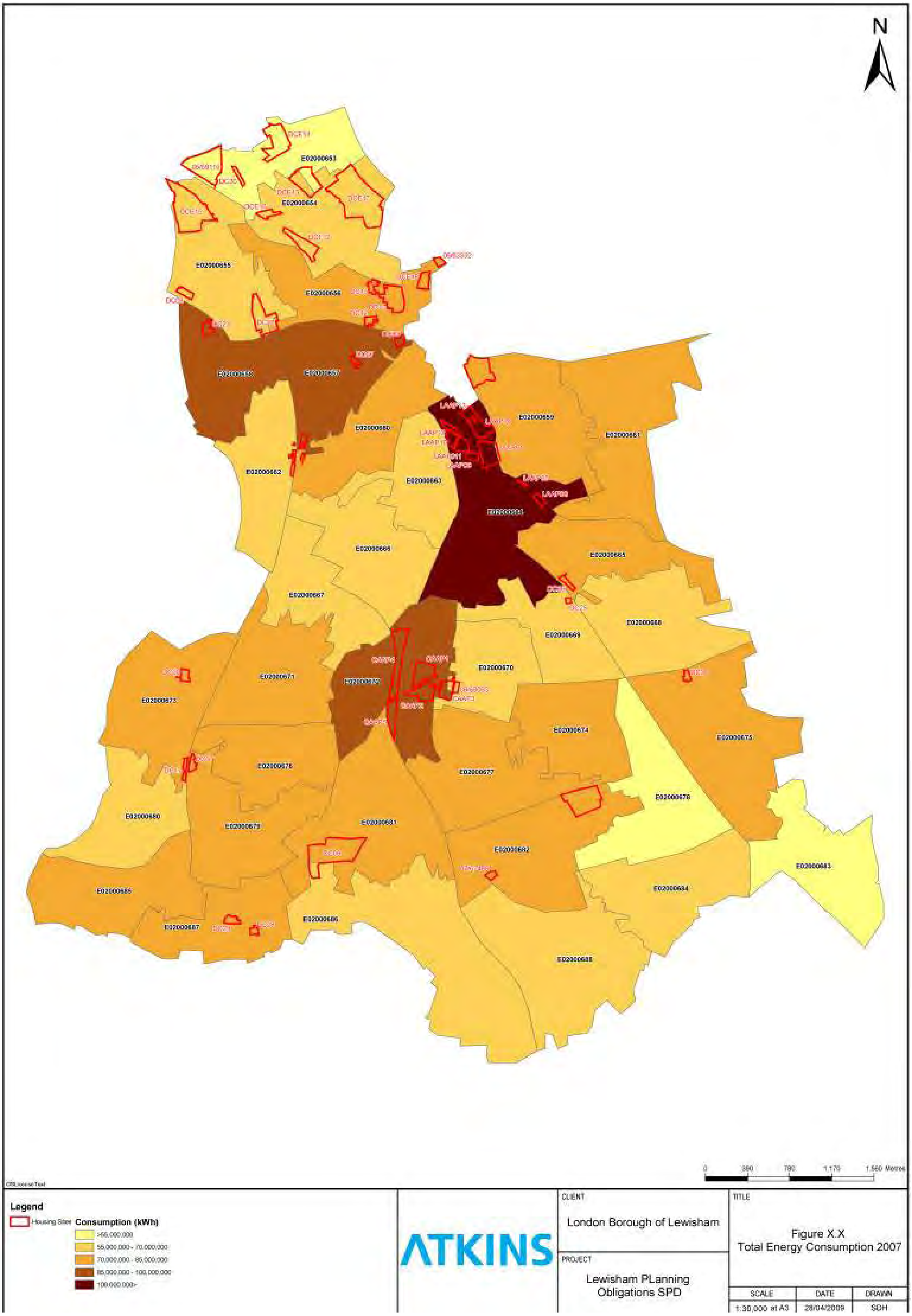

Figure 4.1 – Existing energy consumption and proposed development locations

Assessment of Local Energy Network Opportunities

4.42 Three areas within the borough have been assessed in more detail for the establishment of Local Energy Networks. These are: Deptford and New Cross, Lewisham Gateway, and Catford.

4.43 Baseline assumptions regarding the level of development which would take place within each area were taken from the Council's LDF evidence base documents.

4.44 A range of technical options were prepared to serve development within each area which included a Low Carbon Biomass CHP[10]. An assessment was made of the estimated energy demand (thermal and electrical), base load requirement, and approximate investment cost for equipment and network development.

4.45 Networks were optimised rather than seeking to serve each individual development site within each area.

Deptford and New Cross

4.46 The Deptford and New Cross area is the largest regeneration area within the Borough. Previous preliminary work to investigate the potential of SELCHP was reviewed to consider whether this facility provided the most appropriate solution to serve the area.

Previous work to establish potential of SELCHP

4.47 The South East London Combined Heat and Power (SELCHP) facility located in the north west of the Borough is a strategic scale waste to energy facility which processes waste from a number of London Boroughs. At present the facility generates electricity which is sold to the National Grid. However, the heat used during the process is not used at present and has potential to feed a District Heating Network.

4.48 This opportunity was first considered as part of the London Community Heating Development Study 2005 which reviews the potential for Community Heating across London and the technologies that could be used to supply low carbon heat. The study identified priority areas and nine Community Heating schemes were defined including the SELCHP waste to energy plant to take energy from the plant to new build developments at Convoys Wharf and a number of development projects in LB Southwark. The previous SELCHP scheme proposal was to be partly funded by the LB Southwark (for which it provides benefits) and a CEP capital grant. The London Plan Policy on decentralised energy has important implications for the SELCHP plant because it supports expansion of the plant to other distribution networks that will be required for new development.

4.49 Phase 1A of the 2005 Study contains proposals for housing to the north of the plant, including the large estate, New Place, contains 1,663 dwellings. Adjacent to the plant the Silwood estate was is being re-developed and 750 new dwellings are planned. However planning permission for both schemes has been granted.

4.50 The report notes that the heat load that can be supplied will be located to the north, west and east of the plant. As a result it is possible to phase development to enable the concept to be established before requiring further capital financing. To the east there are a number of estates owned by LB Lewisham that although not currently supplied by District Heating could be converted in the future, in particular four tower blocks which are currently electrically heated.

4.51 To the west of the plant there are a number of housing estates owned by LB Southwark which are already supplied by a heating network. These include Acorn and North Peckham (1,500 dwellings). There is the potential for further expansion to the west to supply the estates examined in the Brixton and Camberwell scheme. The main difficulty with this branch is the need to find a

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[10] Refer to Appendices for technical information on Biomass CHP systems.

route to cross the Old Kent Rd and a tunnel is likely to be needed if major disruption is to be avoided.

4.52 At SELCHP there is at least 40MW of heat available with a low carbon content. The heat load that can be supplied is located to the north, west and east of the plant. As a result it is possible to phase the development to enable the concept to be established before requiring further capital financing. The principal environmental benefit from CHP is a reduction in CO2 emissions, the most important greenhouse gas. For the SELCHP scheme there would also be a significant reduction in NOx emissions.

4.53 Although SELCHP provides enough power to operate 48,000 homes. At present the heat produced is simply dumped into the atmosphere. Connecting these to community heating would increase the biomass energy input into London's energy demand.

4.54 As part of this study several consultations took place with the current operator of SELCHP to explore future development of a Local Energy Network using this facility. It was established that the current operator is not currently considering development of a CHP network for a number of reasons including the current investment climate and uncertainty relating to the phasing of new development. Given that the facility is part owned by the Council, there may be a possibility of including the establishment of a CHP network within the scope and terms when operation of the facility is re-tendered.

4.55 On this basis the consultants considered SELCHP as only one of the potential options to serve the area. Alternative options were also developed to serve the area which did not rely on SELCHP which only has potential to provide heat as the Electricity generation is already fed to the grid.

Alternative options to serve Deptford and New Cross

4.56 Seven development areas were identified within the wards of Deptford and New Cross which have the potential to form the core of the local energy network. The development capacity relating to these sites is set out in Table 4.2 on the basis of the Council's evidence base.

Table 4.2 Deptford and New Cross Key Site Development Assumptions

Location	Total Built up Area	Employment Area	Jobs	Residential Area (m2)	Residential Units
Surrey Canal Road					
Existing	32,800	44,700	360	-	-
Proposed	265,000	44,700	2,500	232,300	2,700
Grinstead Road					
Existing	2,800	2,800	20	-	-
Proposed	16,400	2,800	160	13,600	160
Plough Way					
Existing	12,100	10,000	170	-	-
Proposed	71,000	10,000	160	61,000	750
Oxestalls Road					
Existing	17,000	17,000	80	-	-
Proposed	100,000	17,000	1,000	83,000	950
Arklow Road					
Existing	24,000	24,000	120	-	-
Proposed	45,000	24,000	480	16,000	200
Kent & Sun Wharf					
Existing	8,300	8,300	-	-	-
Proposed	34,000	8,300	350	25,700	300
Convoys Wharf					
Existing	-	-	-	-	-
Proposed	447,045	72,730	-	37,980	3,514

4.57 From the supplied information, forecasts were prepared of the electrical and thermal energy consumption for each site. The energy consumption forecast were based on energy benchmarks from CIBSE[8]. The results of the energy consumption analysis for the Deptford and New Cross development areas (outlined earlier in Table 4.2) are tabulated in Table 4.3.

Table 4.3 Deptford and New Cross Energy requirements MWh & baseline CO_2 emissions

Location	Thermal	Electrical	Total
Surrey Canal Road			
MWh	15,099	16,733	31,832
tonnes CO_2	2,793	8,986	11,779
Grinstead Road			0
MWh	895	997	1,892
tonnes CO_2	166	535	701
Plough Way			0
MWh	3,862	4,229	8,091
tonnes CO_2	714	2,271	2,985
Oxestalls Road			0
MWh	5,456	6,076	11,532
tonnes CO_2	1,009	3,263	4,272
Arklow Road			
MWh	2,283	3,140	5,423
tonnes CO_2	422	1,686	2,109
Kent & Sun Wharf			
MWh	1,870	2,170	4,040
tonnes CO_2	346	1,165	1,511
Convoys Wharf			
MWh	2,035	2,041	4,076
tonnes CO_2	376	1,096	1,473

4.58 It should be noted that the figures of energy consumption (MWh) and Carbon Dioxide emissions (tonnes CO_2) quoted in the table above are estimates only and based on a high level assessment. When the network is designed a more detailed analysis of proposed energy consumption should be undertaken taking account of information such as: building plans and elevations; information on building envelope; and proposed use.

4.59 Five options were identified as potential solutions to serve major sites in the Deptford and New Cross area. These can be considered the most likely broad technical solutions to provide heat and/or power to the area through a local energy network. The options are:

- Option 1: 40MW of available thermal energy from SELCHP;
- Option 2: Centralised biomass CHP system;
- Option 3: As Option 2 plus 20% solar PV, 50% of District Heating Water from solar thermal;
- Option 4: Multiple Biomass CHP Energy Centres networked by a heat main;
- Option 5: Biomass CHP Energy Centre oversized (20%) to meet future demand.

4.60 Each of the identified options would require varying levels of civil and structural works to accommodate such large solutions. Option 1 is the least intrusive of the five options from a structural point of view as no major fuel store or plant room would be required. A network of underground district heating pipe would be the major civil work required.

4.61 Option 2 would require a large scale plant room and fuel store as well as the district heating network would be required. This could be located between Surrey Canal Road, Cannons Wharf and Oxestalls Road (refer to Figure 4.2). The total CHP plant footprint is likely to be between 150-200m². This is excluding the fuel store, since this will depend upon fuel type, delivery method and the number of hours or days' operational requirement held in reserve. It is unlikely that a system of this size could be placed underground due to its size and ample space for fuel storage and deliveries would be required.

4.62 Option 3 provides an enhanced level of energy provision and supplements the CHP facility with solar thermal and solar PV technologies. It has been estimated that over 46,000m^2 of roof space would be required for solar PV to supply 10% of electricity and almost 15,000m^2 of solar thermal collectors to supply 50% of domestic hot water demand which has potential to be established in the area.

4.63 Option 4 is similar to option 2 but using a number of on site energy centres linked by a heat main rather than a single facility.

4.64 Option 5 anticipates and over-sizing of the CHP plant to accommodate future demand, possibly for industrial heat or to serve a wider number of developments. This could result in a comparable increase in CHP plant footprint and fuel storage requirements.

4.65 A map of the area and the potential heat corridors that could be installed is shown in Figure 4.2. This shows the core network located in the north of the area identified. There is potential to extend the network southwards from Convoys Wharf in the future to serve development sites around Deptford Town Centre and Deptford Creek. A further opportunity exists for a smaller satellite network focused on Goldsmiths College campus to the south of the area this is discussed further below.

4.66 There is potential for the feedstock for biomass CHP to be brought to the site by water transport either using wharfage at Deptford Creek or at Convoy's Wharf where the wharf is safeguarded.

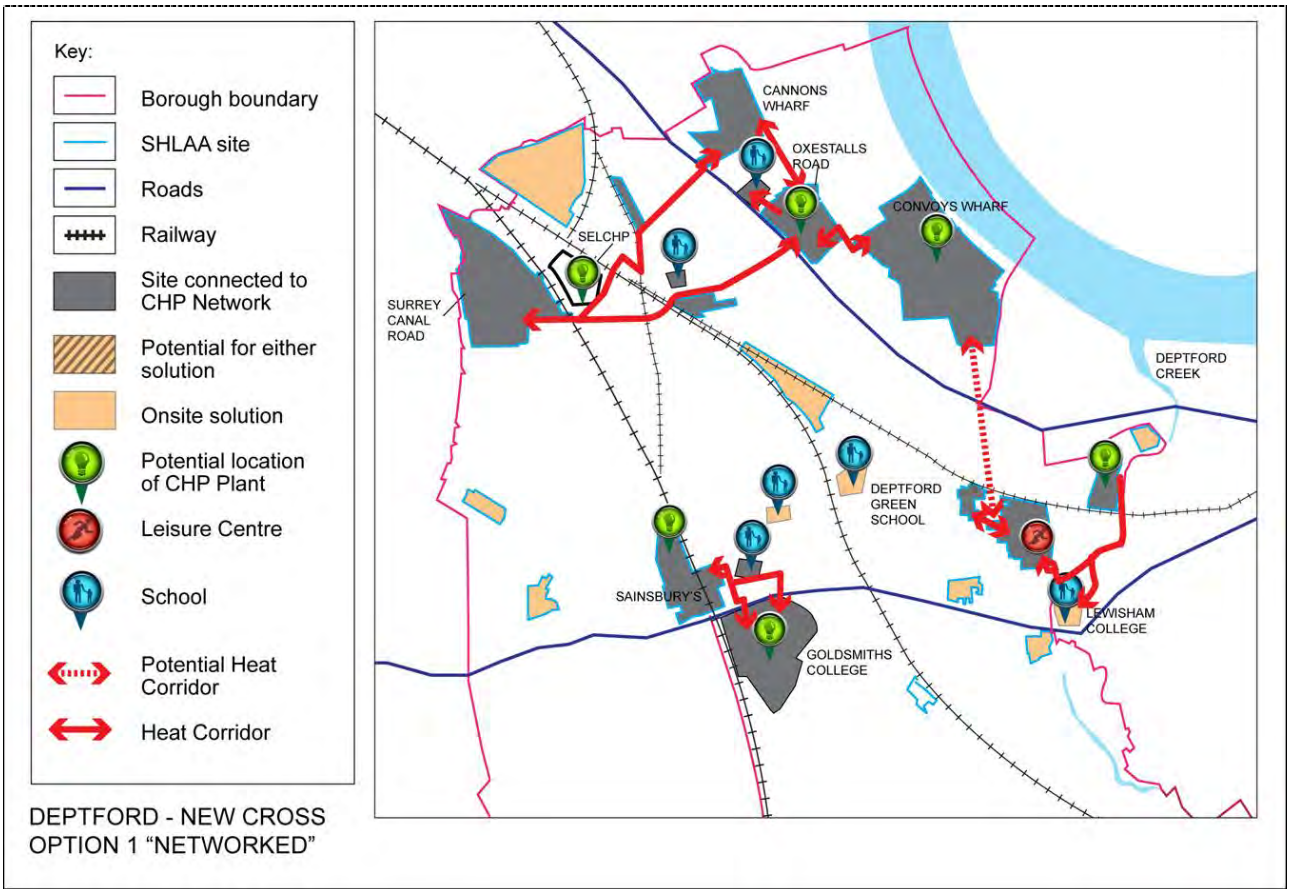

Figure 4.2 Deptford and New Cross: Area Wide Options networked

4.67 The first of these five options relates to the 'waste' heat from SELCHP, which is a 40MW CHP plant located to the northwest in Figure 4.2. The proportion of thermal energy that SELCHP could supply is presented in Table 4.4.

Table 4.4 Deptford and New Cross: Area Wide Option 1

Option 1	Unit	Result
Thermal energy required	MWh	66,885
Potential SELCHP supply	MWh	350,400
Thermal losses	%	15
Thermal energy available	MWh	297,840
Estimated district heating pipe	m	5,500
	£	£1.5m - £2.2m
% of site thermal demand satisfied	%	946

4.68 From the table above it can be seen that SELCHP has the potential to supply the identified proposed developments with year round thermal energy which represents a very good technical solution.

4.69 Four other options were also identified, which investigated the potential of utilising Biomass CHP to provide simultaneous heat and power to the site. The results are presented in Table 4.5.

4.70 From Table 4.5 it can be seen that the optimal CHP capacity to serve the area is approximately 3MWe. This size of system is commercially available and the estimated CO_2 savings are between 50% and 60% for all options (except the SELCHP option as it provides heat only). Option 3, which includes solar PV and solar thermal technologies, has the largest capital costs but with the much reduced size of CHP system there is also a net reduction in CO_2 emissions. This option would also require a significant area of roof space to accommodate the solar panels. However, the annual costs are lower for this option and it is also less reliant on external fuel supplies. Each of the identified options are technically feasible and will lead to a clean supply of heat and electricity for the occupants of the development.

4.71 In terms of cost Option 1 using SELCHP is the lowest cost option but does not provide CHP benefits with Options 2, 3 and 5 costing between £18.4 - 21.8m. Option 3 has a higher up front capital cost but has a lower operating cost.

Other opportunities

4.72 Several other opportunities were identified where there is potential for future development sites to host medium sized CHP facilities:

- Goldsmiths College Campus where a masterplan is being prepared which is also considering future energy options. There is significant potential to link the establishment of a renewables solution with development at the Sainsbury's site to the North. This opportunity is enhanced by the differing energy load requirements required by the college and those required by development identified for the Sainsbury site which are highly complementary in technical terms.
- Deptford Green School – facility to serve the school

Table 4.5 Deptford and New Cross - Area Wide Options 2-5

		Option 1	Option 2	Option 3	Option 4	Option 5
		Thermal energy delivered from SELCHP	Biomass CHP Energy Centre for new development	As Option 2 + Solar PV 10% of elec consumption Solar thermal 50% of DHW	Multiple Biomass CHP Energy Centres networked by heat main	As Option 2 + CHP oversized (20%) to meet increased demand
Technical	Thermal d/x losses	25%	25%	25%	30%	25%
	Electrical d/x losses		7%	7%	10%	7%
	MWhth required	35819	44774	44774	46565	53729
	MWhe required		45256	45256	46525	54307
	Baseload MWhth		13432	6716	13970	16119
	Baseload MW		2.7	1.3	2.8	3.2
	Peak MWth		10.8	10.8	11.3	13.0
	Peak MWe		8.5	8.5	8.8	10.2
	Optimum CHP capacity: heat		4.0	2.0	4.2	4.8
	Optimum CHP capacity: elec		**2.7**	**1.3**	**2.8**	**3.2**
	MWhth delivered by CHP	262800	13298	10074	20954	24178
	MWhe delivered by CHP		8865	6716	13970	16119
	% of site MWhth delivered	734%	30%	23%	45%	45%
	% of site MWhe delivered		20%	15%	30%	30%
	Support boiler MW		6.8	8.8	7.1	8.2
	Woodchip tonnes/yr		18656	15858	19402	22387
Carbon Saved	Total CO2 savings (t/yr)	6627	14865	13711	17606	20781
	Total CO2 savings %	**23%**	**51%**	**47%**	**60%**	**59%**

Capital Investment	Notional CHP Plant £		£13,297,983	£6,648,991	£13,829,902	£15,957,579
	Support Biomass boiler £		£2,721,125	£3,527,064	£2,829,970	£3,265,350
	Other RE investment £		£0	£35,659,242	£0	£0
	District heating pipe m	5532	5532	5532	5532	5532
	District heating pipe £	£1,659,600	£1,659,600	£1,659,600	£1,659,600	£1,659,600
	Grid connect £		£797,879	£398,939	£829,794	£957,455
	TOTAL Capital Investment	**£1,665,132**	**£18,476,587**	**£47,893,837**	**£19,149,267**	**£21,839,985**

Annual Costs	Annual Fuel £	Contract	£839,519	£713,591	£873,100	£1,007,423
	Annual O&M BB £		£13,606	£17,635	£14,150	£16,327
	Annual O&M CHP £		£50,000	£50,000	£50,000	£50,000
	TOTAL Annual Costs		**£903,125**	**£781,227**	**£937,250**	**£1,073,750**

- Deptford Town Centre – A facility hosted at either Lewisham College or the Waves Leisure Centre could serve the area. The proposals for Lewisham College are on hold due to funding issues and the heating system at the Waves Leisure centre has only recently upgraded and has a 15-20 year lifespan which means it may not be replaced over the plan period. Other options to serve this area could either include a facility located within the employment area adjacent to Deptford Creek or the area being linked to the energy network to the north via a heat connector from Convoy's Wharf.

4.73 These opportunities should be considered as proposals for these sites are brought forward. Smaller sites should be considered as part of the general approach established later in this chapter.

Lewisham Gateway

4.74 The second area identified with potential for the establishment of a local energy network were the sites around Lewisham Town Centre. Having reviewed the development pipeline it was established that it would be difficult to deliver an area wide network due to the Lewisham Gateway Project having already been granted planning permission and with a decision pending on an application to at Loampit Vale. The application is accompanied by an Energy Statement[11] which proposes a site wide energy centre to serve the development which includes a new leisure centre linked to a gas fired CHP (not a low or zero carbon energy source).

4.75 In this situation it was considered that the most appropriate strategy to serve the Lewisham Town Centre area would be individual on site solutions rather than an area wide network. Although most of the residential led sites could be assessed on a site by site basis using the calculator developed as part of the study. Further consideration was given to the potential energy strategy for Lewisham Gateway given the scale and wide mix of uses and its potential contribution towards meeting RE targets. It is likely that the energy strategy for the site will need to be developed further in the future to comply with higher London Plan energy targets.

4.76 The Lewisham Gateway proposals are a comprehensive mixed use redevelopment of over 100,000m^2. As part of the proposals all existing buildings would be demolished with intensification in the level of floor space. The proposals comprise of retail, offices, hotel, residential, education, health and leisure premises, car parking and associated infrastructure. The estimated floor areas supplied are set out in Table 4.6, along with the calculated electrical and thermal energy consumptions. The energy consumptions are based on energy benchmarks from CIBSE[8].

Table 4.6 Proposed development areas for Lewisham Gateway

Development	Area m^2	Electrical MWh/yr	Thermal MWh/yr	TOTAL MWh/yr
Shops & Pro services	12000	990	0	990
Restaurants/Pubs	4000	260	700	960
Takeways	1000	45	185	230
Offices	8000	380	480	860
Hotel	3000	158	495	653
Residential/Flats	57000	1532	1527	3059
Education/Health	10000	200	750	950
Leisure	5000	400	1100	1500
500 carpark lots	4920	49	0	49
TOTAL	**104,920**	**4014**	**5237**	**9250**

4.77 The estimated energy demands were used to estimate appropriate area wide renewable energy options. Three options were identified as are as follows:

[11] Hoare Lea, "Loampit Vale – LV11: Energy Strategy", March 2009

- Option 1: Lewisham Gateway biomass CHP Energy Centre;
- Option 2: As Option 1 plus 10% solar PV, and 50% of DHW from solar thermal;
- Option 3: As Option 1 but biomass CHP Energy Centre oversized (20%) to meet future demand;

4.78 A map of the area summarising the proposed energy strategy to serve the area is shown in Figure 4.3 and the results of the analyses are presented in Table 4.7.

4.79 Each of the identified options would require varying levels of civil and structural works to accommodate the technologies. Option 1 would require a large scale plant room and fuel store as well as the district heating network. It is estimated that around 60-90m² of floor space would be required to accommodate a CHP system and backup boilers at this site. This figure excludes the space required for the fuel store, which can vary significantly in size depending upon the hours or days' operational equivalent held in reserve. This is in turn dependent upon the frequency of fuel deliveries. If the plant were to be located inside an existing building, it may be necessary to install fume extraction equipment to meet Building Regulations standards. The flue(s) should also not extend more than one metre above the roof-line if installed in an existing building.

4.80 Option 2 utilises solar thermal and solar PV technologies and it has been estimated that over 1,200m^2 of roof space would be required for solar PV to supply 10% of electricity and over 1,700m^2 of solar thermal collectors to supply 50% of domestic hot water demand.

4.81 Option 3 anticipates and over-sizing of the CHP plant to accommodate future demand, possibly for industrial heat. This could result in a comparable increase in CHP plant footprint and fuel storage requirements.

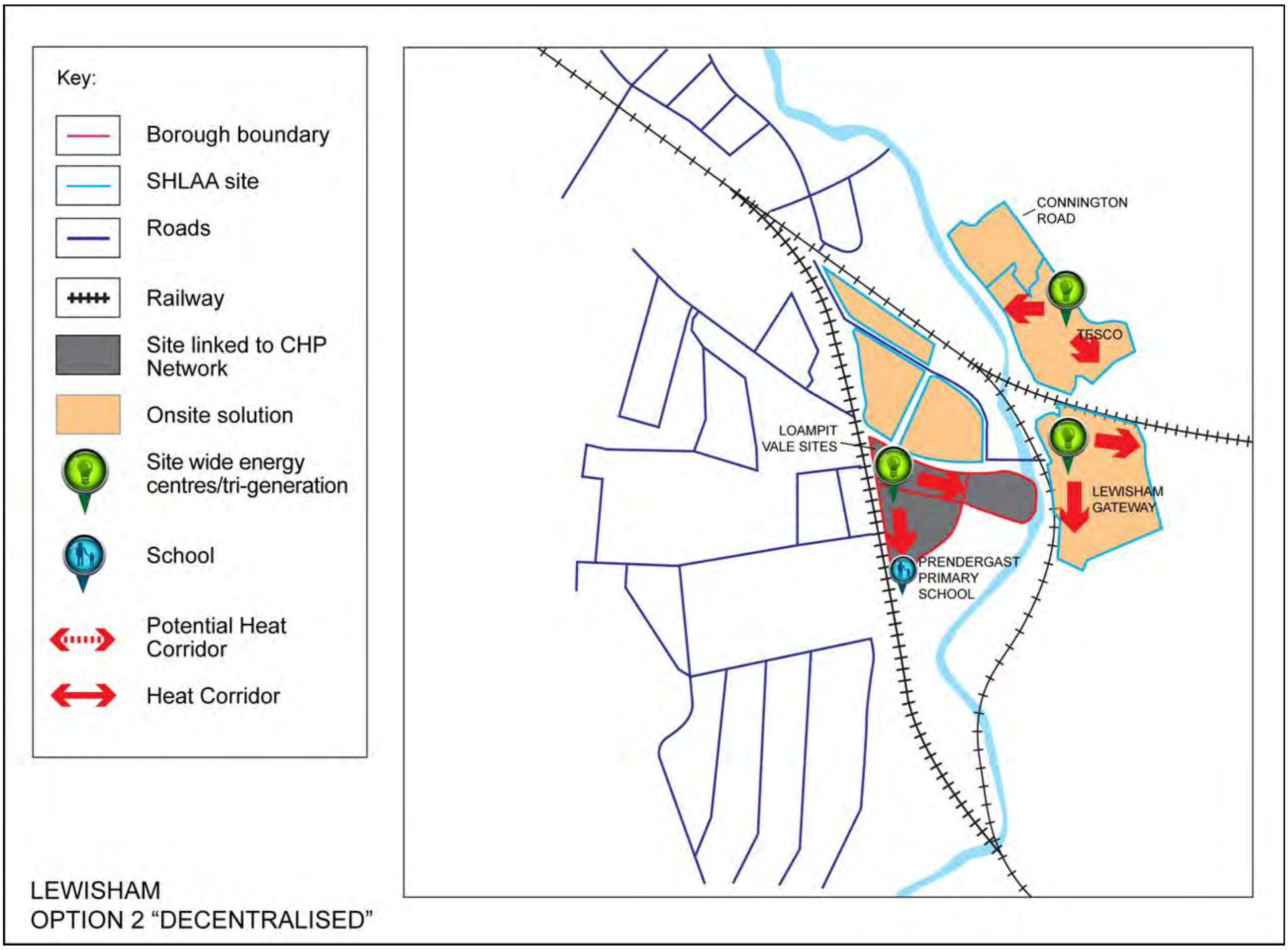

Figure 4.3 Lewisham Town Centre: Area Wide Option – Decentralised approach

Table 4.7 Lewisham Gateway: Area Wide Options

		Option 1	Option 2	Option 3
		Lewisham Gateway Biomass CHP solution	**As Option 1 + Solar PV - 10% of elec consumption Solar thermal - 50% of DHW**	**As Option 1 + CHP oversized (20%) to meet increased demand**
Technical	Thermal d/x losses	25%	25%	25%
	Electrical d/x losses	7%	7%	7%
	MWhth required	6546	4811	7855
	MWhe required	4295	3865	5153
	Baseload MWhth	1964	722	2357
	Baseload MW	0.4	0.1	0.5
	Peak MWth	1.6	1.2	1.9
	Peak MWe	1.0	0.9	1.2
	Optimum CHP capacity: heat	0.6	0.2	0.7
	Optimum CHP capacity: elec	**0.4**	**0.1**	**0.5**
	MWhth delivered by CHP	3535	1299	4242
	MWhe delivered by CHP	2357	866	2828
	% of site MWhth delivered	54%	27%	54%
	% of site MWhe delivered	55%	22%	55%
	Support boiler MW	1.0	0.9	1.2
	Woodchip tonnes/yr	2727	2005	3273
Carbon Saved	Total CO2 savings (t/yr)	2234	1649	2681
	Total CO2 savings %	**72%**	**53%**	**72%**
Capital Investment	Notional CHP Plant £	£1,963,779	£721,724	£2,356,535
	Support Biomass boiler £	£294,567	£281,473	£353,480
	Other RE investment £		£3,548,508	
	District heating pipe m	1500	1500	1500
	District heating pipe £	£450,000	£450,000	£450,000
	Grid connect £	£117,827	£43,303	£141,392
	TOTAL Capital Investment	**£2,827,673**	**£5,046,508**	**£3,302,908**
Annual Costs	Annual Fuel £	£122,736	£90,216	£147,283
	Annual O&M BB £	£1,964	£1,876	£2,357
	Annual O&M CHP £	£21,000	£21,000	£21,000
	Total Annual Costs	**£145,700**	**£113,092**	**£170,640**

4.82 From Table 4.7 the approximate size of biomass CHP system that would be suitable for the Lewisham Gateway development is a 0.4MWe system. This is a relatively small capacity system for this type of technology and a commercially ready system may be difficult to source. It is more likely that a 0.5MWe unit would be available. Option 2, which includes solar PV and solar thermal solutions, has a reduced capacity the CHP system and higher capital costs, but similar to the Deptford and New Cross analysis, the running costs are lower for this option. Access to the fuel store and positioning of the solar systems on-site may be difficult due to the limited space available for this option. It may be possible to locate the CHP system for each of the options underground, however, biomass CHP requires a substantial flue diameter and length which would need to be landscaped appropriately.

4.83 The cost of such a system to serve the proposals is likely to range between £2.8 and £5m depending on the exact solution the developer developed for the site.

Catford Town Centre

4.84 There are a number of development sites clustered around Catford Town Centre. Planning permission has already been granted for a residential led development at the former Catford Greyhound Stadium. The main opportunity for the establishment of a local energy network centres around the redevelopment of the Council's Catford civic centre campus and the adjoining land to the north. Preliminary development options have been developed for this area which would result in a comprehensive mixed use development. This could anchor a network which may be extended to serve other sites which are not anticipated to come forward for development until the longer term (post 2020).

4.85 The development option for the Catford area which has been used to develop a renewable energy strategy for the area was Option B of the Catford Town Centre Viability Appraisal study prepared by Donaldsons on behalf of the Council. The proposed development has a gross floor area of over 170,000 square metres which would also incorporate the existing Lewisham Borough Council buildings (Civic Complex) has a gross floor area of over 58,000 square metres and a new medium rise mixed use development anchored by an 8,000 sq.m foodstore. The energy consumption forecasts for the proposals are set out below and are based on energy benchmarks from CIBSE[8]. Display Energy Certificate (DEC) data was used to estimate the energy consumption for the Civic Complex. The supplied data is listed in Table 4.8 and Table 4.9 and a map of the area with proposed heat corridors is shown in Figure 4.4.

Table 4.8 Proposed development areas for Catford

Development	Area m^2	Electrical MWh/yr	Thermal MWh/yr	TOTAL MWh/yr
Shops & Pro services	29297	2417	0	2417
Offices	32380	1538	1943	3481
Residential/Flats	75230	2022	2015	4037
Education/Health	3720	74	279	353
500 carpark lots	33000	330	0	330
TOTAL	**173,627**	**6,381**	**4,237**	**10,618**

Table 4.9 Annual energy consumption of existing Council buildings in Catford Civic Complex

Development	Area m^2	Electrical MWh/yr	Thermal MWh/yr	TOTAL MWh/yr
LBL Civic Complex	58,746	7,127	9,354	16,481

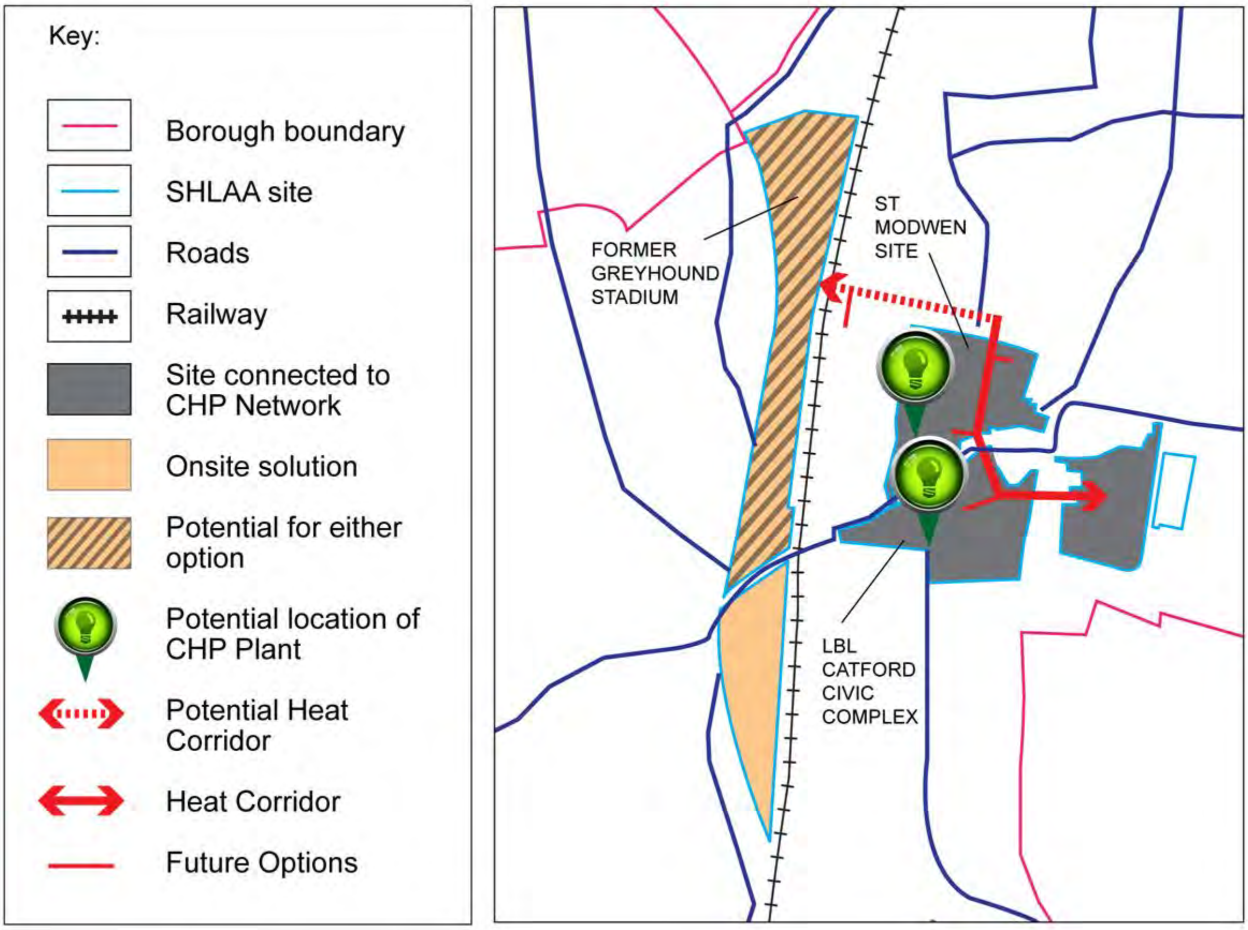

Figure 4.4 - Catford: Area Wide Options

4.86 The estimated energy demands for the proposed development along with the energy demands of the existing Council buildings were used to estimate the appropriate area wide renewable energy options. Four options were identified and are as follows:

- Option 1: Biomass CHP Energy Centre serving the proposed development only;
- Option 2: Biomass CHP Energy Centre serving the proposed development and the existing council buildings;
- Option 3: As Option 1 plus 10% solar PV, and 50% of DHW from solar thermal;
- Option 4: As Option 2 but biomass CHP Energy Centre oversized (20%) to meet future demand.

4.87 Each of the identified options would require varying levels of civil and structural works to accommodate the technologies. For Option 1, a large scale plant room and fuel store as well as the district heating network would be required. A CHP plant and backup boilers is estimated to have an area footprint of between 60-90m². This does not include the extra area required for fuel storage, which can vary significantly depending on the hours or days' operational requirement held in reserve. This will only be identified once factors such as fuel type and the frequency of deliveries have been determined.

4.88 Option 3 utilises solar thermal and solar PV technologies and it has been estimated that over 10,000m^2 of roof space would be required for solar PV to supply 10% of electricity and almost 1,500m^2 of solar thermal collectors to supply 50% of domestic hot water demand.

4.89 Option 4 anticipates and over-sizing of the CHP plant to accommodate future demand, possibly for industrial heat. This could result in a comparable increase in CHP plant footprint and fuel storage requirements.

4.90 From the figures in Table 4.10 Option 4 yields the largest sized biomass CHP system and the greatest carbon savings. The 20% over sizing of the CHP could potentially be also linked to Catford Gyratory. Creating a large heat network between the existing buildings and the proposed developments would allow for a larger annual heat load and thus a more efficient system.

4.91 Located nearby to these sites is the former Greyhound stadium that is being developed as a residential development and a further retail led mixed use scheme which is proposed for the centre of the Catford Gyratory which could potentially be linked to the heat and power networks.

Other Opportunities

4.92 There are a number of other types of development which could also be linked to area wide options such as schools, hospitals/care centres, and supermarkets. Each of these have high thermal and/or electrical demands which if linked with area wide systems can strengthen the viability of district heating and/or power schemes further. For example, hospitals/care centres have high year round thermal demands which are suitable for district wide heating system integration. Supermarkets have very high electrical demands and summer cooling is a requirement for these stores. District wide heating systems can be integrated with on-site absorption chillers to provide cooling during summer months.

Summary of potential for local energy networks

4.93 The study has identified three major local energy networks which on a technical level could be delivered within the Borough in the period up to 2025 which would be anchored by a biomass CHP or by SELCHP providing a renewable source of energy. Where feasible, renewable energy solutions serving a district or multiple buildings are preferred to individual building energy solutions. Area wide solutions are constituted by one or a few centralised plants which feed the network which enables easier management of the emissions and potential air quality impact as well as a more efficient specification of equipment and conveyance of feedstock materials. In this way it is possible to reduce the emission of air pollutants, and the resource depletion with respect to private thermal generation. Furthermore these solutions are significantly more advantageous to a developer in terms of the potential cost incurred which should deliver improved viability and or additional benefits to the community.

4.94 Another issue that must be considered when investigating area wide energy solutions is the implementation timeline. These systems may require several years of planning, design and implementation. For this reason the system should be designed in its final structure, with few possibilities for making major changes to minimise costs.[12] However, it is possible for flexibility to be designed into the system.

4.95 It has been shown that the areas of Deptford and New Cross, Lewisham Gateway, and Catford are suitable for area wide energy solutions based on a high level analysis and these areas would benefit greatly if the identified technologies were implemented. However, further investigations would be required prior to any technical decisions being finalised. The viability of these options is considered in Section 6 of this report.

[12] Verde, V., Chiara, C., "Procedures for the Search of the Optimal Configuration of District Heating Networks", Sep 2005, Int. Journal of Thermodynamics, Vol 8, No. 3

Table 4.10 Catford: Area Wide Options

		Option 1	Option 2	Option 3	Option 4
		Biomass CHP solution for proposed developments	**Biomass CHP solution for proposed & existing buildings**	**As Option 1 + Solar PV - 10% of elec consumption Solar thermal - 50% of DHW**	**As Option 2 + CHP oversized (20%) to meet increased demand**
Technical	Thermal d/x losses	25%	30%	25%	25%
	Electrical d/x losses	7%	10%	7%	7%
	MWhth required	5296	17668	4502	20386
	MWhe required	6828	14859	6145	17344
	Baseload MWhth	1271	4077	636	4893
	Baseload MW	0.3	0.8	0.1	1.0
	Peak MWth	1.3	4.2	1.1	4.9
	Peak MWe	1.6	3.6	1.5	4.2
	Optimum CHP capacity: heat	0.4	1.2	0.2	1.5
	Optimum CHP capacity: elec	**0.3**	**0.8**	**0.1**	**1.0**
	MWhth delivered by CHP	1907	6116	953	7339
	MWhe delivered by CHP	1271	4077	636	4893
	% of site MWhth delivered	36%	35%	21%	36%
	% of site MWhe delivered	19%	27%	10%	28%
	Support boiler MW	0.9	3.0	0.9	3.4
	Woodchip tonnes/yr	2207	7362	1876	8494
Carbon Saved	Total CO2 savings (t/yr)	1466	4704	1851	5645
	Total CO2 savings %	**35%**	**48%**	**44%**	**48%**
Capital Investment	Notional CHP Plant £	£1,271,051	£4,077,234	£635,525	£4,892,680
	Support Biomass boiler £	£400,381	£1,206,861	£355,894	£1,369,950
	Other RE investment £	£0	£0	£9,711,450	£0
	District heating pipe m	3000	3000	3000	3000
	District heating pipe £	£900,000	£900,000	£900,000	£900,000
	Grid connect £	£76,263	£244,634	£38,132	£293,561
	TOTAL Capital Investment	**£2,647,695**	**£6,428,729**	**£11,641,001**	**£7,456,192**
Annual Costs	Annual Fuel £	£99,301	£331,275	£84,406	£382,241
	Annual O&M BB £	£1,779	£6,034	£1,779	£6,850
	Annual O&M CHP £	£21,000	£21,000	£21,000	£21,000
	TOTAL Annual Costs	**£122,080**	**£358,310**	**£107,185**	**£410,090**

Delivery

4.96 If several developments controlled by different developers are potentially captured by a district heat network, then a consensus will need to be achieved before the project's inception as to the burden of investment (if any) to be shared amongst them before works commence. As with other infrastructure works, these should be started before construction of the development begins. However, district heating schemes embody a certain degree of flexibility in that they can be phased according to the build-out schedule of various developments. A modular CHP plant can also have its capacity increased according to incremental increase in demand, though flexibility is limited if the incremental demand is lower than what can be serviced by stages of less than around 250kWe thermal capacity equivalent. Therefore synchronisation with the development schedule will favour planning additional capacity according to larger development blocks, though individual retrofit to the district heat system is viable on an ad-hoc basis for smaller customers as this will not disrupt the demand profile significantly.

On site provision options

4.97 The local energy networks identified above have potential to serve a significant proportion of new development coming forward in the Borough in numerical terms. However there is a need to consider potential provision options for development which may come forward outside of these areas identified and for situations when an on site solution is required to provide an appropriate degree of flexibility in realising local energy targets.

4.98 As described at the beginning of this chapter seven development typologies were established to capture the range of different development sizes and characteristics identified within the Council's housing trajectory, these are:

- Individual dwelling detached/semi-detached;
- Individual dwelling terrace;
- Individual dwelling flat conversion;
- Development of dwellings 10-50 flats;
- Housing/Mixed use site >50-200 units;
- Housing/Mixed use site >200-500 units; and
- Housing/Mixed use site >500 units.

4.99 These typologies have been used as the basis to:

- Assess energy requirements and establish the range of potential on site renewable energy options which may be appropriate in connection with residential led developments in the Borough;
- Provide a basis for estimating the establishment cost of installing renewable energy options;
- Provide a basis to test the viability of renewable energy options (taking into account wider considerations of viability, affordable housing and planning obligations) (Section 6); and
- Enable appropriate policy targets to be established for new development (Section 7).

4.100 For each typology category a case study was identified within the Borough which was representative of developments within each category based on recent applications. The examples used were:

- Development of dwellings 10-50 flats - 237 Downham Way BR1 – 12 unit scheme;

- Housing/Mixed use site >50-200 units - Hindsley Place + Perry Vale – 71 unit scheme;
- Housing/Mixed use site >200-500 units - 72-78 Connington Road SE13 – 270 unit mixed use scheme;
- Housing/Mixed use site >500 units – Oxestalls Road (Not a planning application but representative of mixed use schemes within the North of the Borough).

4.101 In addition the case studies have also been used as the basis to derive Lewisham specific benchmark parameters to inform the excel based ready reckoner tool in order that a broad assessment of potential renewable/low carbon energy options and their viability can be made for any residential led development in the Borough (refer to Section 7).

Scoping of renewable energy options appropriate to the Borough

4.102 The integration of renewable energy technologies into development proposals should take place during project concept and scoping stages rather than seen as an 'add on' which is bolted on to a development at the later stages of scheme design.

4.103 A high level, general, knowledge of all renewable energy technologies is required to understand their suitability to any particular development type, size and location.

4.104 Several sources have been considered in identifying potential renewable sources which may be suitable within an urban area such as Lewisham and within the London context. These are:

- Planning for renewable Energy: A Companion Guide to PPS 22 (2004); and
- Integrating renewable energy into new developments: Toolkit for planners, developers and consultants, Mayor of London (2004).

4.105 These documents identify a range of technologies which are commercially available may be appropriate for use within an urban context these include:

- Wind turbines;
- Photovoltaics;
- Solar water heating;
- Biomass heating;
- Biomass combined heat and power;
- Ground source heat pumps; and
- Small Scale Hydro power.

4.106 A description of these technologies and consideration of the related renewable energy resource present in Lewisham for these technologies has been considered in Annex B.

4.107 Table 4.11 identifies the most important aspects of each technology typical installed capacity and approximate investment costs.

4.108 For each of the technologies considered Table 4.12 highlights specific aspects which are relevant to their application to the development typologies which have been defined. These features include general suitability, typical output, primary advantages and disadvantages.

4.109 Although it appears that average wind speeds within Lewisham are sufficient to support wind facilities (refer to Appendix B) it is unlikely that wind power will make a major contribution towards meeting overall renewable energy targets in the borough in most situations for a number of reasons:

- Local microclimate issues coupled with the presence of multi storey buildings are likely to affect local wind conditions significantly which will affect the efficiency of equipment.
- The availability of land which has the potential to accommodate freestanding wind turbines and is consistent with planning policy objectives relating to Conservation areas and Metropolitan Open Land is likely to be limited.
- Development of freestanding wind turbines will also need to be compatible with adjoining land uses and not harm residential amenity with respect to visual impact, noise and shadow flicker issues which may be difficult to achieve in many locations within Lewisham.

4.110 The most suitable locations may be within employment locations and on education sites as well as microgeneration opportunities linked with residential and householder development. Despite the limited opportunities which may exist this does not preclude wind from consideration as a potential resource where appropriate conditions exist and it is compatible with planning policy.

4.111 The potential for biomass heating and CHP also requires careful consideration as its potential as a resource is influenced by establishing a sustainable feedstock resource and a sustainable means of transporting the resource into the Borough. In addition, it is important that the provision of biomass heating or biomass CHP does not have a significant adverse effect on local air quality or compromise local air quality management strategies. If these considerations can be addressed then it represents a useful renewable resource. These issues are likely to be optimised in connection with medium and larger scale facilities where the technology tends to be more efficient and emissions can be managed more effectively.

4.112 Chapter 7 and Appendix B considers in more detail the planning, locational, design, benefits and other criteria which may be appropriate to take into account when the Council considers proposals for renewable energy development in connection with residential development or other uses and the information which should be provided by applicants when preparing their site Sustainability Strategy and Statement.

Other renewable energy technologies

4.113 There are several potential sources of renewable energy where application within Lewisham is not likely to be widespread due to the lack of opportunity. These include:

- Energy from Waste (Biological processes) – including Anaerobic Digestion, landfill and sewage gas. These technologies may be appropriate for application in the Borough. However, consultation with the Council's waste team did not reveal any existing publicly or privately operated facilities within the Borough which limits potential to establish a facility in the short term.
- Energy from Waste (Thermal processes) – including pyrolysis and gasification. The Borough already has a large scale facility of this type (SELCHP) which has been considered within the report.
- Renewable energy technology - Ground sourced cooling / borehole cooling. This technology may have application within the Borough however it is most suited to commercial/industrial developments where a specific requirement for cooling has been identified.

4.114 These technologies have not been considered in detail within this report. However, should proposals come forward for such facilities should be considered on their merits in accordance with guidance set out in PPS22 and the London Plan.

Guidance on the selection of appropriate technologies

4.115 Guidance set out in PPS 22 Renewable Energy is clear that local planning authorities should not make assumptions about the technical and commercial feasibility of renewable energy projects which are proposed for development. Technological change can mean that sites excluded as locations for particular types of renewable energy development may in future be suitable.

4.116 PPS 1 Supplement identifies that applicants for energy development should not need to demonstrate either the overall need for renewable energy or its distribution, nor question the energy justification for why a proposal for such development must be sited in a particular location.

4.117 However, para 33 of PPS1 Supplement is clear in identifying that in establishing appropriate local and site level targets local authorities should ensure:

- What is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities;
- In the case of housing development and when setting development area or site-specific expectations, demonstrate that the proposed approach is consistent with securing the expected supply and pace of housing development shown in the housing trajectory required by PPS3, and does not inhibit the provision of affordable housing.

4.118 Particularly in the case of renewable energy projects proposed in conjunction with residential development it is appropriate for the Council to give proper consideration to what has been proposed including verifying the appropriateness of technical solutions. Further guidance on what information the council should use to evaluate whether proposals are suitable and guidance on the comparison of different proposals is set out in Chapter 7.

4.119 The remainder of this chapter identifies assumptions regarding the cost of establishing renewable energy provision in conjunction with residential led development within the Borough. These cost assumptions are then used to inform the assessment of viability undertaken in Chapter 6.

Table 4.11 On-site renewable energy: General siting criteria and feasibility considerations

Technology	Typical installed system cost (£)	Technology considerations	Typical Output	Retrofit issues	Primary Advantages (Generic)
Solar thermal Hot Water	Typical single dwelling system: £2,000-£2,500 (flat plate). £3,000 - £3,500 (evacuated tube).	South or southwest facing, un-shaded pitched roof is optimal. Can be installed on flat roofs or vertical facades. Requires a hot water storage tank with a solar coil. Can be integrated with conventional gas boiler or immersion heater for temperature boost when required. Evacuated tubes more efficient but slightly more expensive and are more susceptible to breakages than flat plate collectors.	A typical 4m2 system can produce >50% of the typical family hot water demand over the year. Should provide all the hot water requirements in summer, but an additional source of heat required in the winter.	South or southwest facing roof required. Roof needs to be structurally sound to support weight of panels. Centralised domestic hot water system required. New (larger) water tank required which includes a solar coil.	Free & unlimited resource. Low maintenance Can provide 40-60% of a dwelling's annual hot water requirements. If maintained, can have life spans of over 20 years.
Solar Photovoltaic	Average of £12k for a typical 2kW system (average domestic installation).	Technically viable on any building with south to southwest facing roof, ideally tilted between 30° and 40° from the horizontal. (Tilt between 10° and 50° still gives 90% of the optimal. South facing vertical facades generate about 70% of the optimum.) Need to avoid shading from chimneys, trees, satellite dishes. Crystalline solar panels are by far the most common and are the most efficient. "Thin film" types are less efficient and require more area for the same power output, but look more like coloured glass panes and so can be architecturally very attractive. Solar roof tiles are also available that look like ordinary roof tiles, but these are more expensive. PV panels can also be mounted on frames for buildings with flat roofs.	A typical 2kW system will take up around 14m2 and produce around 50% of the annual electricity demand of an energy conscious family. On average, a system will produce 850kWhpa per installed kW.	PV panels are heavy, and so buildings should be checked that they are structurally strong enough to support the weight. Care needs to be taken to ensure water tightness where the supporting structure for the PV requires penetration of the existing roof. Accessible space needs to be allowed for the electronic inverter and other electrical components.	Free & unlimited resource Low maintenance electrical generation. Easiest form of RE electrical generation to integrate into an urban building
Building Mounted Turbines (<2kW)	Up to 2kW maximum power. £1500-£4000/kW installed capacity	Building mounted wind turbines can either be of the horizontal or vertical axis type. The horizontal axis type are similar to most wind turbines seen across the British countryside, but much smaller. The vertical axis type can be less visually obtrusive and some types are even hidden inside a box. Vertical axis type are less efficient but better able to cope with turbulent conditions. Building mounted turbines are usually secured to gable end walls. Building must be structurally strong enough to withstand vibrations from turbine in high winds. Turbine blades should be placed above any obstructions	Output highly site dependent, 2000-5000 kWh per annum maximum for a 2kW turbine	Most systems are relatively lightweight but care must be taken that the building can support the turbine and that the turbine has access to a good wind resource	Free & unlimited resource Relatively low maintenance. High visibility to provide symbol of Green credentials Can operate in lower wind speeds than larger wind turbines.
Freestanding (Tower) Wind Power (Micro/Small) <100kW	Up to £1500-£4000/kW installed capacity	The smaller turbines in this range are usually sited on small masts and as a result they suffer from turbulent, low wind speeds that are typical in urban environments. Output might be much less than expected due to local wind conditions. The effect of this is that a turbine is likely to struggle to repay its' costs over its operational lifetime. Unfortunately the wind regime in the East of England is the least powerful in the United Kingdom, and so financial returns will be poorer than in better areas. Individual sites could be used provided there is somewhere relatively unobstructed, but typically projects will be of a community scale and may include local retail centres, allotments etc. Wind flow in the urban environment is typically complex and this reduces the yield to the extent that many projects are more about PR value than payback	Output highly site dependent, 20 - 50 MWh per annum maximum for a 20kW turbine	Ensuring that the turbines have clear access to the wind resource and that there is access for installation and maintenance. Distance from turbine to point of use is also a consideration, as long cable runs will increase project cost.	Free & unlimited resource Relatively low maintenance. High visibility to provide symbol of Green credentials Can operate in lower wind speeds than larger wind turbines.
Freestanding (Tower) Wind Power (Medium/Large) 100kW - 2MW	£1500-£2500/kW installed capacity	The installation of these is much more involved than with smaller wind turbines, but the returns are far better. Although they only have a small footprint, Health and Safety considerations in a built up environment make them difficult to site responsibly. But there may be opportunities in non-residential areas for one or two turbines. Unfortunately the wind regime in the East of England is the least powerful in the United Kingdom, and so financial returns will be poorer than in better areas.	A large (750kW) turbine could produce 1,200 - 1,800MWhpa.	Very few expected sites. Consider some industrial estates away from residential areas but it is likely that other constraints (including MOD, radar and airports) will remove these development options. Projects are not suited to individual dwellings but may be incorporated as part of a wider development plan provided there is suitable distance to residential dwellings and no other statutory constraints	Free & unlimited resource. The most economically attractive form of Renewable Energy generation in the UK. The UK has a huge wind resource (over 40% of the European total)
Ground Source Heat Pump (s)	Typical single dwelling systems range from 6-12kW. Prices range typically from £8,000 - £12,000 excluding heat distribution system (under floor heating)	The space available for the external sub soil heat exchanger will determine the system (borehole or shallow horizontal system) used. Where there is adequate free space, horizontal systems can be used, but in built up areas where land area is at a premium, more expensive borehole systems are more common. Higher efficiencies (COP) are achieved with the system delivering the heat at 30-35 °C, which is best suited for under floor heating. This low delivered temperature of heat means that insulation levels and air tightness are very important. Centralised heat stores, heated primarily by the GSHPs are now becoming common place. The heat pump system can also be used in a passive mode to provide highly efficient summer time cooling to the buildings, whilst also increasing the energy stored in the ground for use later in the year. Heat pump systems are well suited to Demand side management and reduced off-peak electricity tariffs. For high rise buildings there are additional costs for pumping the heat to required heights, and the associated pipe losses. Consideration also needs to be given to how residents are charged for the heat that they use. This type of system supplying several homes is only likely be feasible where building is centrally owned and run. When utilising boreholes consideration will need to be given to sub surface conditions and structures such as tube lines, sewers and other infrastructure.	A correctly sized system can supply 100% of a dwellings space heating requirements and contribute 60% towards hot water requirements, typically with a temperature boost provided by an electric emersion coil. Sizes can range from system for a single dwelling to a large system for a whole housing estate.	Sufficient space is required to install the sub soil heat exchangers, (Boreholes require at least 9 meters between them with the depth and so number required determined by local conditions and costs). Older properties are unlikely to have sufficient levels of insulation and air tightness, these will need to be improved as the temperature of the delivered heat to the internal spaces is much lower than a standard heating system. Heat is most effectively delivered using under floor heating but this can be difficult to retrofit. Low temperature radiators can also be used but are less efficient and can take up a lot of space. Sound insulation may also be required for Heat Pump if it is located internally so as not to disturb inhabitants.	GSHPs provide 3 to 4 units of heat for every unit of electricity used in their operation. Utilise a renewable resource (effectively solar energy that has been stored in the ground) Provide a reliable heat source with fairly constant efficiencies due to relatively stable annual ground temperatures. Can be run in off-peak electricity periods and still deliver required heat with substantially reduced running costs. Ideally suited for proposed variable rate tariffs and smart metering.
Air Source Heat Pump (s) and Heat recovery based on exhaust air systems	Install cost for a domestic ASHP is approx £3k -£5k. A correctly sized system can supply 100% of a dwelling's space heating and DHW requirements. Supplying the DHW to in excess of 60°C will reduce the efficiency of the system.	ASHPs are suitable for installation in single or multiple dwellings. There are two main categories of ASHP: Air to Air, and Air to Water. Air to Water heat pumps are similar to GSHPs in that they operate most efficiently in well insulated buildings with underfloor heating. The major selling point for these systems is that require little space for installation, unlike their ground source counterparts. Air to Air heat pumps are installed in buildings with building heating systems utilising air. ASHPs that contribute to the hot water supply will require an associated hot water tank with an immersion heater to boost the domestic hot water temperature if required. In general, the efficiency of ASHPs is less than that of GSHP but this is offset by the lower capital investment associated with ASHP. In addition, heat recovery mechanical ventilation systems incorporating heat pumps are also available that can be considered for some dwelling types.	A correctly sized system can supply 100% of a dwellings space heating requirements and contribute 60% towards hot water requirements, typically with a temperature boost provided by an electric emersion coil. Sizes can range from system for a single dwelling to a large system for a whole housing estate.	As with GSHP under floor heating is the best means of heat delivery. It is likely that the building fabric will need to be upgraded to increase insulation and air tightness. The units can also be installed to support the existing heating system with the gas boiler used as a boost when required but this should only be considered on a site by site basis.	ASHPs provide 2-4 units of heat for every unit of electricity used in their operation. Utilise a renewable resource (effectively solar energy that has been stored in the air) Relatively straight forward to install.
Biomass Boiler (s) for space heating and hot water	Pellet fuel boilers cost range from £5,000 to £14,000 depending on size and distribution system size. There are also wood fuelled space heaters (stoves) which emit heat into the space they are installed only. These cost in the region of £2000-£5000.	Some of the key consideration for this technology concern the availabilty of space for the biomass system, incorporating fuel store, along with the delivery of the biomass fuel. Lewisham has 4 large AQMA's declared for PM10 and NO2, in addition the whole borough has been declared a 'Smoke Control Area'. As a result any pellet boilers will need to be approved under the Clean Air Act. Wood chips will not be acceptable as their moisture content and composition cannot be guaranteed. Pellet boilers with automatic feeds are now available in a size that is suitable for individual domestic properties. Developers should take into account that the fuel hoppers still need refilling by hand (often from bags) which may not be suitable for elderly or disabled people and may be offputting for others. In addition the ash (typically 2-3% of fuel volume) will need to be emptied and disposed of. These latter problems are less of a concern where centrally located and run as large fuel stores are used and ash removed as part of a contract or by maintenance personnel . The majority of fuel will be brought into the borough from outside of London and potentially even the UK.	Pellet boilers can provide 100% of the space and DHW requirement of a property. Wood burning stoves can also be used as a top up to another form of heating. Communal systems serving multiple buildings are particularly attractive as they bring economies of scale and centralised storage systems are much easier to locate and manage.	Pellet boilers require internal or external space for the boiler and storage. The connection to the existing heating system will need to considered to ensure a balanced system. Retrofitting wood burning stoves works well where there is an existing chimney that can be lined (liner required by building regs). Where no chimney is present a dedicated flue can be used. Care will need to be taken when positioning the flue to ensure emissions do not cause problems with other dwellings.	Provides a 'carbon neutral' heat source. Fuel is a renewable resource, and is in the UK. Is also imported. Provides a reliable energy supply
Combined Heat and Power system	£1200-£1800 / kW	A CHP system will typically generate between 1.5 and 2 units of heat energy for every 1 unit of electricity. The economics are determined by the availability of a large heat load, as all electricity generated can either be consumed on site or exported. Such a load may need to be found outside of residential dwellings. For example, hospitals, hotels, leisure centres and swimming pools are all worth investigation as users of the heat. CHP can also be used for cooling in addition to heating, (trigeneration) which can be used for air conditioning or large refrigeration users such as supermarkets. Buildings utilising the heat will no longer require their own boiler, although may retain one for periods of CHP maintenance or times of particularly heavy demand. Care must be taken to reduce noise to an acceptable level, but there are established techniques to manage this.	Depending on size, CHP can provide all or most of the electricity and heat to anything up to an entire district. Micro CHP systems have recently been launched that are suitable for single dwellings but are generally operated to match heat load and thus an electrical network connection is required when heat load is low.	Most suited to industrial/commercial or multi-residential installations. For multiple building installations heat distribution pipes will need to be installed, this could cause considerable disruption.	Low carbon technology. Reliable and proven technology. Integrates well with the existing energy infrastructure. Can be highly efficient across the full year.
Biomass Combined heat and power system	£4000-£7000 /kW	Performance and installation considerations similar to conventional CHP systems, but in addition the on site storage of fuel requires considerable space.	Depending on size, CHP can provide all or most of the electricity and heat to anything up to an entire district.	Same issues as with conventional CHP but also large space required for wood storage.	Zero carbon technology. Can be highly efficient if year round heat load exists at or near to the site.

Table 4.12 On-site renewable energy: Factors affecting suitability of renewable energy options

Technology	General suitability - Individual Dwelling, semi-detached/detached	General suitability - Individual Dwelling, terrace	General suitability - Individual Dwelling, flat conversion	General suitability - Development of dwellings: 10 to 50 flats	General suitability - Housing/Mixed use sites: 50 to 200 units	General suitability - Housing/Mixed use sites: 200 to 500 units	General suitability - Housing/Mixed use sites: 500+ units	General suitability - Redevelopment of employment sites
Solar thermal Hot Water	Typically suitable for all lower density dwellings with suitable roof space/orientation. This technology can also complement other technologies, especially where integrated with thermal stores	No change from semi-detached/detached typology	The suitability of this technology for this building type will be dependent on the dwelling having access to a suitable roof space. The roof space may be shared and not under the control of the building owner. If there is suitable available roof space, consideration is required as the ratio of dwelling floor area to roof space is low for high density dwellings, consequently SHW installations will be more limited in size per dwelling. Suitable facades can be utilised which include SHW, however to be effective these must remain un-shaded for significant periods of the day	As the ratio of dwelling floor area to roof space is low for high density dwellings, SHW installations will be more limited in size per dwelling. Suitable facades can be utilised which include SHW, however to be effective these must remain un-shaded for significant periods of the day. This technology can also complement biomass and heat pump technologies, especially where integrated with thermal stores	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.
Solar Photovoltaic	Technically viable on any building with a south (within 45 degrees of the Azimuth) facing roof, ideally tilted 30-40 degrees from the horizontal. The economics of solar PV are heavily reliant on capital and ongoing financial support. The likely forthcoming feed in tariffs may make PV economically viable within a few years.	No change from semi-detached/detached typology	As with solar thermal hot water systems, the same considerations regarding available roof space are key for a single flat conversion.	As the ratio of dwelling floor area to roof space is low for high density dwellings, PV installations will be more limited in size. Suitable facades can be utilised which include PV, however to be effective these must remain un-shaded for significant periods of the day. The economics of solar PV are heavily reliant on capital and ongoing financial support. The likely forthcoming feed in tariffs may make PV economically viable within a few years.	Same general considerations as 10 to 50 flat development typology. In addition, Solar PV is very suited to buildings with a year round daytime electrical demand (commercial buildings) which have un-shaded roof space. Economics of solar PV are heavily reliant on capital and ongoing financial support.	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.
Building Mounted Turbines (<2kW)	Building mounted turbines are suited to detached or semi-detached houses where the turbine mast can be bolted to the gable end. However, consideration is required as wind turbines are generally impractical within an urban environment due to low wind speeds and turbulence/shadows associated with the built environment. This is a very site specific solution and energy returns from building mounted turbines are questionable	This type of technology is not typically suitable for an individual terrace dwelling, as they are usually fitted to gable end walls. Where a suitable position to secure the unit is available, the same considerations as a semi-detached/detached dwelling need to be observed.	This type of technology is not generally suitable for a single flat conversion.	Multiple building mounted turbines (<2kW) are typically unsuitable for this type of development. Micro/Small scale wind systems (detailed below), bolted to the building, could be more suitable. However the vibration impact on the building may be significant.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	Small scale wind could be included on the roof tops of commercial or industrial buildings. Site specific technology so wind monitoring should be undertaken prior to installation
Freestanding (Tower) Wind Power (Micro/Small) <100kW	Micro and Small scale wind turbines are generally impracticable within an urban environment due to low wind speeds and turbulence/shadows associated with the built environment. There may be a few sites that could cater for this type of technology, where there is suitable land space to house the turbine. In general this type of technology is not typically suitable for an individual urban dwelling.	No change from semi-detached/detached typology	This type of technology is not generally suitable for a single flat conversion.	If an exposed open space can be found nearby to site a freestanding turbine may be able to contribute to the energy supply of the site. However such locations are more the exception than the norm in urban environments. Small scale wind could be included on the roof tops of many high density dwellings in particular blocks of flats or apartments and wind speeds will benefit from high rise buildings. The appropriate siting can be key to maximising yields as the wind profile on roofs can often be building specific. However the vibration impact on the building may be significant.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.
Freestanding (Tower) Wind Power (Medium/Large) 100kW - 2MW	This type of technology is not suitable for an individual dwelling.	This type of technology is not suitable for an individual dwelling.	This type of technology is not generally suitable for a single flat conversion.	Limited sites within Lewisham due the urban nature of the borough and the proximity with Airports and the associated flight paths. Such turbines are more likely to be part of any future offsite contribution.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.
Ground Source Heat Pump (s)	May be suitable for occasional dwellings, dependent on appropriate ground conditions and sufficient land to locate sub soil heat exchanger. Space to locate the heat pump unit and domestic hot water storage tank can also be an obstacle in some residences. Due to the typical minimum size of a GSHP system, this type of technology is typically suited to properties with a floor area >250m2.	No change from semi-detached/detached typology	This type of technology is not generally suitable for a single flat conversion.	Very suitable providing space is available for sub soil heat exchanger For high rise buildings there are additional costs for pumping the heat to required heights and associated pipe losses. Consideration also needs to be given to how residents are charged for the heat that they use. The above is only likely be feasible where building is centrally managed.	Very suitable providing space is available for sub soil heat exchanger For high rise buildings there are additional costs for pumping the heat to required heights and associated pipe losses. Consideration also needs to be given to how residents are charged for the heat that they use. The above is only likely be feasible where building is centrally managed. Larger development will most likely require multiple heat pumps combined with bore hole collectors.	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.	If sufficient space for sub soil heat exchanger and GSHP unit then it may be applicable. Listed buildings may prove difficult to achieve required insulation levels and air tightness. Worthy solution if cooling is required in summer.
Air Source Heat Pump (s) and Heat recovery based on exhaust air systems	This technology type is suitable for installation to single dwellings, the main considerations are that they are visible and have noise emissions so will need to be located appropriately. Heat pumps that provide hot water will require an associated hot water tank and are most suited to supply either under floor heating or oversized radiators.	No change from semi-detached/detached typology	This technology type is suitable for installation to single dwellings, the main considerations are that they are visible and have noise emissions so will need to be located appropriately. Heat pumps that provide hot water will require an associated hot water tank and are most suited to supply either under floor heating or oversized radiators. Good levels of insulation and air tightness within the building required.	Multiple systems of this technology type are suitable for installation to multiple dwellings or as a community based system. Otherwise, same considerations as Individual dwelling: flat conversion	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	No change from development of dwellings: 10 to 50 flat typology.	Refer to previous comments regarding suitability to under floor heating. Also, Air to Air heat pumps can be installed for air heated buildings.
Biomass Boiler (s) for space heating and hot water	Biomass boilers are suitable for individual dwellings which have adequate space for the system and fuel store. However, the cost and availability of biomass increases substantially in line with transportation distances.	This type of technology is not generally suitable for a individual terrace dwelling due to limited space for fuel store and if space is available, access to the fuel store can be difficult.	Individual flats are unlikely to be able to install biomass technologies due to issues with flue placement and fuel deliveries	A community based system utilising centralised Biomass boilers may be suited to low density urban dwellings where the associated infrastructure and plumbing are standard. Larger boilers will generally be more economical, although a few smaller boilers can provide overall annual efficiency gains and backup for maintenance periods.	A community based system utilising centralised Biomass boilers may be suited to high density urban dwellings where the associated infrastructure and plumbing are standard. Potential for even greater economies of scale, particularly as development size increases. Centrally located plant could potentially have multiple boilers and fuels providing greater continuity of supply in the event of plant maintenance/failure or fuel supply problems	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.
Combined Heat and Power system	Typically unsuitable for individual dwellings. However, Micro systems could be viable from 2012 - 2013	No change from semi-detached/detached typology	This type of technology is not generally suitable for a single flat conversion.	CHP is not typically suitable for a development of this scale as the existence of a base heat load is key to the CHP economics	CHP is suitable for mixed use sites if a year round heat demand exists, such as leisure centres or industrial processes. Applicability needs to be assessed on a site by site basis	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.	No change from Housing/Mixed use sites: 50 to 200 unit typology.
Biomass Combined heat and power system	Unsuitable for individual dwellings.	No change from semi-detached/detached typology	No change from semi-detached/detached typology	Biomass CHP is not typically suitable for a development of this scale as the existence of a base heat load is key to the CHP economics	A biomass CHP system small enough to cater for this scale of development is not presently commercially available.	Biomass CHP is suitable for mixed use sites of this scale if a year round heat demand exists, such as leisure centres or industrial processes. Applicability needs to be	No change from Housing/Mixed use sites: 200 to 500 unit typology.	No change from Housing/Mixed use sites: 200 to 500 unit typology.

Modelling of costs and potential renewable energy target levels

4.120 The provision of on-site renewable energy technologies for seven development typologies representative of all residential development in the Borough has been investigated.

4.121 A series of scoping tables have been devised which provide a basis to establish the most appropriate renewable energy technologies that should be considered for proposed sites in terms of scale and suitability and establish the likely capital cost of provision.

4.122 To establish the costs the following steps were taken:

- Step 1 – Establish estimated annual energy demand for each category of development assuming conventional supply from the grid;
- Step 2 – Calculate baseline carbon emissions of the development;
- Step 3 – Calculate the potential contribution of each renewable energy technology;
- Step 4 – Calculate the costs of each technology; and
- Step 5 – Calculate the reduction in carbon emissions of the development and subtract from the baseline.

4.123 Tables have been prepared for different levels of renewable energy generation as a % of total energy required. Requirements have been established for the renewable energy component to be 10%, 20%, 30%, 40%, or 50% of overall energy. The associated level of CO_2 linked to each technology is provided in Appendix B.

4.124 To assess each of the seven identified generic typologies for the provision of renewable energy, assumptions were made on development area and energy consumption.

Energy benchmarks

4.125 Table 4.13 shows the energy benchmarks assumed for residential and for non-residential use. The residential energy assumptions consider that all new homes will be built to at least Level 4 of the Code for Sustainable Homes. As the type of commercial facilities that may be integrated into the mixed use sites is not known at the early stages of planning an average energy consumption figure for non residential uses has been derived based upon consideration of uses commonly included within residential mixed use schemes in the Borough and using energy benchmarks available from CIBSE[8].

4.126 The average was taken across the following building types: general office; high street agency, general retail; large non-food shop; small food store; large food store; restaurant; bar; cultural activities; fitness centre; public building; school; clinic; and workshop. It is recognised that not all of these buildings will be integrated into every development, but in the absence of specific information a mean represents an appropriate approach.

Table 4.13 Energy benchmarks assumed for on-site provision options

Type	kWh/m2 yr	kg CO2/m2 yr
Residential – electrical	69	39
Residential – thermal	73	14
Non-residential – electrical	128	69
Non-residential – thermal	171	32

4.127 The typical typologies and their respective floor area and energy assumptions used in the analysis are shown in Table 4.14.

Table 4.14 Assumed energy consumption for generic typologies

Generic Typology	Development Case Study Example	Gross Floor Area m^2	Total kWh/yr	Total tCO2/yr
Individual dwelling Detached/semi-detached		160	22,788	8.1
Individual dwelling Terrace		105	14,955	5.3
Individual dwelling Flat conversion		65	9,258	3.3
Development of dwellings 10-50 flats	Downham Way	930	132,456	47.2
Housing/Mixed use site >50-200 units	Hindsley Place	5,065	1,145,969	335.8
Housing/Mixed use site >200-500 units	Connington Rd.	16,355	2,345,721	839.5
Housing/Mixed use site >500 units (excluding CHP)	Oxestalls Rd.	100,300	16,945,816	5,938.4

Cost estimates

4.128 The estimates of energy consumption for each typology were used to approximate the capital cost necessary to meet various renewable energy targets. The costs are based on a cost per kW installed for each renewable energy technology. The assumed costs per kW are set out in Table 4.15 and shows low, high and average costs per kW. The three levels of cost relate to the economy of scale realised when installing these technologies.

4.129 In considering appropriate assumptions lower, average or high assumptions have been selected based upon the scale of development served.

Table 4.15 Assumed costs per kW installed for each technology

Technology	Average (£/kW)	High (£/kW)	Low (£/kW)
Solar PV	6500	8000	5000
Wind Power	2000	3000	1000
Small Scale Hydro	5500	8000	3000
Solar Thermal	1445	1714	1176
Biomass Boiler	600	800	400
GSHP[13]	1000	1200	800
ASHP	850	1200	500
CHP	1500	1800	1200
Biomass CHP	5500	7000	4000

4.130 The quoted figures are typical but site conditions can add lead to significant variability the level of investment required. The costs used have reflected typical conditions likely to be experienced in the Borough.

4.131 The specific cost components included for each technology are:

- Solar PV (PV): collectors, roof brackets, inverter, cabling, installation
- Wind Power: turbine, generator set, tower, installation

[13] Note: GSHP cost per kW excludes the costs of the heat collector system (slinky or borehole) as this can vary greatly from site to site.

- Small scale Hydro (SHP): turbine, generator set, weir, civil works, powerhouse, installation,
- Solar thermal or solar hot water (SHW): collectors, roof brackets, connection piping, hot water tank, installation
- Biomass boiler (BB): boiler, accumulator tank, fuel train, storage, installation
- Ground Source Heat Pump (GSHP): heat pump only
- Air Source Heat Pump (ASHP): heat pump, hot water tank, installation
- Micro Combined Heat and Power (CHP): CHP unit, installation
- Biomass CHP (BCHP): CHP unit, fuel train, storage, civil works, installation

4.132 The assumed costs should be taken as guide for considering general feasibility issues. A developer would be expected to carry out a detailed site assessment to determine renewable energy investment costs for a particular site.

Selection of possible renewable energy portfolio options

4.133 The matrices in Tables 4.16-4.21 show the possible renewables technologies which may be considered for different development typologies reflecting the findings of Tables 4.11 and 4.12 and Appendix B.

4.134 The different components have been colour coded according to primary and secondary suitability. Technologies highlighted in green have been identified as the primary solutions which are likely be the most suitable renewable energy technology for that particular development typology at that particular % level of renewable energy contribution.

4.135 Secondary technologies, highlighted in yellow, would also be suitable either combined with or as an alternative to the primary recommendation. The third type of recommendation is colour coded into white cells and these solutions may also be suitable for a particular typology, but it would be very much dependent on local site conditions. Finally, there are a number of blank cells in the tables and these indicate technologies which would not normally generally suitable for that particular development typology.

4.136 Further information for each of the typologies and the contribution of renewable energy technologies can be found in Appendix C. The tables shown in that appendix include details such as: the recommended capacity for each solution; the maximum kWh produced by the system; the percentage of renewable energy provided by each system to each typology; and the tonnes and percentage of carbon emissions saved per annum.

Using the cost tables

4.137 The matrices can be used to investigate the capital required to integrate renewable energy technologies with development. Different tables may be referred to depending on the % of energy requirements to be met from on site renewables.

4.138 The user firstly decides what level of renewable energy contribution is required/desired, i.e. 10%, 20%, 30%, 40% or 50%. The user then selects which typology of development is being investigated, e.g. “Housing/Mixed use site >50-200 units”. The approximate investment cost for each technology under the specified typology and floor area is shown in the adjacent cells.

4.139 The user can apply the scoping tables to their own particular proposed development by scaling up or down from the floor areas of the typologies given. As an example, consider typology “Development of dwellings 10-50 flats” in Table 4.17. The estimated energy consumption is 132456kWh/year based on a floor area of 930m^2. If the user wishes to assess a slightly larger development of 30 flats with a total floor area of 1950m^2, then the estimated investment costs for the identified renewable energy technologies can be scaled up by a factor of 1950/930 for this particular example.

Table 4.16 Technology recommendations key

(green)	Primary technologies - typically suitable for this portfolio
(yellow)	Secondary technologies - alternative solutions that would be suitable for this portfolio but combined with other solutions
£9,999	This technology solution may be suitable for this portfolio depending on site conditions.
(blank)	This type of technology is typically unsuitable for this portfolio
(orange)	**SHW** should only be selected if **CHP/BCHP** is discarded from the chosen portfolio mix

Table 4.17 Renewable Energy scoping: 10% Contribution

10% Contribution from Renewables

						10%								
						Power			Heat				CHP	
Use Class	**Generic Typologies**	**Development Example** (Where applicable)	**Development example** (m2)	**Total kWh/yr**	**RE contribution** (kWh)	**PV**	**Wind**[1]	**SHP**[2]	**SHW**[3]	**BB**	**GSHP**[4]	**ASHP**	**CHP**	**BCHP**
C3	Individual dwelling detached/semi-detached		160	22788	2279	£24,307	£3,902		£3,751	£8,000		£3,600		
C3	Individual dwelling terrace		105	14955	1495	£15,952			£2,462			£3,600		
C3	Individual dwelling flat conversion		65	9258	926							£3,600		
C3	Development of dwellings 10-50 flats	Downham Way	930	132456	13246	£114,795	£15,120	£15,120	£17,261	£13,699	£11,214	£17,467		
C3	Housing/Mixed use site >50-200 units	Hindsley Place	5065	721384	72138	£625,200	£82,350	£82,350	£94,009	£55,957	£61,074	£95,128	£27,052	
C3	Housing/Mixed use site >200-500 units	Connington Road	16355	2345721	234572	£1,563,814	£133,888	£146,060	£225,243	£121,304	£158,876	£181,956	£70,372	£250,210
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	e.g. Oxestalls Road	100,300	16945816	1694582	£11,297,211	£967,227	£1,055,157	£1,627,189	£876,319	£1,147,739	£1,314,478		

Table 4.18 Renewable Energy scoping: 20% Contribution

20% Contribution from Renewables

						20%								
						Power			Heat				CHP	
Use Class	**Generic Typologies**	**Development Example** (Where applicable)	**Development example** (m2)	**Total kWh/yr**	**RE contribution** (kWh)	**PV**	**Wind**[1]	**SHP**[2]	**SHW**[3]	**BB**	**GSHP**[4]	**ASHP**	**CHP**	**BCHP**
C3	Individual dwelling detached/semi-detached		160	22788	4558	£48,615	£7,804		£7,502	£8,000		£8,485		
C3	Individual dwelling terrace		105	14955	2991	£31,903			£4,923			£5,568		
C3	Individual dwelling flat conversion		65	9258	1852							£3,447		
C3	Development of dwellings 10-50 flats	Downham Way	930	132456	26491	£229,590	£30,241	£30,241	£34,522	£27,399	£22,428	£34,933		
C3	Housing/Mixed use site >50-200 units	Hindsley Place	5065	721384	144277	£1,250,399	£164,700	£164,700	£188,017	£149,220	£122,148	£190,255	£54,104	
C3	Housing/Mixed use site >200-500 units	Connington Road	16355	2345721	469144	£3,127,628	£267,776	£292,120	£450,487	£242,609	£317,751	£363,913	£140,743	£500,421
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	e.g. Oxestalls Road	100,300	16945816	3389163	£22,594,421	£1,934,454	£2,110,313	£3,254,378	£1,752,638	£2,295,478	£2,628,957		

Table 4.19 Renewable Energy scoping: 30% Contribution

30% Contribution from Renewables

Use Class	Generic Typologies	Development Example (Where applicable)	Development example (m2)	Total kWh/yr	RE contribution (kWh)	30%								
						Power			Heat				CHP	
						PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached		160	22788	6836	£72,922	£11,706		£11,253	£8,000		£12,727		
C3	Individual dwelling terrace		105	14955	4486	£47,855			£7,385			£8,352		
C3	Individual dwelling flat conversion		65	9258	2777							£5,170		
C3	Development of dwellings 10-50 flats	Downham Way	930	132456	39737	£344,384	£45,361	£45,361	£51,784	£41,098	£33,642	£52,400		
C3	Housing/Mixed use site >50-200 units	Hindsley Place	5065	721384	216415	£1,875,599	£247,049	£247,049	£282,026	£167,872	£183,222	£285,383	£81,156	
C3	Housing/Mixed use site >200-500 units	Connington Road	16355	2345721	703716	£4,691,443	£401,665	£438,180	£675,730	£363,913	£476,627	£545,869	£211,115	£750,631
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	e.g. Oxestalls Road	100,300	16945816	5083745	£33,891,632	£2,901,681	£3,165,470	£4,881,567	£2,628,957	£3,443,217	£3,943,435		

Table 4.20 Renewable Energy scoping: 40% Contribution

40% Contribution from Renewables

Use Class	Generic Typologies	Development Example (Where applicable)	Development example (m2)	Total kWh/yr	RE contribution (kWh)	40%								
						Power			Heat				CHP	
						PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached		160	22788	9115	£97,229	£15,608		£15,005	£9,428		£16,970		
C3	Individual dwelling terrace		105	14955	5982	£63,807			£9,847			£11,136		
C3	Individual dwelling flat conversion		65	9258	3703							£6,894		
C3	Development of dwellings 10-50 flats	Downham Way	930	132456	52982	£459,179	£60,482	£60,482	£69,045	£54,797	£44,856	£69,867		
C3	Housing/Mixed use site >50-200 units	Hindsley Place	5065	721384	288554	£2,500,799	£329,399	£329,399	£376,035	£298,440	£244,297	£380,510	£108,208	
C3	Housing/Mixed use site >200-500 units	Connington Road	16355	2345721	938289	£6,255,257	£535,553	£584,239	£900,973	£485,217	£635,502	£727,826	£281,487	£1,000,841
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	e.g. Oxestalls Road	100,300	16945816	6778326	£45,188,843	£3,868,908	£4,220,627	£6,508,756	£3,505,275	£4,590,956	£5,257,913		

Table 4.21 Renewable Energy scoping: 50% Contribution

50% Contribution from Renewables

Use Class	Generic Typologies	Development Example (Where applicable)	Development example (m2)	Total kWh/yr	RE contribution (kWh)	50%								
						Power			Heat				CHP	
						PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached		160	22788	11394	£121,536	£19,510		£18,756	£11,784	£11,576	£21,212		
C3	Individual dwelling terrace		105	14955	7477	£79,758			£12,309		£7,597	£13,920		
C3	Individual dwelling flat conversion		65	9258	4629							£8,617		
C3	Development of dwellings 10-50 flats	Downham Way	930	132456	66228	£573,974	£75,602	£75,602	£86,306	£68,497	£56,070	£87,333		
C3	Housing/Mixed use site >50-200 units	Hindsley Place	5065	721384	360692	£3,125,999	£411,749	£411,749	£470,043	£279,787	£305,371	£475,638	£135,260	
C3	Housing/Mixed use site >200-500 units	Connington Road	16355	2345721	1172861	£7,819,071	£669,441	£730,299	£1,126,217	£606,521	£794,378	£909,782	£351,858	£1,251,051
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	e.g. Oxestalls Road	100,300	16945816	8472908	£56,486,053	£4,836,135	£5,275,783	£8,135,945	£4,381,594	£5,738,695	£6,572,391		

Consideration of multiple technologies

4.140 The contribution of renewable energy solutions to various typologies has been provided in Table 4.17 through to Table 4.21. Each technology has been appraised on its own merits and the contribution it could make without considering the integration of another renewable energy technology. In many situations it is likely that a development would employ more than one technology to meet a particular target of energy supply from renewable energy (especially if the target is over 40%). Combined renewable energy technologies are termed hybrid renewable energy systems and these have a number of advantages including:

- Increased contribution of clean energy to the site/development;
- Hybrid systems can overcome limitations inherent in either technology when deployed individually in terms of fuel flexibility, efficiency, reliability, emissions and/or economics.

4.141 It is important to note that not all renewable technologies are compatible with each other. Figure 4.5 identifies potential hybrid combinations applicable to developments within the Borough. The matrix has been colour coded into: commercially available combinations; bespoke combinations; and hybrid solutions that would generally not be recommended from a technical or financial perspective.

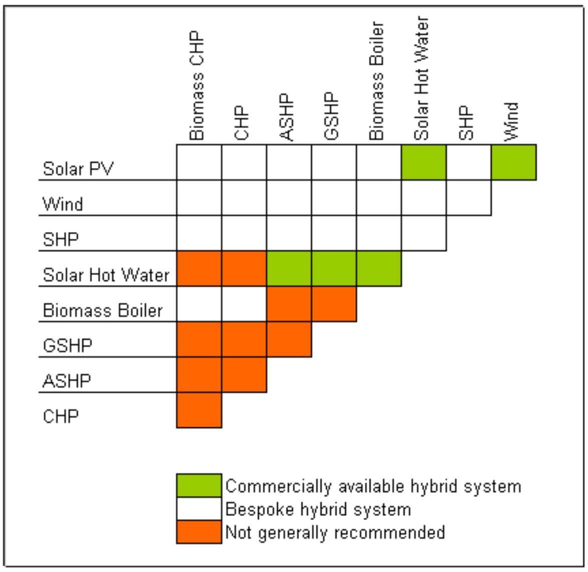

Figure 4.5 Hybrid renewable energy systems

4.142 The most common examples of hybrid systems in the UK involve solar thermal systems integrated with other heating technologies such as biomass boilers or heat pumps. These solutions complement each other as the solar thermal largely satisfies the domestic hot water demand during the summer months which eliminates/minimises the requirement to operate the boiler or heat pump. These combinations require the installation of a hot water tank (or sometimes a larger buffer tank) which can increase the space required within a plant room.

4.143 Other common combinations include solar PV with a renewable energy heating solution such as solar thermal or biomass boiler. These technologies effectively operate separately, one contributing to the electrical supply and the other to the heating supply, but their combined contributions are considered when calculating total renewable energy supplied to a particular site.

Implementation considerations

Scale of potential energy generation

4.144 As previously outlined the biomass CHP systems should be sized to meet baseload thermal demand for the development. Scaling to this parameter eliminates any thermal energy being unnecessarily wasted. Unwanted electrical generation can be spilled onto the local grid. The cost of the energy centre, cost of the district heating pipe network and electrical connections, and the additional generation from renewable energy technologies determine the contribution from the developer;

Distribution and networking options

4.145 Electrical distribution can be done via smart grids or micro-grids networks for example.

4.146 Thermal distribution is delivered via underground pre-insulated district heating pipe networks. Optimal location of the plant is essential to minimise costs and maximise efficiency. The area to be served by the plant can be divided into zones, each including one or more buildings. Routes of existing and proposed services within the site should be considered and incorporated where appropriate.

Business and delivery models

4.147 Area wide sustainable generation requires the technical capability to generate, and the commercial capability to utilise the renewable energy and distribute the power and/or heat to ensure that all available incentives and grants are effectively utilised. Energy efficiency projects require the ability to capitalise the equipment cost and then to demonstrate the efficiencies and typically to charge the business unit on a revenue basis over time. In addition, there must be an emphasis on the identification of opportunities for existing industrial and waste processes to contribute to meeting renewable energy and carbon emissions reduction targets. There must also be an emphasis on the opportunities for linking new or extended development and its supporting energy infrastructure with existing communities. Thus, a suitable business model is necessary for the successful implementation and operation of sustainable energy projects.

4.148 There are a number of business models applicable for the implementation of area wide renewable energy solutions. One effective model that is gaining popularity is an Energy service company (ESCO). The purpose of an ESCO is to identify and drive energy efficiencies and sustainable generation on behalf of an interest group. The mechanism translates the uncertainty of managing an efficiency project or sustainable generation project into a business risk that can be quantified, operated and managed over time. The ESCO model was developed originally to drive energy efficiencies at the point of use (“end-user”) – using capital to install the energy saving device and recovering the as a small revenue charge to on the end users. The scope of the ESCO operations has widened to include examples of small-scale sustainable generation, local distribution, energy efficiencies initiatives, monitoring and building management – and combinations of these. It has been common for CHP plants to be installed on a ‘supply and operate’ basis and it is apparent that large city centre biomass installations are likely to be operated by an

ESCO[14]. Further details relating to business and delivery models are provided in Appendix D.

Project costs

4.149 Low or Zero carbon technologies tend to have higher capital costs than competing fossil fuelled technologies. Capital costs of renewable energy projects are generally site specific, and this is especially true for Biomass boilers, Biomass CHP, Ground Source heat pumps, and Small scale hydropower. This is largely due to the varying level of civil works required for these systems depending on the site conditions.

4.150 For biomass systems a value engineering analysis should be undertaken to determine the optimum duty in terms of capital cost, running cost, and CO_2 savings. This should take into account the size of the fuel and thermal stores required and the value of the plant space. Although wood chips may be available at a lower cost per kWh than other fuels, a biomass installation is rarely justified in strictly financial terms. However for areas where heating makes up a large proportion of total energy demand, they offer an effective means of reducing CO_2 emissions using a sustainable fuel.

Funding

4.151 Renewable energy is primarily supported by the Renewables Obligation and, to a lesser extent, through an exemption from the Climate Change Levy. Additional support is provided through Research & Development (R&D) funding and capital grants. These have been worth approximately £500 million between 2002 and 2008. The Environmental Transformation Fund (ETF) is a new initiative to bring forward the development of new low carbon energy and energy efficiency technologies in the UK. The fund formally began operation on 1 April 2008, and is jointly administered by DEFRA and BERR. Funds within the UK element of the Fund will total £400 million during the period 2008/09 to 2010/11. The UK element of the Fund aims to accelerate the commercialisation of low carbon energy and energy efficiency technologies in the UK. In doing so, it will help reduce the carbon intensity of energy production as well as reduce energy demand. The fund will therefore contribute towards the UK's climate change and renewable energy goals for 2020 and beyond and will specifically focus on the demonstration and deployment phases of bringing low carbon technologies to market. It is not possible to apply directly for ETF funding. Instead, it will be necessary to apply to schemes funded by it, some of which are listed below[15].

4.152 Low Carbon Buildings Programme (LCBP) is a £86m grant programme for micro-generation technologies, launched in April 2006, offering capital grants over 3 years to successful applicants. The main objectives are to assist the application of both energy-efficiency and micro-generation technologies in a range of buildings, driving down costs in the process, and making the micro-generation market more viable. LCBP Phase 1 is relevant to householders and has been extended from July 2010 to April 2011. This timeline is possibly intended to provide funding support until a renewable heat incentive/feed in tariff is instigated. Grants for the installation of micro-generation technologies are available to public sector buildings (including schools, hospitals, housing associations and local authorities) and charitable bodies. Applications are being accepted now until April 2011. There is

[14] CIBSE, "CIBSE Knowledge Series Biomass Heating", September 2007, London
[15] Further details about the ETF are available from: http://www.berr.gov.uk/energy/environment/etf/page41652.html

an upper limit of 300kW for heat applications and the maximum funding available is £200,000 for a single project. An extra £45 million has been provided for the LCBP as a whole from the 2009 budget, but new applicants for solar PV funding will experience a delay in finding out whether or not they have been successful due to the volume of applications[16]. LCBP Phase 2 is part of the UK Environmental Transformation Fund (ETF), a joint BERR/Defra fund to bring forward the demonstration and deployment of low carbon energy and energy efficiency technologies. Organisations can apply for 50% of the cost of installing approved micro-generation technologies, supplied and installed by Framework Suppliers.

4.153 Salix: is an independent publicly funded company that provides interest free conditional grants to the public sector to "…improve energy efficiency, attain targets, reduce energy bills and raise green credentials"[17]. Salix is mainly concerned with funding energy efficiency projects with a short payback period (5 years), but will consider funding renewable energy projects with a payback period up to 7.5 years under certain conditions. Until additional feed-in tariffs are available, this stipulation may make some of the more capital intensive technologies such as solar PV fall outside of its funding scope. Public bodies should, however, consider applying for Salix funding when considering any renewable energy project, as guidance is available for the purposes of checking funding availability without undertaking extensive preparatory work.

4.154 Intelligent Energy Europe (IEE) was launched in June 2003 to offer a more integrated and coherent approach towards the area of non-technological support in the field of energy efficiency and renewable energy sources. From 2007 Intelligent Energy Europe will be part of the Competitiveness and Innovation Framework Programme (CIP). Projects fall under four types of action, General, Creation of New Energy Agencies, Events, and Concerted Actions. Applications cannot exceed €40,000. The CIP aims to encourage the competitiveness of European small and medium-sized enterprises (SME's) and will assist better access to finance and deliver business support services in the European regions.

4.155 Bioenergy Capital Grants Scheme is currently closed but £12 million should be available to 2011. An announcement on the next phase of the scheme is expected to be made during 2009. It is targeted at supporting biomass heat, CHP and Anaerobic Digestion projects in the community, industrial and commercial sectors. It is not available to individual householders. The grants available fund up to 40% of the difference in capital costs between the project and its fossil-fuelled equivalent with a maximum of £500,000 available for a single project[18].

4.156 The Carbon Trust Renewable Energy Interest free loans are available for renewable energy projects that also help to reduce the energy consumption on site. Projects that purely generate renewable energy for export to the grid would not be eligible. Small or medium-sized enterprises (SMEs) in England and Scotland, or all businesses in Wales that have been trading for at least 12 months can borrow from £5,000 to £200,000 – with the repayments based on the savings.

4.157 The Energy Crop Scheme[19] provides establishment grants for approved energy crops. Approved crops include short rotation coppice (SRC) and Miscanthus. The

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[16] http://www.lowcarbonbuildingsphase2.org.uk/index.jsp

[17] http://www.salixfinance.co.uk/thecompany.html details of renewable energy funding available at: http://www.salixfinance.co.uk/laprojects.html

[18] http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,20166&_dad=portal&_schema=PORTAL

[19] http://www.defra.gov.uk/corporate/regulat/forms/erdp/generic/ecs.pdf

crops must be used for heat, CHP or power generation. Establishment grants are one-off payments, designed to cover a percentage of the standard costs of establishing approved energy crops, 40% for Miscanthus and SRC. This includes activities such as ground preparation, fencing, purchase of planting stock, planting, weed control and first year cutback. The level of funding depends on the area of land under agreement and the crop grown. Grant funding to help establish producer groups are also available. These must be legal entities and 50% funding will be provided or a maximum of £200,000 per group.

4.158 Enhanced Capital Allowances (ECA) scheme is for businesses who wish to install plant or LZC generation equipment that fit energy efficiency or renewable energy criteria. Under this scheme businesses can write off 100% of the capital cost of the equipment against their taxable profits during the period the investment was made[20].

4.159 The Renewables Obligation requires power suppliers to supply a certain proportion of their electricity production from renewable energy. If they cannot provide some or all of this themselves, they can buy Renewable Obligation Certificates (ROCs) from other parties, including generation from on-site renewables. A ROC is issued for each MWh of power generated. Certain renewable energy technologies and technical configurations/standards qualify for two ROCs per MWh, such as solar PV. ROCs are issued for power generated, not just for surplus power exported to the grid. To give certainty to the industry, ROCs have been guaranteed to 2037 by the Government. As the obligation increases, this indicates a stable or rising price for ROC's.

4.160 Renewable Heat Obligation is presently a provision within the Energy Act for the roll-out of the Renewable Heat Obligation. This will function in a similar way to ROC's, but for renewable heat, such as that which is generated by biomass boilers. The details of this scheme have not as yet been finalised; projects instigated now and in the next few years should benefit from it.

4.161 The UK Government is currently undertaking a major change in its method of supporting renewable energy generation. Where there are two proposed schemes which are likely to affect the funding of renewable energy generation within Lewisham: the Renewable Heat Incentive (RHI); Feed-In Tariffs (FITs) - supporting small-scale clean electricity.

4.162 FITs will be available for installations of up to 5MW (potentially including micro CHP up to 50kW electrical capacity) generation capacity per site. The Government has proposed that the following technologies will be legible for a FIT: Wind, Solar PV, Hydro, Anaerobic digestion, Biomass and Biomass CHP and non-renewable microCHP. It is proposed that that the heat output of CHP will be rewarded through the FIT until the RHI scheme becomes operational.

4.163 The Government is working towards a start date of April 2010 for FITs and April 2011 for the RHI. Whilst the Government has not clarified the exact mechanism and levels of financial support for each scheme, it is likely that a tariff price will be provided for each kWh used/generated throughout the scheme period, until at least 2020. The Government has also stated that eligible installations completed from 15th July 2009, until the operational date of the two schemes, will benefit from the support from the date the scheme launches.

4.164 The Government is yet to clarify the mechanism regarding ownership of the installation and receipt of the tariff. It is stated that it will be up to landlords and

[20] http://www.eca.gov.uk/etl/default.htm

tenants to come to arrangements. It has also been proposed that rights to the tariffs may be assigned through a bilateral agreement, allowing the installer of the installation to claim the tariff and provide the building owner a guaranteed income.

4.165 The table below details the proposed generation tariff levels for the first year of the FIT scheme 2010 to 2011.

Table 4.22 - Proposed table of generation tariffs for the first year of FITs (2010-11)[21]

Technology	Scale	Proposed initial tariff (p/kWh)	Annual degression (%)
Anaerobic digestion	Electricity only	9	0
Anaerobic digestion	CHP	11.5	0
Biomass	<50kW	9	0
Biomass	50kW-5MW	4.5	0
Biomass	CHP	9	0
Hydro	<10kW	17.0	0
Hydro	10–100kW	12.0	0
Hydro	100kW–1MW	8.5	0
Hydro	1-5MW	4.5	0
PV	<4kW (new build)	31.0	7
PV	<4kW (retrofit)	36.5	7
PV	4-10kW	31.0	7
PV	10–100kW	28.0	7
PV	100kW–5MW	26.0	7
PV	Stand alone system	26.0	7
Wind	<1.5kW	30.5	4
Wind	1.5–15kW	23.0	3
Wind	15–50kW	20.5	3
Wind	50–250kW	18.0	0
Wind	250–500kW	16.0	0
Wind	500kW–5MW	4.5	0
Existing microgenerators transferred from RO[34]		9	N/A

4.166 Climate Change Levy Exemption Certificates allows renewable generators to benefit from Levy Exemption Certificates (LEC's). The Climate Change Levy (CCL), a tax on the industrial use of energy, is applied by suppliers to non-domestic consumers of 'non-exempt' electricity currently at a rate of £4.56/MWh, and gas at a rate of £1.5/MWh. Renewable energy is exempt from the CCL, therefore an organisation with significant renewable energy portfolios or generation assets will benefit financially from this. Generators who produce renewable energy and are accredited by Ofgem receive LEC's which they can sell, via suppliers, to

[21] Department of Energy & Climate Change "Consultation on renewable electricity financial incentives 2009, July 2009

customers who are exposed to the CCL. The value to the generator is therefore a negotiated percentage (up to 85%) of the £4.56/MWh that the customer will save through purchasing renewable output.

Deliverability

4.167 Developers should undertake further detailed technical feasibility studies once initial options (whether on-site or area wide) have been appraised.

4.168 For Biomass CHP for example this will include further demand assessments, pipe-work design for the heat distribution systems detailing the exact course, layout and flow requirements for the system for example. If a dedicated energy centre is necessary the site's ability to receive and handle the volumes of biomass assessed. The distribution of electricity to the grid will need to be negotiated with the Distribution Network operator.

4.169 For medium and larger scale facilities where a developer may require funding or technical support from an energy supply partner a detailed Business Plan Modelling is usually required, as is the securing of the requisite capital financing. Business Plan Modelling should take into account full operation and maintenance issues from technical operation of the plant through to billing and metering arrangements. The delivery options for providing the service may range from bespoke structures such as community or cooperative ownership, to co-opting the resources of a utility company, to the formation of an ESCO, or any combination thereof[22]. An ESCO may be non-profit making in order to control costs to the end user.

[22] NHBC Foundation *Community Heating Combined Heat and power* [online] http://www.nhbcfoundation.org/LinkClick.aspx?fileticket=Ev%2f%2bSNIFrK4%3d&tabid=339&mid=774&language=en-GB

5. Retrofit of the existing building stock

Introduction

5.1 Within Lewisham the domestic sector accounts for the largest share of carbon emissions in the Borough (see Table 5.1). Whilst new developments can be developed to meet relevant Code for Sustainable Code standards and renewable energy targets. To make significant in-roads in reducing carbon emissions there is a need to tackle the existing stock through retrofit to address energy efficiency and/or by converting properties so that energy requirements are part met from renewable energy sources.

Table 5.1 – Borough CO_2 Emissions 2006

Source	Quantity	Units	%
Industry and Commercial	316	kt CO_2	26%
Domestic	563	kt CO_2	46%
Road Transport	341	kt CO_2	28%
Total	1,219	kt CO_2	100%
Population (mid-year estimate 2006)	256	000's	N/A
Per capita emissions (t)	4.8	t CO_2	N/A

5.2 The energy trajectory assumptions used in this report require a substantial implementation of energy efficiency measures in the existing stock, in order to support an overall carbon emission reduction strategy.

Policies and standards

5.3 There are a number of previous, current and proposed Government initiatives and policies aimed at reducing carbon emissions from the household sector, these include:

- Home Energy Conservation Act (HECA)
- Supplier Obligations, such as the Energy Efficiency Commitment (EEC), replaced by the Carbon Emissions Reduction Target (CERT)
- Improving building standards
- Improved product standards e.g. EU Directive 2005/32/EC
- Fiscal stimulus packages for energy efficient materials and technologies
- Community Energy Saving Programme (CESP)
- Information, coordination and advice from organisations such as The Energy Saving Trust (domestic) and The Carbon Trust (commercial).
- The Warm Front programme
- The Decent Homes Programme

5.4 A summary of some of these key programmes are detailed below:

HECA

5.5 The Home Energy Conservation Act 1995 (HECA) is a Government energy efficiency scheme for residential accommodation. It requires every UK local authority with housing responsibilities to prepare, publish and submit an energy conservation report detailing[23]:

- Practicable and cost-effective measures to significantly improve the energy efficiency of all residential accommodation in their area; and
- Report on progress made in implementing the measures

5.6 It is thought that the greatest improvements to energy efficiency have been delivered through programmes such as EEC/CERT, Warm Front and Decent Homes. A review of the HECA was undertaken by DEFRA in 2007 followed by a consultation process, to decide future options of the HECA. Policy responsibility for the HECA has also recently been transferred from DEFRA to the Department of Energy and Climate Change (DECC), where a decision on the future of HECA is pending.

Warm Front and Decent Homes

5.7 The Warm Front scheme and The Decent Homes programme have both been successful improving the energy efficiency of social housing stock and providing measures to vulnerable and low income households. These initiatives have typically contributed to better energy performance of social sector buildings than private rented and owner-occupied homes.

5.8 The Warm Front scheme provides grants to vulnerable and low income households for energy efficiency measures including improving central heating. The 2008 Pre-Budget Report announced a further £100 million of new funding for the scheme.

Supplier Obligations

5.9 One of the other main energy efficiency drivers is due to where the Government has placed obligations on energy suppliers to reduce the domestic sectors energy use and associated carbon emissions, through introducing Supplier Obligations (SOs). Mandatory targets to implement energy efficiency options are given to suppliers based on a domestic customer base threshold.

5.10 The first SOs were called the Energy Efficiency Standards of Performance (EESOP), this programme ran in four phases between 1994 and 2002. The first SO scheme was replaced with the Energy Efficiency Commitment (EEC), this ran in two phases: EEC1 from 2002 to 2005; EEC2 from 2005 to 2008. EEC2 had an overall UK energy saving target of 130 TWh, however this was exceeded as actual savings were reported as 187TWh.

5.11 The EEC has been replaced with a new scheme, the Carbon Emissions Reduction Target (CERT). The current CERT programme runs from 2008 to 2011. CERT is the UK (Great Britain only) Government's current main policy measure to reduce energy use in the domestic sector. This current scheme has moved emphasis away from energy to carbon savings, with an overall target of saving 154Mt CO_2.

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[23] defra, "Home Energy Conservation Act 1995", http://www.defra.gov.uk/environment/climatechange/uk/publicsector/localauth/heca95/#Background, website cited 15.05.09

5.12 Both the EEC and CERT programmes require a proportion of financial assistance to be provided to ‘priority’ groups, consisting of households in receipt of certain Government benefits or where a member of the household is over 70. The ‘priority’ group proportion has been reduced in the CERT scheme form 50% (EEC) to 40%.

EEC Primary Investment Measures

5.13 The predominant installed options of the EEC scheme included cavity wall and loft insulation, where these two measures provided the largest overall energy savings. These options were followed by upgrading lighting to energy efficient CFL lamps, installing new central heating systems (45,000 homes) ((including CHP)) and solid wall property insulation (41,000 homes). In addition 5% of energy savings were attributed to the provision of energy efficient appliances, replacing older units.

CERT

5.14 The CERT programme has seen a change of scope from the EEC scheme, where along with energy savings, emission reductions are required from: increasing the amount of electricity generated or heat produced by micro generation; increasing the amount of heat produced by any plant which relies wholly or mainly on wood.

5.15 On 11 September 2008, the Prime Minister announced proposals to amend CERT as a key element of his £1 billion Home Energy Saving Programme. The central proposal is a 20 per cent uplift to the target, which is expected to boost supplier household energy efficiency investment by some £560m by 2011 and increase the scheme’s lifetime carbon savings to 185MtCO_2 (31MtCO_2 more than under the original CERT target) thereby making a significant contribution to Government’s environmental and social ambitions. The Department of Energy and Climate Change is currently undertaking a public consultation to seek views on the proposed amendments[24]

Post CERT

5.16 The Government is seeking new initiatives post CERT; these could be formed on the CESP pilot project and the conclusions of the Heat and Energy Saving (HES) consultation.

5.17 The Government’s Heat and Energy Saving Strategy Consultation suggested an equivalent of a 30% reduction in CO_2 from households by 2020 compared to 2006.

5.18 CESP is a relatively new £350 million Community Energy Saving Programme, it aims to offer free and discounted energy efficiency measures including central heating and insulation in around 100 low income communities across Great Britain. This could also support initiatives for community heating.

5.19 The HESS consultation strategy document aims to clarify the Government’s longer term strategy for energy efficiency. The outcome of this work will play a significant contribution to determining the increase in energy efficiency to the existing building stock in LBL. The Government aims for a future ‘whole house’ approach in comparison to today’s method of installing measures one at a time. In addition, the Government has also outlined the potential of Energy Services Companies (ESCos) to help deliver energy savings.

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[24] defra, “Energy supplier obligation: Carbon Emissions Reduction Target (CERT)”, http://www.defra.gov.uk/environment/climatechange/uk/household/supplier/cert.htm, website cited 15.05.09

Ecohomes XB

5.20 One of the challenges for the Borough to improve energy efficiency in the existing stock, will be dependent on a system to assess and prioritise improvements. The EcoHomes XB methodology could be considered.

5.21 In April 2007, EcoHomes (a version of BREEAM for dwellings), was replaced with the Code for Sustainable Homes for new housing. However, EcoHomes XB remains for existing housing stock.

5.22 EcoHomesXB is a self assessment tool which has been designed as an easy to use desk based assessment using data already to hand. It provides the method and gives a tool to assist and guide in the improvement of environmental performance whilst recognising the restraints and practicalities facing existing housing[25].

5.23 EcoHomesXB has been developed by BRE in conjunction with the Housing Corporation, to allow stock holders of existing housing to assess and monitor the environmental performance of their stock. This facilitates the tracking of improvements made during routine maintenance and minor refurbishment and provides a constant monitor of performance against a benchmark figure. It also helps to highlight areas that require attention and helps prioritise maintenance and refurbishment works[25].

5.24 Unlike other BREEAM schemes, EcoHomesXB doesn’t give a rating of pass, good, very good & excellent but is based on a single score allowing stock holders to benchmark their initial performance and then to set realistic targets leading up to an eventual goal[25].

Improved Energy Efficiency – Lewisham Background and Progress

Background

5.25 Energy consumption within the borough’s homes is the single largest source of CO_2 emissions[26].

5.26 In 2007 Lewisham transferred housing management to a number of providers: an arms length management organisation (ALMO), housing associations and PFI companies.

5.27 Information regarding the type of housing in the Borough is provided in the following tables, data sourced from the Lewisham Carbon Reduction and Climate Change Strategy Document[26]. The document also provides the following key points:

- Over 66% of Lewisham’s housing stock was built pre 1945;
- Over 70% of the detached, semi-detached and terraced housing was built pre 1919;
- Nearly 80% of the purpose built flats were built post 1945 and over 25% were built post 1980;

[25] BRE, “EcoHomes XB”, http://www.bre.co.uk/page.jsp?id=724, website cited 03.06.09
[26] Lewisham, “Carbon Reduction and Climate Change Strategy”, July 2008

- Approximately 75% of the converted properties typically constructed pre 1919 (21,200 converted dwelling being contained within pre 1919 buildings).

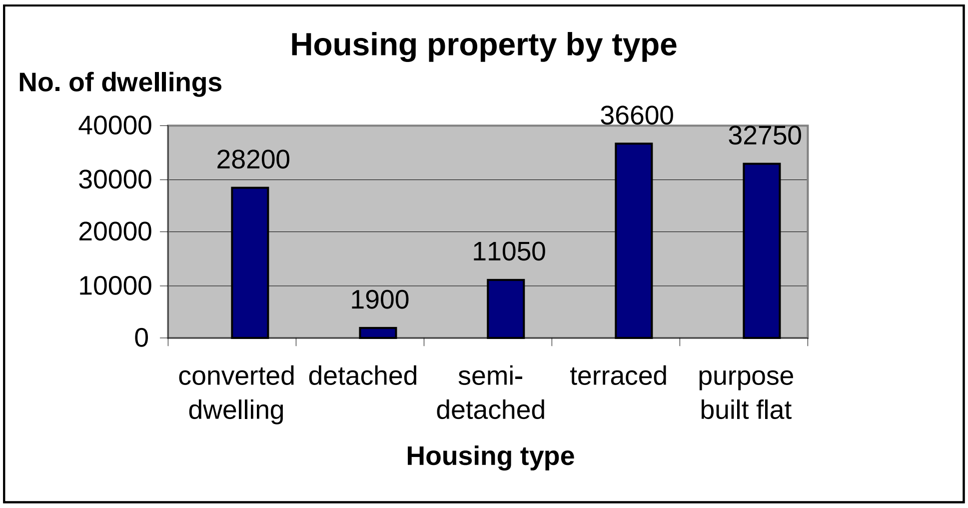


Figure 5.1 – Housing by type

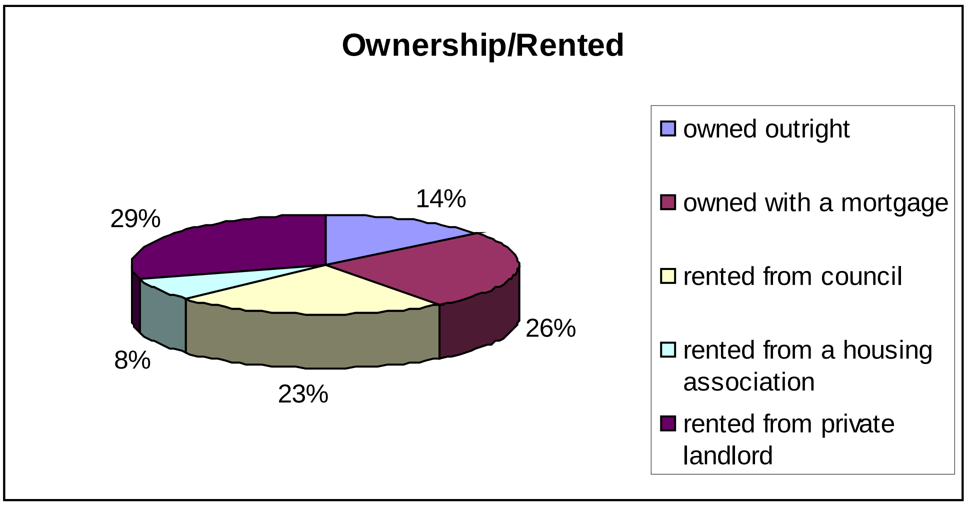


Figure 5.2 – Housing by tenure

Progress

5.28 The Borough has joined an ambitious Carbon Management Programme (partnering with the Carbon Trust) to reduce carbon emissions in the Council's operations by 10% by 2010, as measured by national indicator 185, and 50% by 2015. One of the objectives of this exercise is for the Borough to lead by example. This extensive project will improve the energy efficiency of council buildings and schools.

5.29 The Borough has launched a new Innovations Fund. The aim of this is expand on existing schemes and lever additional external funding in order to introduce a range of projects including: a green schools initiative; extending the scope of schemes to improve energy efficiency in housing and tackle fuel poverty.

5.30 Lewisham have launched a pioneering Energy Action Zone, this provides advice and financial support to residents. The main focus of this program has targeted those who may be vulnerable to fuel poverty. This was first introduced in three wards (Downham, Brockley & Evelyn) in 2007 and with a planned extension to a further 3 wards in spring 2009.

5.31 The HECA programme required local authorities to produce improvement plans aimed at achieving a voluntary 30% energy efficiency improvement by 2006 or 2011.The London Borough of Lewisham has made good progress, where the most recent DEFRA HECA report (11th progress report), for from the 1st of April 1996 to 31st March 2007, details overall improvements in energy efficiency of 23.1%.

5.32 11,200 homes in the borough received energy efficiency improvements, consisting of new central heating systems and improvements to insulation between 1995 and 2006.

5.33 One of the main drivers for energy efficiency improvements in the Borough in recent years has been due to the requirement for all social and private landlords to bring their stock to up to at least decent homes standard by 2010. This would involve the provision of an energy efficient heating system and basic insulation measures.

Spatial Targeting of Carbon Reduction Initiatives

5.34 To complement and help provide an evidence base for future initiatives and analysis was undertaken to identify areas where investment should be targeted for improving the energy efficiency in the existing housing stock. A range of initiatives were examined to identify organisations that offer support for the improvement of efficient energy use in Lewisham Borough's existing housing stock. The following organisations were researched:

- The GLA Low Carbon Zones Initiative;
- The Warm Front Programme;
- Carbon Emissions Reduction Target Funding Programme; and
- The Carbon Trust.

5.35 In order for households to receive support under the above schemes they must meet the qualifying criteria set out. The criteria set often include several social and physical indicators to establish need. They include:

- Inefficient energy use (fuel poverty) in housing; and
- Households in receipt of benefits or tax credits. These are:

  - Housing benefit / Council tax benefit;

  - Income support

  - Jobseekers allowance;

  - Pension Credit

  - Disability living allowance

  - Incapacity Benefit / Disablement pension
- The GLA Low Carbon Zones Initiative, as well as the CESP, targets the "poorest LSOA's".

Social and Physical Indicators

5.36 The relevant ONS datasets were examined in order to determine which areas in Lewisham met the criteria set by the programmes and could be potentially targeted for funding. For the social indicators the following datasets were considered:

- Disability living allowance claimants, 2007;
- Incapacity benefit/ Severe disablement allowance claimants, 2007;
- Income support claimants, 2007;
- Jobseekers allowance claimants, 2007;
- Pension credit claimants, 2007;
- All claimants of housing benefits/ Council tax benefits, 2005; and
- IMD rankings, 2007
- Probability of housing being in poor condition

5.37 Appropriate thresholds were established for each dataset to establish the areas in greatest need which related to criteria for funding schemes. The IMD rankings which are qualifying criteria for GLA and CESP programmes target the "poorest LSOA'S". This was taken to mean the Lower Layer Super Output Areas (LSOA's) with high rankings in the index of multiple deprivation. At a national level, it is the top 20% of IMD rankings which are considered to be the most deprived.

5.38 For the purpose of this exercise, the top 20% of the IMD rankings in Greater London were examined in order to establish a regional threshold to which LSOA's in Lewisham can be compared. Although this does not reflect Lewisham's IMD ranking on a national context, the Greater London region comprises of some of the most deprived and affluent areas in the UK. As such, a comparison focusing only within the region is appropriate especially as some programmes relate specifically to London.

5.39 Physical condition is a further indicator used within funding programmes aim to target dwellings with poor energy efficiency. The most up to date dataset available for all LSOAs in the Borough to reflect housing in poor condition which tend to have poor energy efficiency was "Housing in Poor Condition; Probability of any dwelling being below Decent Homes' Standard- 2007" a number of criteria included within Decent Homes relate to energy efficiency.

Identifying the Need for Retrofitting

5.40 All datasets were also benchmarked at regional level (Greater London) in order to establish a reference point and level of significance for each of the criteria. This made it possible to determine how the LSOA's in Lewisham compared to LSOA's in Greater London and identify the areas with the highest priority for intervention.

5.41 A scoring system was developed to determine the significance of social and physical indicators and identify those LSOA's which met the most criteria. The data was grouped into three headings and each group was given a scoring weight. The groups were; IMD rankings, social benefits and housing in poor condition.

5.42 The information on housing condition was given a 50% weighting (a potential total of 8 points), due to it being the greatest determinant of physical need. Social indicators represented 37.5% of the total score. There are a total of six individual types of benefits which have been extracted which are relevant criteria for energy programmes equal weighting was given to each benefit (1 point for each benefit). Finally, the IMD rankings will hold a 12.5% weight (potential total of 2 points). The scoring was based on the following rationale:

- IMD: LSOA's in Lewisham were given 2 points if they were above the top 20% of the region's most deprived areas;
- Benefits: There are six benefits identified in the criteria. Each dataset relating to individual benefits were analysed and allocated a threshold. The number of households receiving a specific benefit in the LSOA were compared to the regional threshold set for households receiving the same benefit. Where a LSOA in Lewisham was above the allocated threshold, it was given 1 point. This provided a potential total of 6 points for each LSOA, for the benefits indicator;
- Housing in Poor Condition: The ONS dataset reflected the probability of housing in a LSOA being in poor condition. This indicator reveals the proportion of housing in an area that needs carbon reduction funding. The score for this ranged from 2 – 8 points and were determined as follows:

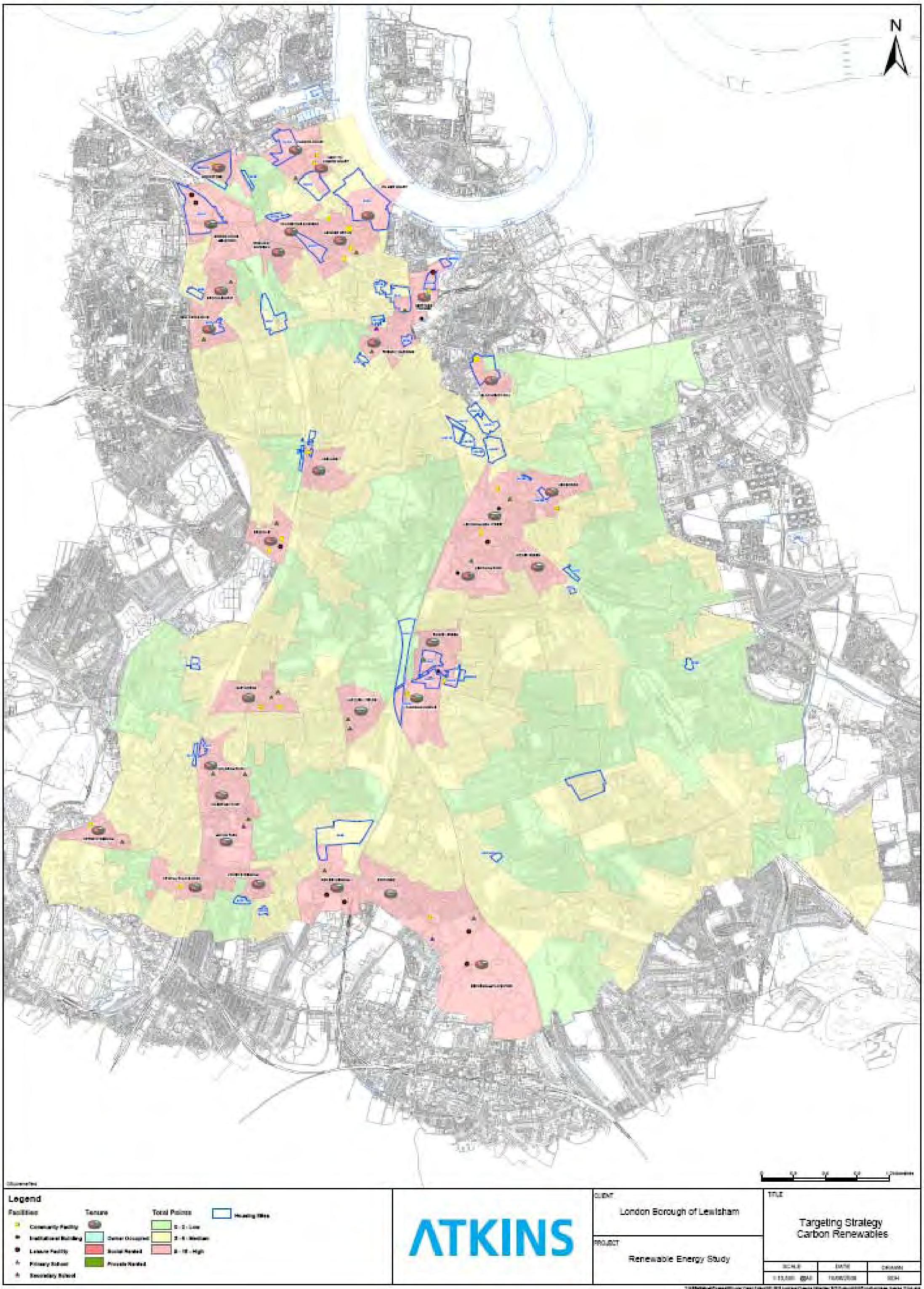
Probability greater than 49%	8 points
Probability between 45% - 48%	6 points
Probability between 40% - 44%	4 points
Probability between 35% - 39%	2 points
Probability less than 34%	0 points

Carbon Reduction Priority Areas

5.43 The maximum points a LSOA could potentially score is 16. The points achieved by LSOA's in Lewisham ranged between 0 and 14 points. In order to determine category for high, medium and low priority areas, the final scores were compared to other LSOA's in London.

5.44 Upon establishing the top and lower brackets of the final scores, 9 points and 2 points respectively, the LSOA's in Lewisham were mapped based a traffic light colouring scheme, whereby LSOA's in red indicate the highest scores and the areas that meet the specified criteria of the funding programmes (see Figure 5.3). The LSOA's mapped in red are therefore most eligible for funding for improving energy efficiency in the existing housing stock.

Figure 5.3 – Carbon Reduction Priority areas



Profiling areas of greatest need

5.45 Other information relating to LSOAs in areas of greatest needs was collated to profile of the housing stock type and tenure and community facilities to identify potential scope for improving energy efficiency within these areas. On average, 58% of the housing stock in the red LSOA's are Social Rented housing, 13% are privately rented and 29% are owner occupied. Sites identified within the Council's SHLAA were also plotted to show potential housing sites which may be able to incorporate renewables provision. Deptford and New Cross

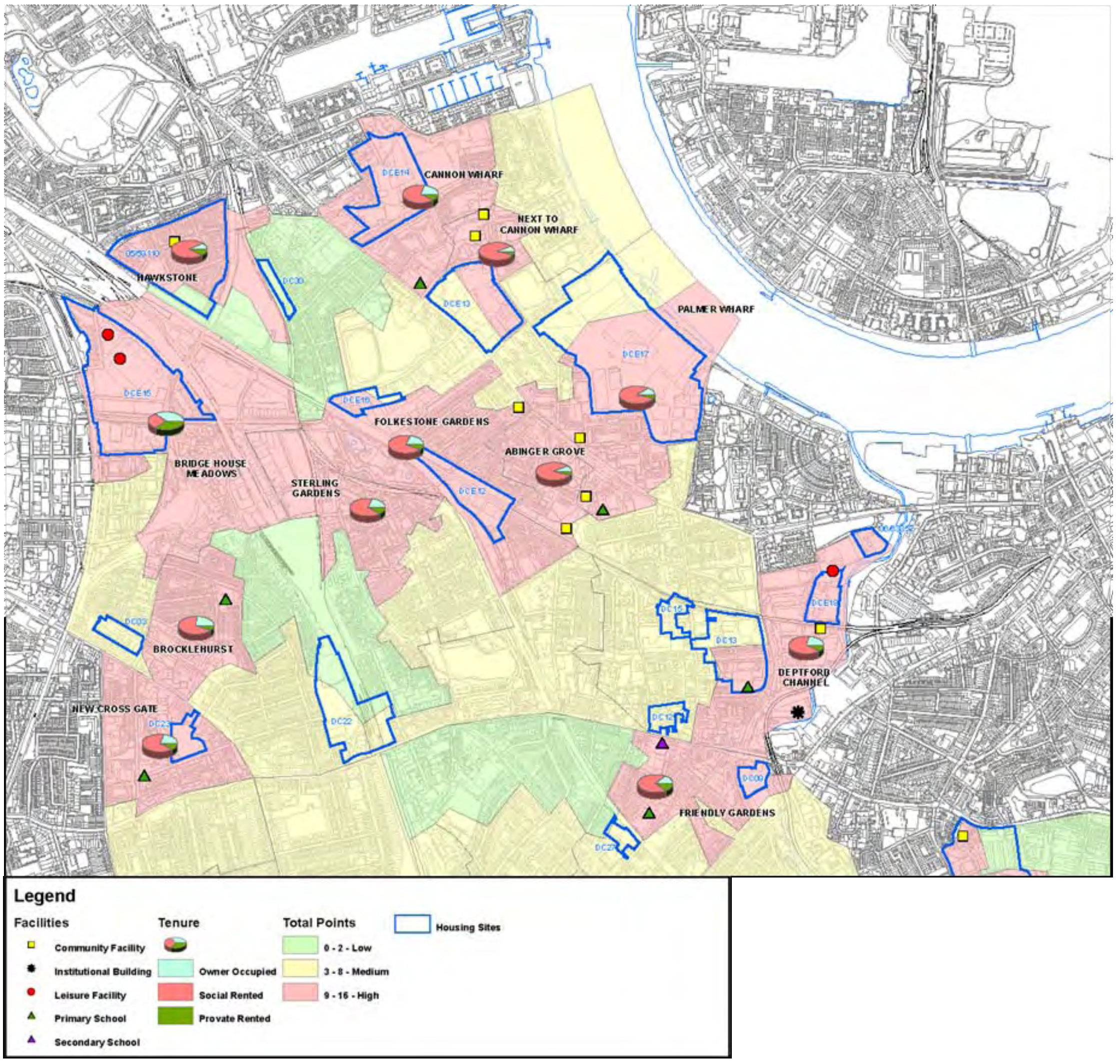
Deptford and New Cross

5.46 The Deptford and New Cross area has the most potential for future development. This is shown by the sites outlined in blue. The locations of these sites overlap the targeted LSOA's and are as such provide th greatest opportunities for the provision of area wide renewable energy sources. It is evident that the red LSOA's i.e. LSOA's most eligible for funding, are concentrated throughout the north-west of the Borough.

5.47 The existing social infrastructure in the red LSOA's in the Deptford and New Cross section includes a number of community centres, primary and secondary schools. Two of the main amenities in this section are the Millwall Football Stadium in the north-west and Lewisham College towards the south-east.

5.48 The existing housing stock throughout the red LSOA's consists of a majority of social rented accommodation (71%). The proportions of owner occupied and private rented accommodation are at 18% and 11%, respectively. A large majority (circa 75%) of dwelling types in these LSOA's are purpose built flats, revealing a concentration of this type of development in these deprived areas. Furthermore, 13% of dwellings are end terrace and 7% are converted flats. The remaining 6% are detached and semi- detached housing.

Figure 5.4 - Carbon Reduction Priority Areas Deptford and New Cross



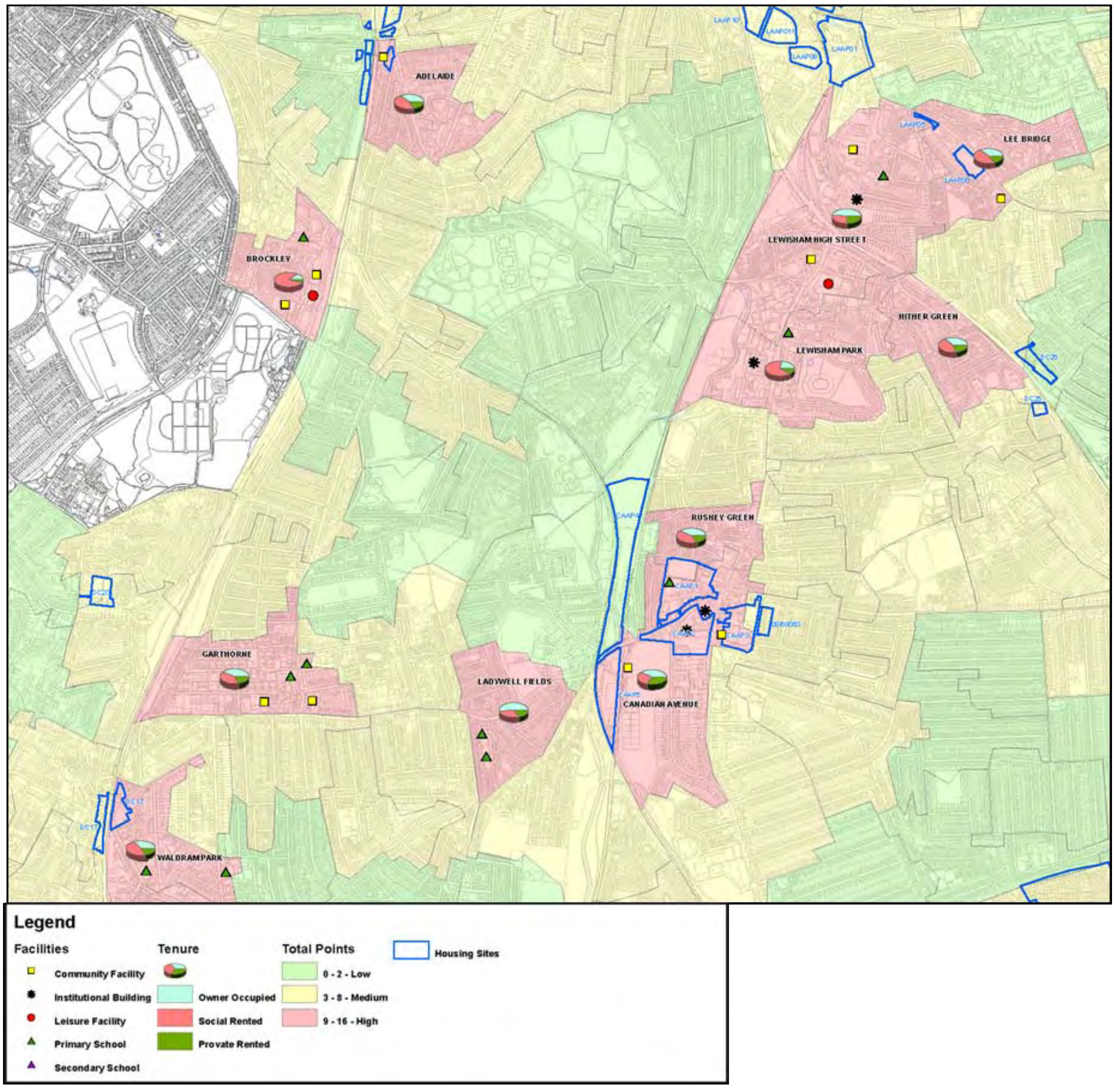
Centre of the Borough

5.49 Another concentration of LSOA's with potential for funding and housing stock improvements is situated in the centre of the Borough, positioned along Lewisham High Street. The map shows that there are four red LSOA's, identified as Adelaide, Brockley, Garthorne and Ladywell Fields, on the perimeter of this section and a concentration along the high street, which stretches from Canadian Avenue in the south to Lee Bridge in the north.

5.50 Primary and secondary schools and community centres are spread out rather evenly throughout this section. However, the main amenities and public facilities are located along this north-south concentration. These include the University Hospital Lewisham and its associated facilities, as well as Lewisham Town Centre.

5.51 Some 45% of dwellings in the red LSOA's of this section are social rented accommodation. Owner occupied dwellings make up 37% of the existing housing stock and 18% is private rented accommodation. Of the housing stock in targeted LSOA's, 40% are purpose built flats. Converted flats consist of 27% of dwellings and 22% are terrace housing. The housing stock in this LSOA's is more mixed with detached and semi-detached properties also represented at 11%.

Figure 5.5 – Carbon Reduction Priority Areas - Centre of the Borough

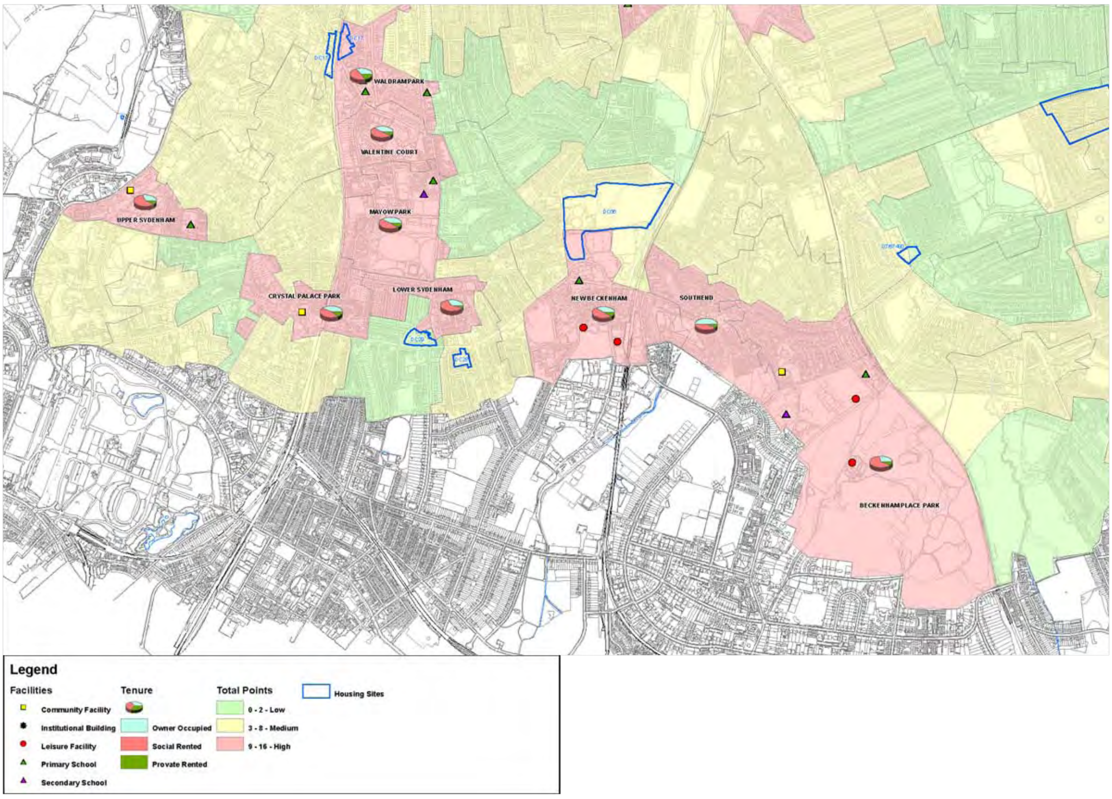


South of the Borough

5.52 There are a fewer sites in the south of the Borough that have the potential for future development. All but one of these sites are situated along the edges of the red LSOA's, and are ideally located to deliver area wide energy to the dwellings in these areas. The red LSOA's in this part of the Borough have leisure facilities, community facilities and primary and secondary schools for their residents, but residential dwellings are the predominant use.

5.53 The housing type in the targeted areas in this section is chiefly purpose built flats, as is the case for the Deptford and New Cross and Lewisham High Street sections. In the south of the Borough, the proportion of purpose built flats is 56%. Other than purpose built flats, terrace housing make up 20% of the housing stock and 13% are flat conversions. The remaining minority is also detached and semi-detached houses, at approximately 11%.

Figure 5.6 – Carbon Reduction Priority areas South of the Borough



Estimating need for energy efficiency improvements

5.54 The English Housing Condition Survey (EHCS) is a national physical survey of the existing housing stock in England, and is commissioned by Communities and Local Government. The EHCS merged with the Survey of English Housing (SHE) in 2008 to form the English Housing Survey (EHS). The survey covers all tenures and housing types and involves a physical inspection of a sample of properties by professional surveyors. These findings are then extrapolated to provide representative data for different housing types and tenures.

5.55 The surveys examined for this report provide information on energy use and the efficiency of the existing housing stock. The information acquired from the EHCS has been related to Lewisham Borough. This section identifies an estimate of those dwellings within Lewisham's housing stock that have inefficient energy use and would benefit from energy efficiency measures.

5.56 The 2006 EHCS data reveals the proportion of dwellings without central heating and dwellings without loft insulation. As aforementioned, it has been assumed that this proportion can be related to Lewisham Borough. As such, the probable proportions and number of different housing tenures without central heating and without loft insulation are shown in Table 5.2 below.

5.57 The statistics on dwellings without double glazing can be seen in Table 5.3 below. Unlike the statistics on central heating and loft insulation, the figures on housing without double glazing are based on housing types.

Table 5.2 – Estimated dwellings in need of selected improvements

	Tenure			Without Central Heating (EHCS)			Without Loft Insulation (EHCS)		
Priority Area	**Owner Occupied**	**Social Rented**	**Private Rented**	**Owner Occupied**	**Social Rented**	**Private Rented**	**Owner Occupied**	**Social Rented**	**Private Rented**
				8.70%	**21.90%**	**13.30%**	**3.80%**	**6.20%**	**1.60%**
Red	6184	11478	2674	538	2514	356	235	712	43
Yellow	27248	20651	8663	2371	4523	1152	1035	1280	139
Green	20410	6091	4072	1776	1334	542	776	378	65
Total Dwellings	**53842**	**38220**	**15409**	**4684**	**8370**	**2049**	**2046**	**2370**	**247**

Table 5.3 - Estimated Dwellings in need of Double Glazing

	Housing Type					Without Double Glazing				
Priority Area	**Detached**	**Semi Detached**	**Terrace Housing**	**Purpose Built Flat**	**Flat Conversion**	**Detached**	**Semi Detached**	**Terrace Housing**	**Purpose Built Flat**	**Flat Conversion**
						9.00%	**11.00%**	**19.00%**	**27.00%**	**48.00%**
Red	418	1338	3583	11916	3032	38	147	681	3217	1455
Yellow	1595	6705	18364	16846	13166	144	738	3489	4548	6320
Green	1197	6030	12489	6797	4182	108	663	2373	1835	2007
Total Dwellings	**3210**	**14073**	**34436**	**35559**	**20380**	**289**	**1548**	**6543**	**9601**	**9782**

Table 5.4 – Potential CO2 reductions if improvements are made

	Central Heating			Loft Insulation			Double Glazing				
Priority Areas	**Owner Occupied**	**Social Rented**	**Private Rented**	**Owner Occupied**	**Social Rented**	**Private Rented**	**Detached**	**Semi Detached**	**Terrace Housing**	**Purpose Built Flat**	**Flat Conversion**
Red	949,046	4,434,135	627,352	123,919	375,269	22,561	15,650	61,227	283,200	1,338,405	605,430
Yellow	4,181,696	7,977,812	2,032,444	546,014	675,178	73,093	59,717	306,821	1,451,491	1,892,143	2,628,987
Green	3,132,282	2,353,051	955,340	408,989	199,143	34,357	44,816	275,933	987,131	763,439	835,062
Total	**8,263,024 kgCO2/yr**	**14,764,998 kgCO2/yr**	**3,615,136 kgCO2/yr**	**1,078,922 kgCO2/yr**	**1,249,590 kgCO2/yr**	**130,011 kgCO2/yr**	**120,182 kgCO2/yr**	**643,980 kgCO2/yr**	**2,721,821 kgCO2/yr**	**3,993,987 kgCO2/yr**	**4,069,478 kgCO2/yr**
Total Savings	**26,643,158 kgCO2/yr**			**2,458,523 kgCO2/yr**			**11,549,450 kgCO2/yr**				

Energy Saving Trust's Homes Energy Efficiency Database (HEED)

5.58 The Homes Energy Efficiency Database (HEED) is a national database that is designed to monitor carbon reduction and fuel poverty in existing housing. The database tracks the sustainable energy characteristics of the UK's housing stock and collects datasets on energy efficiency and property survey information, such as Energy Performance Certificates. According to the Energy Saving Trust, the HEED currently represents approximately 42% of the existing housing stock, as it describes over 10 million UK homes.

5.59 The information provided in the HEED and ECHS on energy saving features in housing are similar. Both surveys provide information regarding double glazing, loft insulation, central heating and several other features. However, a chief difference between the two sources is that the HEED provides total figures on energy saving features, whereas the EHCS divides its findings on features according to different categories of housing and provides a more defined level of information.

5.60 For example, the HEED data (Table 5.5) identifies the total number of households, and their corresponding percentages, which have different kinds of loft insulation, or none at all. However, the EHCS (see Table 5.6) provides the same data on loft insulation but divides it according to either housing types, tenure, NRF district, broad region or dwelling age. The tables below provide a comparison between a HEED table regarding loft insulation and an EHCS table regarding to loft insulation based on tenure.

Table 5.5 – HEED Data – Loft Insulation

Loft Insulation		
Properties with no loft insulation	5,111	10.1%
- less than 25mm	526	1.0%
- with 25 - 49mm	1,299	2.6%
- with 50 - 74mm	2,559	5.1%
- with 75 - 99mm	1,856	3.7%
- with 100 - 149mm	3,610	7.2%
- with 150 - 199mm	1,609	3.2%
- with 200 - 249mm	663	1.3%
- with 250 - 299mm	953	1.9%
Unknown / Not Available	32,238	63.9%
Total :	**50,424**	**100%**

Table 5.6 –ECHS Data – Loft Insulation by tenure

	no insulation	less than 50mm	50 up to 99mm	100 up to 149mm	150 up to 199mm	200mm or more	no loft	total
								thousands
Owner occupied	594	514	3,351	5,609	2,178	2,460	735	15,442
Private rented	161	71	697	667	211	221	582	2,611
Local authority	41	31	195	551	240	422	607	2,086
Registered social landlord	22	17	168	495	287	416	444	1,850
Total	**819**	**633**	**4,412**	**7,322**	**2,916**	**3,520**	**2,368**	**21,989**

Carbon savings and indicative retrofit cost estimates

5.61 The next stage was to quantify the possible carbon dioxide emissions which could be saved if measures to improve energy efficiency were implemented within those dwellings which would benefit from such measures.

5.62 The potential savings and indicative unit costs are illustrated in Table 5.7. Details are provided for a range of potential energy saving measures, along with their corresponding installation costs and savings (energy, fuel cost and carbon emissions).

Table 5.7 - Energy Efficiency Options

Measure[27]	Costs/£[27]	Net Energy Savings[27]		
		Energy kWh/yr	Fuel Cost £/yr	kgCO2/yr
Cavity Wall insulation	454.33 (could be reduced to £250 with grant)	3012	77.86	634 (up to 800[28])
Loft insulation (professional)	346.36	1489	38.41	313
Loft insulation 0 – 270mm[28]	250 (based on grant availability)	5087	£205	1000
Loft insulation (DIY)	147.54	1277	32.95	269
Solid wall insulation (external) - to U value of 0.35W/M2k	4682.85 (typically 45 to 65m2	10502	271.23 (up to 500[28])	2210 (up to 2500[28])
Solid wall insulation (internal) - to U value of 0.45W/M2k	3180.78 (professional installation)	9928	256.45 (up to 470[28])	2090 (up to 2400[28])
Insulated wallpaper	1819.89	3417	95.3	719
Tank insulation top up	17.75	800	20.27	168
Draught proofing	125.58	631	16.3	133
Glazing E to C rated	259.40	389	10.08	82
Glazing C rated in place of single glazed units[28]	*2500*	*3474*	140	750
A rated in place of B (building reg minimum) rated boiler installation	262.07	1866	43.58	356
A rated (condensing) in place of conventional boiler[28]	2,250	4218	170	875
Fuel switching oil, elec or coal to gas	2182.56	7116	502.19	4061
Heating controls - upgrade with boiler	112.58	181	4.3	35
heating controls - extra	183.49	1457	34.62	282
CFLs	4.125	8	2.08	8
Efficient halogens	3.22	3	0.88	3

[27] Data sourced from summary report of energy efficiency measures carried out throughout the EEC programme. Based on a 3 bed semi-detached house. The cost is an average of the information provided for both priority group housing and other housing. Costs based on significant economies of scale achieved by Energy Suppliers during the EEC programme
[28] Data sourced from The Energy Saving Trust. Heating savings based a gas heated semi-detached house, with 3 bedrooms, with a gas price of 4.03p/kWh

5.63 Of the measures identified insulation (wall and loft) are the two measures which should be initially addressed due to their cost/benefit attributes. However, the type of wall insulation that can be installed is dependent on the construction technique of the building. Dwellings built post 1920 were typically constructed with cavity walls, consequently these dwellings should be targeted as an immediate priority.

5.64 A significant proportion, over 50%, of dwellings in Lewisham was constructed pre 1919. This type of building stock provides conflicting opportunities, whilst these buildings typically consumer greater amounts of energy, they are inherently more expensive to improve. Solid wall insulation (internal or external) is therefore necessary for these dwellings, if deemed to be a priority cost-effective measure.

5.65 Aggregate CO2 savings for all priority area categories are provided within Table 5.4. It shows that replacing all conventional boilers in the Borough with A rated boilers and switching from oil, electricity or coal to gas could save a net figure of over 26.6 million kg of CO2 emissions per year (kg CO2/ year). By ensuring all single glazed windows are replaced by at least a C rated glazing, Lewisham could save approximately 11.5 million kgCO2/year. Loft insulation installations in homes, ranging between 50mm and 270mm, could reduce the Borough's carbon emissions by over 2.4 million kg CO2/year.

5.66 Table 5.8 shows annualised savings based on the application of measures over the course of the LDF period. The number of dwellings adapted each year for each measure is reflects the EHCS average of 4% of the existing housing stock was improved each year between 2001 and 2005.

5.67 Assuming this rate of improvement 76% of the existing dwellings which would benefit from improvement would be tackled by 2025. The annual cost of implementing central heating improvements to 604 dwellings per year would be some £945,425. The annual cost for installing loft insulation to 186 homes each year is £46,243 and the cost of fitting double glazing windows to 1,111 dwellings would be £1,532,190.

Energy Efficiency Conclusions

5.68 The assumptions described above can be used to provide an alternative (lower) CO2 saving compared with the one assumed within national Government targets. The pace of implementation which will be achievable will depend of the resources and incentives available to the Council, landlords and owners to tackle energy efficiency.

5.69 Energy efficiency in the existing building stock is seen as one of the key cost effective measures of reducing carbon emissions and should be a key policy requirement, whilst it is recognised that obtaining funding is critical.

5.70 Lewisham is making excellent progress and will need to continue with the good work of initiatives such as the Energy Action Zone (EAZ) scheme and assist residents understand the government help, grants and funding on offer, advise occupants on the benefits of energy efficiency and promote the uptake of schemes such as Warmer Homes Grants, the Warm Front Programme, CERT grants up to 2011/2012 and other programmes.

5.71 The completion of EAZ throughout the Borough will provide the necessary information, through communicating with residents (letters, door step visits & household surveys), to help understand the available energy efficiency and low and zero carbon technology opportunities.

5.72 To achieve the required energy efficiency improvements in the existing stock and to consequently meet the required CO2 emission reductions, relating to national indicator 186, the Council will need to develop policies further to address the challenges and opportunities presented in the Borough.

5.73 To support the development of energy efficiency policy, the Borough can utilise data sourced from SAP ratings and EPCs for Social Housing, to assist the prioritisation of dwellings/buildings for energy efficiency improvements. The Borough could also consider using a system such as EcoHomes XB to develop a strategy and implementation plan.

5.74 Lewisham will need to follow the results of the Government Low Carbon Transition Plan and related consultations and update its Carbon Reduction and Climate Change Strategy in due course to implement its recommendations.

Table 5.8 - Indicative Costs of Improvements at existing take up rates.

	Base Housing Stock	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Without Central Heating	**15104**	604	1208	1812	2417	3021	3625	4229	4833	5437	6042
Cost per Year		£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425
Without Loft Insulation	**4662**	186	373	559	746	932	1119	1305	1492	1678	1865
Cost per Year		£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243
Without Double Glazing	**27763**	1111	2221	3332	4442	5553	6663	7774	8884	9995	11105
Cost per Year		£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190

	Base Housing Stock	2017	2018	2019	2020	2021	2022	2023	2024	2025
Without Central Heating	**15104**	6646	7250	7854	8458	9062	9666	10271	10875	11479
Cost per Year		£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425	£945,425
Without Loft Insulation	**4662**	2051	2238	2424	2611	2797	2984	3170	3357	3543
Cost per Year		£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243	£46,243
Without Double Glazing	**27763**	12216	13326	14437	15547	16658	17768	18879	19989	21100
Cost per Year		£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190	£1,532,190

Retrofitting Renewable Energy Solutions to existing properties

5.75 The opportunities within the Borough relating to the existing stock would be to retrofit renewable energy generation to properties as a home improvement or through refurbishment. The key issues relating to retrofit of renewable and low carbon technologies are discussed below.

Technical and Cost Issues

5.76 Since the majority of buildings are not newly built, any extensive market penetration of on-site renewable energy technologies must eventually comprise of a majority of systems being retro-fitted to existing buildings. It is generally accepted that retro-fitting renewable technologies is a significantly more costly than integrating on-site renewable solutions during building construction. This is because the works required during retrofit often include extensive overhaul of the building's electrical and/or heat transmission system. In a commercial or public sector building, works may disrupt the normal operation of the building, with concomitant cost implications. In this case, retrofitting renewable solutions in the above building types becomes more convenient as part of a major refurbishment.

5.77 With renewable heat systems such as solar thermal or biomass boilers, extra costs and technical difficulties can be minimised by synchronising the retrofit with the cyclical replacement of all or part of the building's heating plant.

Building integration

Solar thermal and solar PV

5.78 These systems require optimal positioning of the collector surface. Building orientation and available surfaces for retrofit present opportunities as well as challenges for a successful retrofit. Solar PV offers the most opportunities, as these systems can be integrated with windows, skylights, solar shading, or the roof. Sloped roofs in the UK are often already oriented at the correct (or near correct) vertical angle for solar PV and solar thermal systems[29]. Orientation should be within 30° east or west of south, with orientation towards south being ideal. Adjacent or taller buildings, trees and other structures can present variable obstructions at different times of the year and day due to the angle of the sun during its daily traverse over the horizon, whilst deciduous trees may present a variable obstruction due to the above factors and seasonal loss of foliage.

5.79 Whilst diurnal and seasonal shading can be accurately simulated to assess viability on building simulation software, this is often considered too costly a process for smaller sites and often a suitably qualified person will be able to make a system viability assessment by a site visit before any works are attempted.

Biomass boilers, CHP and biomass CHP

5.80 Biomass boilers are a similar size to equivalent natural gas boilers, but they are not always interchangeable because of the particular fuel handling requirements for biomass. Whilst there is a choice of fuel handling and delivery mechanisms for biomass, these always require more space, so basement plant rooms may not always be suitable without extensive alteration. The potential pollution effects of biomass are a key issue. Where emissions would have a significant effect on

[29] This is between 30° and 45° in the UK, though a slope of up to 60° is acceptable [online] http://www.segen.co.uk/eng/solar/siting.htm

local air quality, biomass would probably not represent an appropriate renewable energy option. These issues are specifically relevant in conservation areas due to the visbility and height of stacks/chimneys. Where after mitigation these would have a significant effect on the character of Conservation areas or the setting of listed buildings then again biomass may not represent an appropriate option.

5.81 Space restrictions may lead to a decision to use pellets, as this fuel has a much higher volumetric energy density than woodchip, so presents a reduced storage challenge but with higher fuel costs. Vehicular access to the plant room or storage facility is also necessary, and this may require extra road building to facilitate access. In most cases, the heat distribution system is unaffected by the integration of a biomass thermal system.

5.82 Natural gas CHP and biomass CHP have greater requirements beyond biomass heat systems, because the plant requires more space than boilers. In response to this, manufacturers have introduced containerised modular designs which may be situated adjacent to the building(s) they are serving. Site specific extensions to the heat distribution pipe-work are therefore necessary.

Wind power

5.83 Small wind systems require a wind survey lasting six months to a year to establish the wind resource at a site which may vary greatly from the area wind resource information available in the public domain. Large buildings may be compatible with turbines of several kW capacity on a flat roof, but this practice is not widespread. Instead, ground mast mounted turbines are usually chosen, but extensive grounds free from obstructions such as trees and other buildings will be necessary to ensure performance near or equal to that quoted by the manufacturer. In an urban setting, the turbine(s) are unlikely to be situated so far from the building that cabling losses or grid connection becomes significant. Micro building-mounted wind systems need robust mounting to avoid vibration problems. This is unlikely to be a problem for larger buildings, but careful mounting is required for houses.

GSHP and ASHP

5.84 GSHP presents a challenge for retrofit, although it is entirely possible in many buildings, especially those which already have an under-floor heating system. If a building does not have one, the floor(s) will have to be removed for the fitting of a lower temperature underfloor system or alternatively large low temperature radiators can be installed. An area of land adjacent to the building will also need to be available for excavation in order for the laying of “slinky” or other pipe-work under the ground. The area of land needed will be contingent upon the building’s heat demand and should ideally be based on a lower demand based on a refurbishment to reduce the building’s space heating needs. Boreholes are also suitable to be used as part of a renewable energy retrofit, but this can be a costly and technically demanding exercise as foundations and other subsurface works will need to be avoided or accommodated for.

5.85 Air-source heat pumps are much cheaper and technically less challenging to retrofit, as the system installation involves the main heat pump mechanism being fixed to the building or very close to it. It can also be fixed to the building envelope above ground if necessary. Again, ASHP may require a change to an underfloor heating system, but this is not always the case. ASHP systems require a buffer tank so space will need to be found for this before installation can take place.

Planning Permission

5.86 Recent changes to the General Permitted Development Order mean that certain types of micro renewables do not require the benefit of planning permission through a planning application.

Solar thermal and solar PV

5.87 Planning permission for these systems has been relaxed recently with the stipulation that panels/tubes should not protrude more than 200mm from the building. If they are not building mounted (free standing), they should not be more than four metres in height or less than five metres from the site boundary.

Biomass boilers, CHP and biomass CHP

5.88 CHP systems produce noise and this may need to be estimated before installation can take place, regardless of whether the installation is intended to be external or inside the building. Planning permission is likely to be necessary for an external installation. Special planning permission may be required if a flue exceeds one metre above roof height.

Wind power

5.89 Although Planning Policy 22 states that renewable energy installations should be encouraged, intended small wind systems should involve written permission from the relevant planning authority. An intended installation is also more likely to be successful if those owning/occupying adjacent properties are consulted prior to installation. Small wind systems are unlikely to breach noise limits, but complaints have been successfully lodged in a small minority of cases even though noise limits have not been breached. A full Landscape and Visual Impact Assessment will not be necessary in the majority of cases for small wind systems. Visual effects such as flicker can be a problem with any wind system, though its effects are greatly attenuated for smaller systems and this is unlikely to present a barrier to installation in most cases.

GSHP and ASHP

5.90 Planning permission is generally not required for GSHP, but a larger array may require planning permission insofar as it requires extensive engineering works. ASHP is not covered by Statutory Instruments at present, but legislation is expected soon. Therefore there is some ambiguity surrounding the planning requirements for ASHP, especially as regards objections on the grounds of noise which could necessitate a pre-installation noise assessment. This may be rendered unnecessary by forthcoming legislation[30].

[30] [online] http://www.energysavingtrust.org.uk/Generate-your-own-energy/Getting-planning-permission

6. Viability testing

Approach

6.1 PPS1 Supplement requires that local targets are tested based on evidence of local feasibility and potential for renewable and low carbon technologies to supply new development. Any targets set by the Council should be evidence based and viable having regard to overall site development costs. The approach should be consistent with securing the supply and pace of housing and not inhibit the provision of affordable housing.

6.2 This chapter considers these issues by testing the costs of different renewables technologies which may be deployed within the Borough including on site solutions and local energy networks.

6.3 To test the impact of different policy thresholds on viability there is a need to consider the cost of renewables options in the context of other site development costs in the Borough. This has been carried out using a number of development appraisal case studies.

Development Appraisal Framework and Assumptions

6.4 The development appraisal framework has been developed to be consistent with other studies being undertaken by the Council. The primary appraisal tool which has been used has been the GLA Three Dragons Toolkit, using default assumptions for Lewisham. Several pieces of information have been included within the model where locally evidence was available, which provides more up to date information for the Borough as whole:

Assumptions on values and revenues

6.5 Land values, revenues in different parts of the Borough and affordable housing assumptions have been utilised from the Affordable Housing Viability study undertaken for the Council by BNP Paribas to reflect changes in the housing market since the Three Dragons tool was last updated.

6.6 For each case study an allowance for Planning Obligations has been made with reference to the Draft Planning Obligations SPD.

Assumptions on Costs

6.7 The default construction costs used in the GLA Three Dragons model for the 50-200 units scheme and the 200-500 units were initially found to be at variance with prevailing BCIS costs (See Tables 6.1 and 6.2). Through initial testing this had a significant effect on scheme viability the difference was most marked for medium and larger sized schemes which included a higher proportion of flats. Instead the default costs were substituted with BCIS construction costs relating to each typology.

Table 6.1 – Comparison of Three Dragons Default Costs and BCIS Costs (based on heights) Q2 2009

Cost Input	GLA 3 Dragons Default Costs	BCIS - Costs for London Postal Districts
Flats (5 & less storeys)	£1,695	£1,079
Flats (6-15 storeys)	£2,307	£1,298
Flats (16-40 storeys)	£2,970	£1,673

6.8 It is also possible to relate BCIS costs to floor areas used for each typology. The floor areas inserted into the BCIS database were based on the average floor space for the units in each scheme.

Table 6.2 – Comparison of Three Dragons Default Costs and BCIS Bespoke Costs Q2 2009

Development Types	GLA 3 Dragons Default Costs	BCIS - Costs for London Postal Districts
Individual Semi-detached/ detached	£1,261	£985
Individual Terrace	£1,261	£1,089
Individual Flat Conversion	£1,104	£1,013
Small development circa 10-50 units/flats	£1,695	£1,079
Housing/mixed use site >50-200 units	£1,695	£1,079
Housing/mixed use site >200-500 units	£2,307	£1,298
Housing/mixed use site >500+ units (excluding CHP)	£2,970	£1,673

Relationship with Code for Sustainable Homes

6.9 The GLA Toolkit provides a linear appraisal of a certain proposal and balances basic cost and sales assumption to provide an output on viability. The primary position from which construction cots have been considered are the requirements of (Part L of Building Regulations). Construction costs, therefore, were adjusted to also reflect the costs associated with the Codes for Sustainable Homes Levels 3 and 4 (CfSH) and BREEAM “Very Good” and “Excellent” Ratings.

6.10 Information on the costs associated with Code for Sustainable Homes have been drawn form the ‘A Cost Review of the Code for Sustainable Homes’ (Cyril Sweett, Feb. 2007) and ‘Cost Analysis of The Code for Sustainable Homes’ (Communities and Local Government, Jul. 2008). These two documents provided cost estimates associated with different dwellings types for each level of the code. Table 6.3 provides a summary of the overall costs of Code for Sustainable Homes. The construction and infrastructure costs in the code not linked to renewables were separated from to avoid double counting and to enable modelling of Lewisham specific costs rather than national defaults.

Table 6.3 – Costs of implementing Code for Sustainable Homes

	Flat £/ Unit	Flat Average Size 65.5 m2	Terrace £/ Unit	Terrace Average Size 85.0 m2
Code 1	£460 / Unit	£7 / m2	£275 / Unit	£3 / m2
Code 2	£1,648 / Unit	£25 / m2	£1,713 / Unit	£20 / m2
Code 3	£2,622 / Unit	£40 / m2	£2,899 / Unit	£34 / m2
Code 4	£4,318 / Unit	£66 / m2	£4,545 / Unit	£53 / m2
Code 5	£6,672 / Unit	£102 / m2	£6,936 / Unit	£82 / m2
Code 6	£12,003 / Unit	£183 / m2	£20,771 / Unit	£244 / m2

6.11 The table above relates only to flats and terrace housing, as these were the housing types examined in the case studies. The costs per square metre were used in determining the additional costs to each case study and thus testing the viability of a realistic and current proposal.

6.12 For BREEAM the cost adjustment factors have been drawn from the in house Faithful and Gould database of costs for completed schemes adjusted for 2009. The following construction cost adjustment factors were considered in relation to non-residential development.

Table 6.4 – BREEAM Cost Adjustment Factors

	% Increase in Cost
BREEAM PASS	0%
BREEAM GOOD	0.40%
BREEAM VERY GOOD	1.70%
BREEAM EXCELLENT	7%

Planning Obligations Assumptions

6.13 The consultant replaced the default Section 106 assumptions provided in the GLA Toolkit with locally representative package for each case study. The assumptions used the electronic calculator developed as part of the Planning Obligations SPD to derive "prioritised contributions" for each case study.

6.14 For affordable housing, a range of different of assumptions were explored which are discussed further below. The base case used was a 35% affordable housing threshold, although the impacts of increased thresholds up to 50% were considered (See Appendix E). A 70:30 split was assumed between social rented and intermediate housing and grant assumptions reflected the GLA toolkit assumptions.

Case studies

6.15 To consider the impact of the range of renewable energy generation targets in the Borough, seven different case studies representative of the range of different residential and residential led mixed use developments in the Borough were tested to consider the marginal and overall effect of the potential costs associated with possible renewable energy policy thresholds and their effect on the viability of development and housing delivery. The case study results are indicative of other similar sized developments in the Borough and link with the typologies and renewables portfolios described within Chapter 4 of this report.

6.16 The first three case studies tested were different types of individual dwellings. These were an individual semi-detached or detached house, an individual terrace house and a single converted flat. The remaining four case studies were larger in scale and were mostly mixed-use schemes. In order to use assumptions for each case study, similar sized schemes proposed in Lewisham were used as a basis for information. Below is a list of the typologies used for this exercise and the corresponding proposed development:

- Small development circa 10-50 units/flats – Example - 256 Lewisham High Street
- Housing/mixed use site >50-200 units – Example: Hindsleys Place and Perry Vale
- Housing/mixed use site >200-500 units – Example: 72-78 Connington Road
- Housing/mixed use site >500+ units (excluding CHP) – Example - Oxestalls Road.

Sensitivity testing

6.17 The potential impacts the possible renewable energy targets would have on the viability of each case study and development typologies in the Borough were established. A range of different factors were subsequently applied to reflect the achievement of required construction standards and thus explore the consequential impact on overall development costs and viability these assumptions had. The two core scenarios below were established, which used the following assumptions:

- Scenario1: Development in Summer 2009. Current residual land values and development and revenues, CfSH Level 3, BREEAM: Good, Affordable housing 35%.
- Scenario 2: Development in improved circumstances with10% Uplift in residual Land Values and revenues, 5% decrease in construction costs compared with Summer 2009, CfSH Level 4, BREEAM: Very Good, Affordable Housing 35%.

6.18 These scenarios were then used to explore the implications of different construction and infrastructure costs linked to potential renewable targets. The implications of alternative affordable housing thresholds are also considered below.

6.19 Appendix E includes the detailed appraisal findings and results which are summarised below.

Renewable energy establishment costs

6.20 The establishment costs for each renewable technology which were applied were drawn from the tables included within Appendix B and summarised in Chapter 4.

6.21 Technology costs were modelled for renewable contributions of 10%, 20%, 30%, 40% and 50% of total energy requirements for each case study and for each technology. For the purpose of sensitivity testing, it is appropriate to model individual technologies separately to explore potential limits. Should technologies be combined then costs will lie within the limits of the renewable energy technology costs identified.

6.22 The individual technologies which were tested included:

- Photovoltaic (PV);
- Wind energy (turbines, freestanding towers);
- Small hydro plant (SHP);
- Solar thermal hot water (SHW);
- Biomass boiler (BB);
- Ground source heat pumps (GSHP);
- Air source heat pumps (ASHP);
- Combined heat and power systems (CHP); and
- Biomass combined heat and power systems (BCHP).

6.23 The viability of centralised local energy network proposals was considered separately. The following sections highlight the significant effects the costs of the identified technologies have on the viability of the development typology case studies.

On site options

6.24 For each of the development typologies, Appendix C shows the range of cost assumptions. The two indicators (the cost per dwelling unit and the cost per sq.m) provide a basis of comparing costs between different development typologies and policy targets.

6.25 In general, it can be seen that for all technologies the cost per sq.m and the cost per unit decrease as the size of the development increases when comparing within the same policy targets.

6.26 On a cost per sq.m basis, Photovoltaic (PV) technologies are significantly more expensive than the other technologies at present compared with the other technologies. For an individual semi detached house with 20% of energy requirements provided by renewables (See Table C.2) the cost for PV is £303 per sq.m compared with most other technologies ranging between £45 and £55 per sq.m. Ground source heat pumps (GSHP) and gas CHP have lower costs than this at approximately £29 and £13 sq.m respectively.

Local Energy Networks

6.27 For the centralised local energy networks, the cost per sq.m for the options based on Biomass CHP (without oversizing or combination with other technologies) is between £15-£32 per sq.m, which is cheaper than an on site renewables solution. Those options combining Biomass CHP with other technologies were in the order of £45-£70 per sq.m.

Table 6.5 – Local Energy Networks Establishment Costs/sq.m

Local energy Network	Option 1	Option2	Option 3	Option 4	Option 5
Deptford and New Cross	£1.70	£18.88	£48.95	£19.57	£22.32
Lewisham Gateway	£26.95	£48.10	£31.48	N/A	N/A
Catford Town Centre	£15.25	£37.03	£67.05	£42.94	N/A

Current and Future Viability

6.28 These additional costs were added to the outputs of the GLA 3 Dragons Toolkit for each case study, in order to derive the impact of each renewable energy option on viability.

6.29 Table 6.6 shows the developer's return for each case study under Scenario 1, without the added costs of individual renewable energy technology. For the purpose of this exercise, it has been assumed that a developer's return must be above 15% for a scheme to be viable.

6.30 Table 6.6 shows that at 35% affordable housing all development case typologies would provide a profit despite the additional costs associated to achieving Code 3 and a "Good" BREEAM Rating.

Table 6.6 – Scenario 1 Viability Summary

Code 3 & BREEAM Rating: Good	Scheme Viable?	Developer's Return without renewables
1-9 Semi-detached/ detached units	YES	83.80%
1-9 Terraced Units	YES	57.00%
1-9 Flat Conversions	YES	34.20%
Small development circa 10-50 units/flats	YES	58.10%
Housing/mixed use site >50-200 units	YES	33.90%
Housing/mixed use site >200-500 units	YES	49.10%
Housing/mixed use site >500+ units (excluding CHP)	YES	60.80%

6.31 The viability of the same schemes was subsequently tested to reflect the Scenario 2 assumptions. The scenarios for each of the development typologies were adjusted to reflect improved circumstances. According to work conducted by BNP Paribas for the Council's Affordable Housing Viability Study, in Scenario 2, housing sales values are likely to improve and increase between 5% and 20%, while construction cost may drop by between 5%-10%. Therefore an assumption that housing sales values would increase by 10% and that construction costs decreased by 5% was adopted.

6.32 Table 6.7 shows that most of the returns likely to be achieved by developers in these improved conditions would increase significantly.

Table 6.7 - Scenario 2 Viability Summary with BCIS Costs

Code 4 & BREEAM Rating: Very Good	Scheme Viable?	Developer's Return without renewables
1-9 Semi-detached/ detached	YES	110.40%
1-9 Terraced units	YES	79.70%
1-9 Flat Conversions	YES	53.20%
Small development circa 10-50 units/flats	YES	81.80%
Housing/mixed use site >50-200 units	YES	53.60%

Housing/mixed use site >200-500 units	YES	71.60%
Housing/mixed use site >500+ units (excluding CHP)	YES	83.70%

Implications for different Policy targets - Scenario 1

6.33 The following is a summary of the impacts that the different policy targets (% of energy generation provided by on site renewables) would have on the viability assuming 35% affordable housing provision. Each technology has been considered separately assuming that it could provide all of the energy required from renewable sources to meet the target.

Delivering 10% Renewable Energy

6.34 All typologies would be viability with 0% of energy requirements met from on site renewables.

Table 6.8 – Delivering 10% Renewable Energy at Code 3 & BREEAM Rating: Good

Scenario 1: Code 3 & BREEAM Rating: Good									
Delivering 10% Renewable Energy									
Typology	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
1-9 Semi- detached / detached units	YES	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Terraced units	YES	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Flat Conversions	YES	YES	YES	YES	YES	YES	YES	YES	YES
Small development ca. 10-50 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 50-200 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 200-500 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site >500+ units	YES	YES	YES	YES	YES	YES	YES	YES	YES

Delivering 20% Renewable Energy

6.35 Delivering 20% of energy requirements from PV technology to flat conversions would not be viable. The viability of other typologies would not be affected significantly.

Table 6.9 – Delivering 20% Renewable Energy at Code 3 & BREEAM Rating: Good

Viability at Code 3 & BREEAM Rating: Good									
Delivering 20% Renewable Energy									
Typology	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
1-9 Semi- detached / detached units	YES	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Terraced units	YES	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Flat Conversions	NO	YES	YES	YES	YES	YES	YES	YES	YES
Small development ca. 10-50 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 50-200 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 200-500 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site >500+ units	YES	YES	YES	YES	YES	YES	YES	YES	YES

Delivering 30% Renewable Energy

6.36 In addition to flat conversions, the viability of mixed use schemes consisting of 10-50 units would be affected if PV technology were to be used to meet a 30% target for on site renewable energy generation. The other typologies would be viable.

Table 6.10 – Delivering 30% Renewable Energy at Code 3 & BREEAM Rating: Good

Viability at Code 3 & BREEAM Rating: Good Delivering 30% Renewable Energy									
Typology	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
Individual Semi- detached / detached	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual Terrace	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual Flat Conversion	NO	YES	YES	YES	YES	YES	YES	YES	YES
Small development ca. 10-50 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 50-200 units	NO	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 200-500 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site >500+ units	YES	YES	YES	YES	YES	YES	YES	YES	YES

Delivering 40% Renewable Energy

6.37 Delivering a 40% renewable energy target through PV technology would effect the viability of 1-9 terraced houses and schemes comprising of over 500 units. All other schemes and technologies would be viable under this target.

Table 6.11 – Delivering 40% Renewable Energy at Code 3 & BREEAM Rating: Good

Viability at Code 3 & BREEAM Rating: Good Delivering 40% Renewable Energy									
Typology	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
1-9 Semi- detached / detached	YES	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Terraced units	NO	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Flat Conversions	NO	YES	YES	YES	YES	YES	YES	YES	YES
Small development ca. 10-50 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 50-200 units	NO	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 200-500 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site >500+ units	NO	YES	YES	YES	YES	YES	YES	YES	YES

Delivering 50% Renewable Energy

6.38 In addition to those typologies identified previously delivering 50% renewable energy through PV technology would also effect the viability of schemes of 1-9 semi-detached / detached units. Other technologies would be viable in relation to each of the development typologies.

Table 6.12 – Delivering 50% Renewable Energy at Code 3 & BREEAM Rating: Good

Viability at Code 3 & BREEAM Rating: Good Delivering 50% Renewable Energy									
Typology	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
1-9 Semi- detached / detached	NO	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Terraced units	NO	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Flat Conversions	NO	YES	YES	YES	YES	YES	YES	YES	YES
Small development ca. 10-50 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 50-200 units	NO	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 200-500 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site >500+ units	NO	YES	YES	YES	YES	YES	YES	YES	YES

6.39 The figures show that PV technology is the only renewable energy technology that if relied upon for the sole technology for meeting targets would significantly diminish the viability of schemes significantly (assuming provision of 35% affordable housing). All other technologies would not have a significant effect on viability under these assumptions.

Implications for Different Policy Targets – Scenario 2

6.40 The following is a summary of the impacts that different renewable energy generation policy targets would have on the viability using the findings from the seven case studies relating to development typologies and the costs of individual technologies.

Delivering Renewable Energy under Scenario 2 Conditions

6.41 Under the improved financial conditions of Scenario 2, all of the development case studies are viable with the inclusion of the renewable energy technologies, up to and including the 40% threshold.

6.42 At a provision of 50% renewable energy, the viability of 1-9 terraced houses and 500+ unit schemes would be effected if the targets were to be met solely by PV technology.

Table 6.12 – Delivering 50% Renewable Energy at Code 4 & BREEAM Rating: Very Good

Scenario 2: Code 4 & BREEAM Rating: Very Good									
Delivering 50% Renewable Energy									
Typology	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
1-9 Semi- detached / detached	YES	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Terraced units	NO	YES	YES	YES	YES	YES	YES	YES	YES
1-9 Flat Conversions	YES	YES	YES	YES	YES	YES	YES	YES	YES
Small development ca. 10-50 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 50-200 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site> 200-500 units	YES	YES	YES	YES	YES	YES	YES	YES	YES
Housing /mixed use site >500+ units	NO	YES	YES	YES	YES	YES	YES	YES	YES

6.43 More of the case studies remain viable under Scenario 2, than under the Scenario 1 conditions, because of the assumptions used for improved market conditions. Although the costs of achieving Code Level 4 and a “Very Good” BREEAM Rating have been increased for Scenario 2, these have a negligible effect on the overall effect on viability and profit margins, due to the increase in sales values and reduction of construction costs, anticipated by BNP Paribas. However, there is a need for viability issues to be reconsidered as the CfSH escalator increases up to 2016.

Effect of potential electricity and heat generation revenue and Feed in Tariff and Renewable Heat Incentive

6.44 A significant element affecting the potential uptake and viability of renewable energy technologies is the effect of the introduction of the Feed in Tariff (FIT) and Renewable Heat Incentive (RHI) in April 2010. For renewables which are installed for to formal introduction of the scheme tariff payments will be back dated to July 15 2009 to avoid a delay in uptake.

6.45 The design of these incentives is intended to remove uncertainty and risk regarding the potential return on investment in renewables by:

- Simplifying grid connection;
- Guaranteeing a market for electricity generated by developments and fixing a price offered by electricity suppliers;
- Providing an additional tariff for electricity exported to the grid
- Providing a similar approach for heat (details not yet published);

6.46 In the next few months the Electricity suppliers who operate the grid (EdF in London) will be establishing their administration structures to reflect the new system.

6.47 The effect of these incentives will be to reduce the payback periods for renewable energy installations to between 5 and 10 years for most technologies and some 20-25 years for Solar PV. This will improve the business case for investing in renewables and may encourage developers to optimise opportunities relating to sites.

6.48 The Feed in Tariff has been designed to offer a 6-8% return on the initial investment to encourage take up. This is similar to tariffs operating in other European countries.

6.49 The tariffs have the potential to provide an additional revenue stream once the initial capital outlay has been paid off. The tariff is to be payable based on the amount of heat and electricity actually supplied and would represent a revenue stream to the developer rather than a cost. In this situation, a discounted cashflow approach would be appropriate for considering the viability for renewables rather than treating establishment of renewables as an up front cost.

6.50 However, many developers may not wish to diversify their business to administer the supply of electricity and receipt of tariffs and may opt to transfer the rights to receive generation and export tariffs (in the case of electricity generation) to a third party. The third party could be an owner occupier or RSL following completion and installation and commissioning of equipment. In this case the benefits accruing to the occupier would be reflected in the sales price of the dwelling (with the cost of installation passed on to the occupier/RSL). The operating costs associated with maintenance would also be transferred in this case. This option is likely to prove attractive due to the income tax allowances which are currently attracted for renewables installation.

6.51 With medium and high density developments with a high proportion of leasehold properties the rights may be transferred to a management company or landlord following completion of the development who would take on responsibility for the benefits and costs associated with renewables. In this situation, the developer could make a one off charge for the transfer of the right to generate alternatively. The benefits of generation could be offset from the overall service and maintenance charged once the initial capital costs have been paid off.

6.52 A third model would be a partnering approach whereby a developer partners with a renewable energy provider prior to construction of the development. The renewables partner would build, operate and manage the renewables elements of the scheme so the effect of the costs and benefits of installing renewables is neutral. Again the owner would be paid by the renewables company for the right to generate. Such a model could work equally well for dwellings of a single unit as well as larger schemes.

6.53 Given the limited life of the FIT tariff, which will last only to 2020, it is possible that landowners will seek to install renewables technologies on vacant or unoccupied sites and premises on a temporary basis in advance of development, especially as the credit crunch may delay the start of development.

Effect of Alternative Affordable Housing targets

6.54 The modelling of potential renewables options considered the implications of the cost of renewables on development viability, based on the assumption of an affordable housing provision at 35%.

6.55 The Council is seeking to establish a target of 50% affordable housing in the Borough within its Core Strategy document. The Affordable Housing Viability Assessment prepared by BNP Paribas has substantiated the potential for this to be delivered over the course of the plan period, particularly in improved market conditions and in circumstances when housing grant is available.

6.56 The affordable housing potential for individual sites will continue to be tested through use of the Three Dragons Affordable Housing Toolkit. In many circumstances affordable housing will be provided in the range between 35% and 50%.

6.57 It is important that renewable energy targets do not impact on the pace of housing delivery or the provision of affordable housing which may be achieved. However, planning obligations and appropriate renewable energy infrastructure is part of the package of infrastructure which is required to make development acceptable.

6.58 The marginal cost of renewable energy infrastructure for schemes is relatively small in terms of the impact on viability (for example typically a 0- 2% on overall costs for targets up to 20% for most technologies).

6.59 With reference to Appendix B, even when policy requirements for up to 50% on site energy generation are considered for large developments comprising of more than 200 units, the upfront cost of renewables installation would represent the equivalent revenue received for 2-4 units at sales prices in the Borough. For developments between 50 and 200 units, the figure is 1-2 units and for developments less than 50 units the marginal cost is around 15-30% of a unit.

6.60 To determine the effects a 50% threshold for affordable housing may have on viability, Table 6.13 summarises and compares the developer's returns of the case studies with potential affordable housing provisions of 35% and 50% under Scenario 2 using the Three Dragons Toolkit. The table shows how viability is affected in each case by the inclusion of an example renewable energy technology with 20% of energy requirements met by on site renewable energy.

6.61 Solar Hot Water was chosen to be tested as its cost lies close to the average for the domain of costs for different technologies[31]. This technology was subsequently tested against both 35% and 50% affordable housing provision.

Table 6.13 – Comparison of 35% and 50% Affordable Housing Provision

	Developer's Return				
	35% Affordable Housing with SHW		50% Affordable Housing with SHW		
Typology	**Return (£)**	**Return (%)**	**Return (£)**	**Return (%)**	**Difference in Return**
Example scheme - Small development ca. 10-50 units	£4,776,232	81.2%	£4,257,932	76.4%	4.8%
Example Scheme - Housing /mixed use site> 50-200 units	£4,536,899	51.5%	£4,141,199	49.2%	2.3%
Example Scheme - Housing /mixed use site> 200-500 units	£25,001,808	70.3%	£21,233,558	63.1%	7.3%
Example Scheme - Housing /mixed use site >500+ units	£57,466,394	79.2%	£47,056,440	70.2%	9.0%

6.62 The table shows that setting a requirement for a 50% affordable housing provision and assuming that a 20% renewable energy target met by a typical renewable energy technology (in this case, SHW technology) would be able to achieve a viable scheme for each of the typologies with more 10 or more units.

6.63 Moreover, the difference in return between a 35% provision and a 50% provision would not be substantial. For the case studies examined in the above table, the difference in developer's return ranges between 2.3% and 9.0%. As this variation is relatively small in percentage terms, it should not impose a disproportionate burden on the capability to secure deliver affordable housing or slow the pace of housing delivery.

6.64 Furthermore, with the introduction of the Feed in Tariff and the Renewable Heat Incentive in 2009/2010, installation of renewables will now represent a significant revenue stream and be a benefit to the developer rather than a cost.

6.65 However, the decision on the appropriate renewables strategy for a particular site would need to be made prior to development as costs escalate if equipment and supporting M&E systems are retrofitted. Therefore although the tariffs reduce payback periods they do not reduce the up front establishment and connection costs which may have an effect on viability.

6.66 Alternatively developers may seek to optimise the generation of renewables to reflect economies of scale, the business case for renewables and the tariff structures of electricity suppliers who are

[31] To determine this, the costs per sq. metre for all the individual technologies were averaged. The individual technology with the median cost per sq. metre was solar thermal hot water (SHW).

likely to offer greater generation tariffs within Power Purchase Agreements for larger electricity generators.

6.67 The next chapter considers the implications of the findings of the viability assessment for the establishment of policy targets.

7. Policy recommendations and targets

Introduction

7.1 The introduction of the Government's Renewable Energy Strategy and associated package of incentives is likely to impact on the market for renewable energy and improve the attractiveness of incorporating renewable energy facilities within new development and to smaller electricity and heat suppliers.

7.2 It will be important that the policy approach to be adopted in the Local Development Framework is sensitive to these changes. Targets should be flexible enough to avoid the up front capital investment costs of installing renewables impacting on overall scheme viability or the delivery of affordable housing whilst encouraging developers to 'try harder' to maximise the percentage of energy generation which is generated from renewable sources. Such an approach will facilitate lower per capita carbon dioxide emissions from the domestic sector in the future.

7.3 Whilst this study has considered the potential for renewable energy, the Council's approach acknowledges wider goals relating to reducing overall CO_2 emissions. This can be achieved by applying the Mayor London's energy hierarchy which seeks to reduce overall energy consumption through utilisation of low and zero carbon technologies within new development, delivering energy efficiently including use of decentralised energy networks as well as delivering renewable low and zero carbon energy.

7.4 The impact of policy targets relating to renewable energy interact with other wider polices relating to CO_2 emissions reduction and requirements of the Code for Sustainable Homes which include energy as an integral component. This study has modelled the effect of renewables targets in relation to other policy requirements (refer to Section 6).

7.5 Within Lewisham the potential for integration of renewable energy generation is influenced by the scale of renewable energy resources in the Borough and critically the viability and deliverability of development where facilities are to be provided in conjunction with development.

7.6 Consistent with guidance outlined in PPS1 Supplement requirements for renewable energy provision should not impact on the supply of new homes or the provision of affordable housing and the requirements for other infrastructure necessary to make development acceptable. Not withstanding the feed in tariffs available for renewable energy generation, these issues affect the financial viability of development which is influenced by the percentage of overall energy requirements which are provided on site as installation and connection needs to take place at the time of development and represents an up front cost. There is significant variation in the establishment cost of different types of renewable energy technologies.

7.7 These considerations set out within the evidence base have influenced the Council's emerging approach to establishing appropriate policy targets for renewable energy.

7.8 The Councils approach to renewable energy provision and related issues of sustainable design and construction, and energy efficiency are set out in Draft Core Strategy Policy 8.

Core Strategy Policy 8 Sustainable design and construction and energy efficiency

1. The Council will explore opportunities to improve the energy standards and other sustainability aspects involved in new developments. The Council would expect all new developments to reduce CO_2 emissions through:

   a) compliance with other Core Strategy policies on sustainable movement, local air quality, flood risk reduction and water management, sustainable design, open space and waste management; and

   b) application of London Plan policies relevant to climate change, air quality, energy efficiency, and sustainable design and construction. This would include the use of living roofs and walls.

2. Applications for all new developments with a floorspace of 1,000m^2 or 10 or more residential units) will be required to:

   - submit a sustainability statement according to the requirements of London Plan policy and the London Plan SPG on Sustainable Design and Construction to demonstrate how sustainability issues have been taken into account at all levels of design and construction;
   - provide an Energy Statement according to the requirements of London Plan policy and the London Plan SPG on Sustainable Construction and Design demonstrating the expected energy and carbon dioxide savings through a lean, clean and green strategy;
   - maximise the opportunity of supplying energy efficiently by prioritizing decentralised energy generation (clean) for any existing or new developments according to the requirements of London Plan Policy and promoting the use of SELCHP (South East London Combined Heat and Power Plant) as an energy source for the Mixed Use Employment Locations (MELs) in the Deptford New Cross area;
   - meet at least 20% of the total energy demand through on-site renewable energy (green).

3. All new development comprising of the creation of new dwellings will need to comply with the Code of Sustainable Homes standards by achieving:

   - Level 4 by 2010;
   - Level 5 by 2012; and
   - Level 6 by 2016.

4. All new minor and major commercial development will be expected to be built to a minimum of BREEAM (Building Research Establishment Environmental Assessment Method) Very Good standard, and incorporate renewable energy in line with requirements of the London Plan or national policy, whichever is the greater.

7.9

Policy framework and supporting justification

7.10 Section 2 of this report provides a summary of national, regional and local policies and guidance relating to renewable energy. This section demonstrates how the Council's emerging policy approach relates to guidance within national planning policy guidance and the London Plan.

7.11 It is important that Planning Policies are in general conformity with national planning policy and the London Plan unless other evidence supports a different policy approach.

PPS1 Supplement

7.12 PPS 1 identifies that planning authorities should provide a framework that promotes and encourages renewable and low carbon energy generation and that policies should be designed to promote and not restrict renewable and low-carbon energy and supporting infrastructure.

7.13 Planning authorities are expected to have an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies to supply new development in their area.

7.14 This study (Chapter 4 and Appendix C) has considered the potential renewable resources in Lewisham which are have the potential to make a significant contribution towards meeting the objectives of national planning policy guidance and the London Plan.

7.15 It is appropriate for planning authorities to:

- set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured;
- where there are particular and demonstrable opportunities for greater use of decentralised and renewable or low-carbon energy than the target percentage, bring forward development areas or site-specific targets to secure this potential;
- In bringing forward targets there is a need to set out the type and size of development to which the target will be applied; and
- ensure there is a clear rationale for the target and it is properly tested.

7.16 In considering a development area or site-specific target, this study has paid particular attention to opportunities for utilising existing decentralised and renewable or low-carbon energy supply systems notably SELCHP and to fostering the development of new opportunities to supply proposed and existing development.

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

7.18 When specifying requirements for new development to secure energy from decentralised and renewable or low-carbon energy sources, it is appropriate for the Council to set specific requirements to facilitate connection. These are set out below and are included within the Council's Planning Obligations SPD.

7.19 Well-founded development area and site-specific targets drawn up in line with PPS 1 Supplement should facilitate significant proportions of the energy supply of new development to be secured from decentralised and renewable or low-carbon energy sources.

7.20 Policies are required to demonstrate that what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities.

7.21 This study has considered the technical feasibility, costs of bringing sites to market and potential options for implementation of both decentralised energy networks and the portfolio of on site renewables options which can be deployed in the Borough. The assessment of viability included in Section 6 has also accounted for other planning obligations required to address the impact of development and the other development needs of the Borough.

7.22 The study has considered how renewable energy policies within the Core Strategy could interact with other policies in order that the expected supply and pace of housing development shown in the housing trajectory and the provision of affordable housing is not inhibited.

7.23 This chapter sets out how potential developers should be advised on the on the implementation of the local requirements, and how these will be monitored and enforced.

London Plan

7.24 The policies of the London Plan pre-date national planning policy guidance. The 20% Policy target included within Policy 4A.7 is linked to the reduction of carbon dioxide emissions through the generation of on site renewable energy unless it can be demonstrated that it is not feasible rather than the amount of energy generated (as identified within national planning policy guidance).

7.25 The Draft London Plan (October 2009) identifies that development should make the fullest contribution towards reducing CO2 emissions and established minimum requirements linked to national targets relating to the Code for Sustainable Homes and BREEAM.

7.26 This study has modelled overall energy consumption in the Borough to 2025 based on these national targets to identify the overall energy demand within the Borough in order to provide a baseline and trajectory against which progress can be monitored as development proposals incorporating renewable energy and other low and zero carbon technologies are implemented and improvements to the efficiency to existing stock are made.

7.27 The London Plan identifies an energy hierarchy which should be used to assess applications which afford priority to sustainable design and construction measures, followed by supplying energy efficiently including priority for decentralised energy production (including decentralised energy networks) and finally use of renewable energy.

7.28 Policy 4A.6 provides a sequential approach towards selecting heating and cooling systems for major developments prioritising linking to existing CCHP/CHP networks. However there is not currently a heat network linked to the SELCHP facility in the Borough. However, there are proposals to establish a London Combined Heat and Power network which could link facilities such as SELCHP and other new facilities generating clean/renewable energy with new development and existing communities.

7.29 The Government's Zero Carbon Consultation has defined a different hierarchy for consideration of managing carbon dioxide emissions in relation to zero carbon development which in order of priority identifies the following measures:

7.30 **Energy efficiency:** requiring all homes to be built to 'very high' standards of energy efficiency. Energy efficiency standards are regulated by the Code for Sustainable Homes and through Part L of the Building regulations.

7.31 **Carbon compliance:** is the minimum level of reduction in carbon dioxide emissions compared with to current building regulations that is required to be achieved on-site (including through renewable, low or zero carbon electricity generation and heat) or via direct connection of low and zero carbon heat (which does not include gas fired CHP).

7.32 **Allowable Solutions:** is a range of measures which that can be taken in the locality or further afield (including outside of the Borough) to deal with residual emissions that cannot be dealt with through carbon compliance measures alone. These solutions can cover regulated emissions (space heating, ventilation, hot water and fixed lighting) covered by Part L of the Building

Regulations and unregulated emissions including emissions from cooking and appliances. Allowable solutions would include commuted sums towards local energy efficiency programmes and retrofit of the existing building stock.

7.33 Consistent with the London Plan after opportunities for energy reduction have been considered, it is recommended that the policy approach in the Borough gives priority to on site generation where facilities can be accommodated in physical terms and take account of other policy considerations (i.e Carbon Compliance rather than allowable solutions).

7.34 The viability assessment has identified that in cost terms at least 30-40% of overall energy requirements have the potential to be accommodated on site without recourse to Allowable Solutions subject to compatibility with other planning policy objectives and space requirements. Only in situations where there are other physical or development constraints which preclude the use of on site renewables should allowable solutions be acceptable.

7.35 Within the three areas within the Borough (Deptford and New Cross, Lewisham Town Centre and Catford Town Centre) which have the potential to be served by decentralised energy networks the Council should prioritise these within the policy unless more appropriate on site solutions which deliver greater benefits in terms of energy generation or carbon dioxide savings are appropriate.

7.36 A key decision is to base local renewable energy policy targets on Carbon Dioxide savings or the % of energy which is generated from renewable sources (focusing on production).

7.37 The Council's proposed approach of linking carbon dioxide reduction targets with the Code for Sustainable Homes and BREEAM through policy is consistent with the London Plan approach.

7.38 The renewable energy target should be linked to the amount of energy generated as this provides a more effective basis to implement and monitor policies. Furthermore use can be made of the new national register is being created which will provide a database of both large and small scale renewable energy installations which can be used to assist in monitoring policy implementation including the period after occupation of the dwelling. At present it is not possible to establish whether equipment being installed is actually being used for their intended purpose or is operating effectively beyond claims made regarding optimal performance.

7.39 Based on the evidence provided in this study we have identified a range of policy options which would provide a sound basis for developing appropriate renewable energy targets within the Core Strategy.

Defining Renewable energy targets

7.40 Based on the evidence provided within this report the recommended approach to defining renewable energy targets is set out below.

Residential and residential led mixed use schemes

7.41 We recommend that a borough wide target is established for renewable energy generation. This would provide a benchmark against which proposals for development should be assessed using an open book approach to scheme assessment.

7.42 **Applications for all residential led schemes with ten or more dwellings and non residential development greater than 1,000 sq.m should meet a minimum of 20% of total energy demand through on site renewable energy (green).**

7.43 Energy demand should be calculated using Building Regulations (2006 publication) plus the energy demand associated with other energy uses not covered by Building regulations.

Reasoned justification

Renewables resource

7.44 An assessment of renewable and low carbon energy resources available in Lewisham has been undertaken. This is described in Section 4 of the report and associated Appendix B.

7.45 The main technologies which have potential for widespread application in the Borough for sites of all sizes are:

- Wind turbines;
- Photovoltaics;
- Solar water heating;
- Biomass heating;
- Biomass combined heat and power;
- Ground Source heat pumps;
- Air source heat pumps; and
- Small scale hydro power.

7.46 In addition there is significant potential for the establishment of local decentralised energy networks whereby, heat is supplied via CHP networks rather than on site. The greatest opportunities for deployment in the Borough exist within Deptford and New Cross, Catford Town Centre and Lewisham Town Centre. Smaller opportunities may also exist within future estate renewal programmes and in connection with major commercial, and retail development, and major health and secondary and tertiary education projects. There is an opportunity for SELCHP to anchor a heat network in the Deptford and New Cross area to provide heat to key development sites in this area. In addition, Section 4 has identified that there is scope to add additional sources of Biomass CHP generation to connect with the network.

7.47 There is scope for potential local energy networks in the Borough to be linked with the wider London Thames Gateway Heat Network which is being developed.

7.48 The scale of renewable and low carbon energy resources available within Lewisham are sufficient that the Borough can to fully contribute towards meeting national and regional targets for carbon dioxide emissions reduction taking into account of the conditions required to support deployment including physical characteristics, wider planning policy considerations and property market dynamics and viability issues.

7.49 In most situations there are likely to be a choice of renewable energy technologies which can be deployed to meet the targets. However, not all of the technologies which have been proven viable in financial terms will be suitable in every location. Within a built up urban area such as Lewisham the deployment of large standalone wind turbines in some locations may be constrained by a sustainable wind resource and compatibility with wider planning policy objectives. The deployment of biomass heating and CHP is dependent on having a sustainable feedstock source and strategy and transportation strategy. In addition, it is important that emissions from biomass heating/CHP facilities do not have a significant impact on air quality.

The renewables target

7.50 This study has modelled the effect of several potential renewable energy targets relating to 10, 20, 30, 40 and 50% of total energy demand for the following types of residential schemes which capture the range of developments represented within the Council's housing land supply trajectory. These include:

- Individual detached/semi detached dwelling which can be used to quantify individual dwellings or multiples of this housing type;
- Individual terrace or multiples of this housing type;
- Individual flat conversion;
- Development of 10-50 flats;
- Housing mixed use site >50 – 200 units;
- Housing mixed use site >200 – 500 units;
- Housing mixed use site >500 units.

7.51 Through examining a range of case studies an assessment was made of the potential renewable energy and associated CO_2 savings which could be provided by different technologies for each policy target for in relation to each typology. In addition, the cost of installing each solution was established using recognised cost benchmarks (refer to Section 4 and associated Appendix C).

7.52 The costs were then examined within the context of a development appraisal framework which was used to assess the impact on development viability. This included sensitivity testing of:

- Improvement in the local property market;
- Affordable housing targets;
- Interaction with Code for Sustainable Homes levels 3&4 and BREEAM;
- Typical developer contributions package; and
- Overall costs of development.

7.53 The outcomes of the assessment demonstrated that although the minimum target is set at 20% (compatible with the current approach set out in the London Plan) it is likely that higher levels of renewable energy generation could be secured over the life of the Core Strategy given especially given the introduction of the Feed in Tariff and Renewable Heat Incentive and likely improvement in property market conditions.

Cost and viability issues

7.54 With reference to Section 6, assuming implementation of CfSH Level 4 and securing an affordable housing provision of 35% (typical provision which is secured in the Borough and consistent with UDP Policy) a range of renewables technologies could be secured which could meet 50% of total energy demand which would not have an impact on development viability. The only technologies which would not prove viable are solar photovoltaics (PV) which are only viable to meet up to 20% of energy demand.

7.55 It is not recommended that a target greater than 20% of total energy consumption is established in policy at this time. This is because the Council wishes to maximise the supply of affordable housing in the Borough. An open book approach would enable a target greater than 20% minimum to be secured in circumstances when it is viable to do so.

7.56 Table 6.13 demonstrates that the difference in return between the 35% and 50% affordable housing target equates to a difference in the rate of return of between 2% and 9%. However a 20% target could still be secured with 50% affordable housing. Therefore 20% should be adopted as the minimum target.

7.57 Although a higher target could be established this may be incompatible with achieving greater levels of affordable housing provision for some development schemes.

Development types

7.58 The assessment has shown that although that there are variations in the cost of implementing renewable energy targets depending on scheme sizes (average cost per sq.m). Overall, the 20% target can apply to schemes of all sizes and locations within the Borough without having a significant effect on viability.

7.59 Although it is viable to apply renewable energy targets to smaller residential/mixed use schemes (less of less than 10 units) the policy is to be applied to schemes over this size. The Council will promote and encourage renewable energy generation in connection with smaller schemes but will not require it. This is because of the administrative and resource requirements of administering the target and because of the additional costs placed on development proponents in terms of the likely need to prepare a development appraisal/energy statement and obtain professional advice regarding the application of the targets and identification of appropriate renewables technologies.

7.60 It is recommended that the Council should review this position once the target is operational. The Council should consider preparing a Supplementary Planning Document or supporting guidance which demonstrates how on site renewable energy generation can be achieved for smaller schemes including where, when and how this can be achieved.

Use of near site and allowable solutions

7.61 The analysis of the costs on installing different renewables technologies has demonstrated that it is possible to meet the requirement on site without recourse to near site or allowable solutions for all development sizes.

7.62 However, other policy objectives may preclude the installation of some renewables technologies due to site conditions or where installation would cause significant effects. The circumstances where this may arise are:

- Where the site is located within an area of Metropolitan Open Land;
- Where the site is located within a Conservation area or its setting;
- Where the site has an effect on a listed building;
- In relation to stand alone wind turbines this may due to inappropriate site conditions and effects relating to noise, visual impact and residential amenity;
- In relation to biomass boilers and Biomass CHP where it is not possible to secure a sustainable feedstock source and method of transportation or where the proposed equipment to be installed would have a significant effect on local air quality;
- Where there is in sufficient space to install ground source heat pumps and other solutions are not appropriate.

7.63 In these circumstances it is appropriate to meeting the shortfall in energy demand and associated CO_2 reductions through an off site allowable solution. These should either be an alternative off site renewables solution where a firm proposal is identified and delivery is certain or a commuted sum payment which can be pooled to support specific carbon reduction projects in the Borough.

Application of the targets

7.64 The proposed Core Strategy Policy 8 enshrines the Mayor of London energy hierarchy principles for development proposals with 10 or more dwellings or 1,000 sq.m which the Mayor of London uses to assess major schemes referred to the Mayor.

7.65 The London Plan Policy 4A.1 provides the opportunity for policies to be applied to developments of all sizes and not only developments above a specific threshold and national planning policy guidance is clear that the size or type of development should not be a limiting factor limiting opportunities for renewables. In addition the Consultation Draft Replacement London Plan identifies that proposals should make the fullest contribution towards reducing carbon dioxide emissions.

Open book approach

7.66 It is necessary to undertake open book appraisal for developments of over 10 dwellings (where an assessment is already undertaken for considering planning obligations for affordable housing).

7.67 The assessment in combination with preparation of a Sustainability and Energy Statement can be used to establish whether a higher target can be achieved. An open book development appraisal (incorporating the Three Dragons affordable housing toolkit) can address the parameters which need to be considered to demonstrate financial viability and be used to model the (beneficial) effect of the Feed in Tariffs and the Renewable Heat Incentive through examining their effect over the course of the project. This requirement exceeds the existing Mayor of London Sustainable design and construction guidance but is a necessary consideration of the contribution of renewable energy is to be maximised.

Ready Reckoner

7.68 An electronic ready reckoner tool has been derived to summarise the findings of the evidence base in order that an assessment can be made of likely energy generation, and associated CO2 savings for a range of renewables technologies for different residential development typologies for any given renewable energy generation target. A sample ready reckoner example is included in Appendix G.

Energy Hierarchy and consideration of Local Energy networks

7.69 Within the context of the energy hierarchy after consideration has been given towards reducing carbon dioxide emissions. Prior to considering renewable energy the London Plan promotes the efficient supply of energy through encouragement of use and establishment of Decentralised/local energy networks.

7.70 The evidence base considered locations within the Borough where the establishment of renewable energy networks should be prioritised. The major opportunity is at Deptford and New Cross where planned development is concentrated and where there are opportunities to make use of SELCHP.

7.71 Section 4 demonstrates that establishment of local energy networks in Deptford and New Cross and at Lewisham and Catford Town Centre is feasible and commercially viable.

7.72 Table 7.2 summarises the contribution which potential options could make. Although the initial pre-feasibility work has provided an indication of potential contribution which local networks could make the options considered were not exhaustive and the scope of eth study did not account for the potential to connect with the wider London Thames Gateway Heat Network. There is likely to be scope for optimising networks following business case and pre-design stages to deliver greater contributions.

7.73 Not withstanding these considerations there is potential for such a network to achieve at least 35% of energy demand within schemes within Catford Town Centre, 40% at Deptford and New Cross and 50% at Lewisham Town Centre.

7.74 Compared with on site solutions a major benefit associated with these options is that they offer a much lower cost solution. Furthermore, in improved market conditions there may be potential for the renewables contribution here to be complemented by the addition of further on site renewables to increase generation capacity further if there is a sufficient business case and there would be no significant effect on viability.

7.75 Although, where local energy networks have the potential to be established it has been demonstrated that potential exists to satisfy a higher proportion of overall energy demand (>20%) from renewable sources than the minimum target. Within the context of the energy hierarchy, opportunities to reduce energy consumption through low and zero carbon technologies should be considered first before considering decentralised energy and renewables.

7.76 In this context, the Sustainability Statement and Energy Statement process should be used to establish and compare opportunities for decentralised energy and renewables for individual sites in conjunction with opportunities for carbon reduction.

7.77 Where it is demonstrated that local energy networks can make a contribution this should be prioritised to help underpin investment in network infrastructure.

Table 7.1 – Potential targets linked to local energy networks

Local Energy Network		Option 1	Option 2	Option 3	Option 4	Option 5	Potential renewable generation which may be achieved
Deptford and New Cross	Total Energy Requirement MW/hr yr	90,030	90,030	90,030	93,090	108,036	
	Renewable Energy Contribution MW/hr yr	35,819	22,163	16,790	34,924	40,297	
	% Renewable Energy Contribution	40%	25%	19%	38%	37%	40%
Lewisham Town Centre	Total Energy Requirement MW/hr yr	10841	8676	13008	N/A	N/A	
	Renewable Energy Contribution MW/hr yr	5892	2165	7070	N/A	N/A	
	% Renewable Energy Contribution	54%	25%	54%	N/A	N/A	50%
Catford Town Centre	Total Energy Requirement MW/hr yr	12124	32527	10647	37730	N/A	
	Renewable Energy Contribution MW/hr yr	3178	10193	1589	12232	N/A	
	% Renewable Energy Contribution	26%	31%	15%	32%	N/A	35%

Circumstances when higher targets may be sought

7.78 The consideration of on site renewables options and the potential for local energy networks has shown that the potential contribution of renewables does not vary significantly in the Borough given issues of development viability. In the Borough there is currently potential to achieve between 20%- 50% of total energy demand from renewable or low carbon sources.

7.79 On the basis of information contained within the Sustainability and Energy Statement and open book financial appraisal, the contribution which should be sought from renewables for individual proposals should reflect the level of Code for Sustainable homes to be achieved (and associated carbon dioxide emissions reduction) and the level of affordable housing and other planning obligations which have a significant influence on overall development viability.

Other types of development

7.80 For other types of development the specific opportunities for on site renewables generation and possible CO_2 savings are influenced very much by specific user requirements. This study has not considered these specific opportunities given that details regarding the opportunities and the energy profile of future users are not yet known.

7.81 The recommended approach is that the Council should seek contributions for non residential proposals with more than 1,000 sq.m of floorspace.

7.82 Major opportunities exist in relation to major institutional users such as the Council, Goldsmiths College, Schools, and University Hospital Lewisham. In addition, larger scale A, B and D -class uses also have the potential to accommodate significant renewable energy generation capacity.

7.83 Using the approach set out in the Mayor of London Energy Toolkit, applicants should establish the likely energy usage profiles at the outset of development and agree with the Council appropriate options to be considered.

7.84 The policy should identify that the Council is seeking to maximise the potential for development to meet energy requirements through the establishment of on site renewable energy generation.

7.85 The package of regulation and incentives included within the Government's Renewable Energy Strategy particularly the Renewables Obligation provides a significant incentive for commercial, retail, industrial, and institutional users to actively consider renewable energy generation. Non residential users normally have greater energy requirements so any opportunity for occupiers and users to make cost savings has the potential to improve their competitive advantage.

Other DPDs and SPDs

7.86 Whilst the Core Strategy is the appropriate document to include policies identifying opportunities for renewable energy including borough including locational or site specific targets for on site generation. It is appropriate for renewable energy issues to also be addressed within other DPDs in order to establish how policies should be applied and implemented.

Development management policies DPD

7.87 This document should include a criteria based policy outlining the considerations which will be taken into account in assessing renewable energy proposals either as stand alone proposals or integrated with other types of development.

7.88 The purpose of the policy would be to contribute towards national and regional targets for carbon dioxide emissions reduction and to generate a greater proportion of energy from renewable sources. Further justification is provided by the wider environmental, economic and social benefits associated with renewable energy generation which may be secured.

7.89 Proposals for development to generate energy from renewable sources should normally be permitted (including the facilities and any associated transmission lines and heat or power connections, buildings and access roads) provided that the following considerations are addressed and there are no significant adverse impacts on:

- Historic environment including townscape, Conservation Areas and the character or setting of listed buildings;
- Landscape, townscape or visual impact (in terms of their siting, layout, design);
- Ecological designations;
- Local air quality (a key consideration for biomass heat and biomass CHP); and

- Residential amenity in respect of noise, dust, odour and traffic generation.

7.90 In addition provision should be made for the removal of the facilities and reinstatement of the site, should facilities cease to be operational.

7.91 For biomass CHP projects, the need to transport crops to the energy production plant does have the potential to lead to increases in traffic. The Council should make sure that the effects of such increases are minimised by ensuring that generation plants are located in as close a proximity as possible to the sources of fuel that have been identified. In addition, consideration should be given to the transport of biomass feedstock by water including the utilisation of safeguarded wharf facilities in the Borough.

7.92 In terms of considering appropriate technologies for specific sites officers should use the London RenewablesToolkit (2004) prepared by the London Energy Partnership and published by the Greater London Authority. The document provides a series of flow charts to guide the assessment and selection of individual sites for renewable energy technologies.

Requirement for Sustainability Statements

7.93 Consistent with Core Strategy Policy Option 23 on Sustainable Design and construction and energy efficiency and in accordance with Policy 4A.3 applicants for large developments are required to submit a sustainability statement.

7.94 Throughout the London Plan reference is made to 'major development' but this does not appear to be defined. Option 23 of the Council's Core Strategy options also usefully refers to a threshold. Distinguishing the scale of development is a helpful mechanism to the development of a policy approach and its enforcement. In the Mayor of London Order 2008 large scale development is (amongst other things) defined as:

- Category 1A - Development which comprises or includes the provision of more than 150 houses, flats, or houses and flats.
- Category 1B - Development (other than development which only comprises the provision of houses, flats, or houses and flats) which comprises or includes the erection of a building or buildings outside Central London and with a total floorspace of more than 15,000 square metres.

7.95 However, this definition is not necessarily the same as 'major development' a term that is also used throughout the London Plan. European Directives set the 1,000 sq m trigger which is becoming more universal.

7.96 This study has identified that there are opportunities to secure on site renewable energy generation from small developments including those less than 10 units in size. However, it would not be appropriate for individual householders to prepare a Sustainability Assessment. Instead requirements could be established within a Supplementary Planning Document dealing with residential design or sustainable design and construction which provide guidance on how the policy should be applied.

7.97 For developments of more than 10 dwellings it would be appropriate for a sustainability statement to be prepared which establishes the potential for renewable energy provision. The objectives of a strategy should be to:

- Apply the energy hierarchy;
- Considered how potential on and near site renewables generation can be maximised;
- Demonstrate that costs and potential benefits have been considered including interaction with other policy requirements; and
- Demonstrate that full consideration has been given to the potential delivery options.

7.98 The information included within the strategy and the steps taken to complete the strategy are described within the London Energy Toolkit as amended by recent changes in Government Policy.

7.99 The key steps to be followed are:

- Draw up a shortlist of renewable technologies to consider;
- Calculate predicted annual energy demand of the site using the benchmarks provided in this report;
- Calculate baseline carbon dioxide emissions for the development using latest carbon emissions factors (benchmarks included in this report);
- Calculate the contribution of each proposed renewable energy technology;
- Calculate the costs of technically feasible renewable technologies including establishment, connection and finance costs;
- Calculate the revenue to be received through Renewable Obligation Certificates (ROCs) Feed in Tariffs (generation and export components) and Renewable Heat Incentive (RHI);
- Demonstrate that consideration has been given to the potential business case and Power Purchase Agreement with an Electrical Supplier;
- Assess the benefits of technically feasible renewable technologies including end user benefits considering whole life costs, local and global benefits and developer benefits;
- Calculate the reduction of baseline carbon emissions for the development;
- Calculate the annual amount of electricity (KW/he per year) and/or heating or cooling (Kw/hth per year) which will be met by on site renewables or from near site renewables taking account of delivered energy and end use demand taking account of efficiency and the coefficient of performance;
- Within the development appraisal show the effect of the costs of renewable energy generation options with other Planning Obligations including affordable housing;
- Identify the approach to be taken for the operation and long term maintenance of the installation;
- Provide justification for the preferred approach to meet the requirements of the policy;
- Provide proposals for inclusion in a Planning Application; and
- Derive requirements to be included within a Planning Obligation.

Requirements for inclusion in Design and Access Statements

7.100 Design and access statements when they are required should identify how renewable energy facilities will be successfully integrated with development. Key issues for consideration include:

- Location and siting of renewable energy facilities;
- Space requirements of proposed renewables portfolio;
- Conservation areas and listed buildings;
- Siting and screening of plant;
- Access arrangements for maintenance and servicing;
- Connections to local energy networks; and
- Design guide sustainable design and construction.

Site specific allocations DPD and AAPs

7.101 The Site specific Allocations DPD should refer to renewable energy policies and targets identified within the Core Strategy including any opportunities relating to particular sites.

7.102 The Lewisham and Catford Town Centre AAP documents when they are taken forward should give consideration to how on site generation targets identified within the Core Strategy should be implemented within these areas including further details relating to the establishment of local energy networks as these become available.

Use of Conditions and Planning Obligations

7.103 PPS1 Supplement advises that 'Planning conditions or planning obligations can be used to secure the provision and longer-term management and maintenance of those aspects of a development required to ensure compliance with the policies in this PPS. Where there are existing decentralised energy supply systems, or firm proposals, planning authorities can expect proposed development to connect to an identified system, or be designed to be able to connect in future. In such instances and in allocating land for development, planning authorities can set out how the proposed development would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

7.104 The Council should continue to require the establishment of appropriate renewable energy infrastructure through the use of conditions linked to the policy target and justified by a Sustainability Statement and Design and Access Statement for larger schemes.

7.105 The Council should consider contributions towards renewable energy infrastructure on a case-by-case basis.

7.106 To secure energy from decentralised and renewable or low-carbon energy sources, the Council may set specific requirements from developers. In advance of any move towards a Community Infrastructure Levy it would not be appropriate to establish a standard charge for most development.

7.107 However, it would be including Planning Obligations in certain situations linked with the opportunities identified within this study:

Establishment

7.108 In Deptford and New Cross, Lewisham Town Centre and Catford and in other locations where the need arises may require contributions towards the establishment of energy generation infrastructure. Applicants should discuss with the Council how the proposals would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

7.109 Landowners and developers should be made aware of the requirement to connect with decentralised energy networks during pre application discussions which take place with the Council.

7.110 Planning Obligations may be required towards establishment of facilities where centralised renewable energy generation facilities serving the site are provided off site.

Connection

7.111 This will require installation of pipework on site and potentially across public highways to serve individual buildings and provision of equipment (or capability for equipment to be provided). Planning Obligations may be required for the provision of off site infrastructure and connections.

7.112 Before obligations of this type are required it would be important that further feasibility work is carried out to develop the proposals and associated business case.

Operation

7.113 Normally this aspect will be addressed through conditions. However, it is important that there is a clearly identified strategy for the operation and long term management of renewable energy equipment. This will include:

- Consideration of appropriate connection costs including related electricity or heat distribution infrastructure.
- Proof of a business plan and demonstrating the viability of the preferred approach towards meeting targets including consideration of costs, revenue and the effect of incentives (major development).
- An identified supplier and agreement in principle (Power Purchase Agreement, CEM, ESCO) (Major development).
- Identification of how maintenance of renewables infrastructure will be dealt with (i.e. service charge etc.). The Council may also seek contributions to secure the provision and longer-term management and maintenance of those aspects of a development required to ensure compliance with the policies set out in PPS 1, the London Plan and the Lewisham Core Strategy.
- Where it is proposed that biomass boilers should contribute towards meeting renewable energy target set out in the London Plan or Core Strategy these facilities should comply with environmental regulations. Where the residual impact of such facilities would have a significant impact on air quality then developers may be required to make developer contributions towards appropriate mitigation.
- Renewable energy facilities and associated infrastructure should be brought into use before first occupation.
- Planning Obligations may be sought for the costs associated with monitoring of renewable energy facilities.

7.114 Any requirement should be fair and reasonable and, in particular, not restrict those with responsibility for providing energy to new development, or the occupiers, to any one energy provider in perpetuity.

Decommissioning

7.115 In certain situations such as installation of temporary renewable energy infrastructure it may be appropriate to include a condition requiring decommissioning and removal of infrastructure and facilities.

Allowable Solutions

7.116 In certain circumstances where a site is not suitable for hosting on site renewables or to be served by connected heat facilities then it may be appropriate for Planning Obligations to secure Allowable Solutions. The solutions could be referred to specifically within the S106 agreement and potentially linked to a commuted sum.

Potential for Local Development Orders

7.117 Where there are proposals to establish local energy networks such as at Deptford and New Cross and Catford the Council should give positive consideration to the use of local development orders (LDO) to secure renewable and low-carbon energy supply systems.

7.118 The order could in effect provide planning permission for certain categories of development required to deliver the network which are not covered by existing permitted development rights. It is likely that the main generation facilities would not be included within the order and that the LDO would focus on pipework and ancillary equipment.

7.119 The LDO should be complemented by appropriate guidance relating to siting and design in order to ensure that local energy networks are delivered successfully.

Framework for implementation and monitoring

7.120 Government Guidance identifies that effective monitoring and review is essential in securing responsive action to tackle climate change. The successful implementation of policies on climate change depends on active stewardship. Where monitoring suggests that implementation is not being achieved in line with an agreed strategy or that the strategy is not delivering the expected outcomes, it is essential to respond promptly and effectively.

7.121 At present the GLA collates appropriate information on renewable energy facilities relating to larger developments which are referred to the Mayor. Under the current approach this is adequate as the Council's Policy follows the London Plan.

7.122 In the future the Annual Monitoring report should collate information on renewable energy matters. Indicators should be linked to those which are monitored through national and regional databases which are to be established. The criteria which should be considered for monitoring are:

- Installed capacity of renewable energy infrastructure;
- Annual electricity generation from renewable sources;
- Annual heat generated from renewable sources; and
- Carbon dioxide emissions displaced by in Borough renewable energy generation.

7.123 Information relating to the first 3 indicators will be available to be sourced from the register of renewable energy installations to be established by the Office for Renewables Deployment.

7.124 The Annual Monitoring report should assess progress against the policy objectives by type and size of development in order that it is effective in shaping future policy and the relationship between establishment of renewables facilities and the relationship with housing delivery.

Delivery mechanisms

7.125 To take forward the findings of this study further work is required to further define the detailed feasibility and business case of the local decentralised energy networks identified for Deptford and New Cross. This should utilise support potentially available to the Council through the London Energy Partnership and London Development Agency relating to the energy masterplanning support package and opportunities linked with establishment of the London Thames Gateway Heat Network. Possible delivery mechanisms are highlighted within Appendix D.

Appendix A

Energy Consumption and CO2 Emissions Reduction Trajectory

A.1 Projected Domestic Energy Consumption

			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Existing Housing Stock	**Existing Elec**	kWh	442096492																		
	Existing Gas	kWh	1691852112																		
		Sub total	2133948604																		
	Existing Elec	CO2 kg	251110807																		
	Existing Gas	CO2 kg	328219310																		
		Sub total	579330117																		
	Existing CO2 ratio	Elec:Total	43%																		
	CO2 Reduction	%	0%	0%	0%	3%	5%	8%	11%	14%	16%	19%	22%	25%	27%	**30%**	33%	35%	38%	41%	44%
	Existing Energy	CO2 kg		579330117	579330117	563530205	547730293	531930380	516130468	500330556	484530643	468730731	452930819	437130907	421330994	405531082	389731170	373931257	358131345	342331433	326531521
	Existing Elec	CO2 kg		251110807	251110807	244262331	237413854	230565378	223716901	216868425	210019948	203171471	196322995	189474518	182626042	175777565	168929089	162080612	155232136	148383659	141535182
	Existing Gas	CO2 kg		328219310	328219310	319267874	310316438	301365003	292413567	283462131	274510695	265559260	256607824	247656388	238704953	229753517	220802081	211850645	202899210	193947774	184996338
	Existing Elec	kWh		442096492	442096492	430039315	417982138	405924961	393867784	381810607	369753430	357696253	345639076	333581899	321524721	309467544	297410367	285353190	273296013	261238836	249181659
	Existing Gas	kWh		1691852112	1691852112	1645710691	1599569270	1553427848	1507286427	1461145006	1415003585	1368862163	1322720742	1276579321	1230437900	1184296478	1138155057	1092013636	1045872215	999730793	953589372
		Sub total		2133948604	2133948604	2075750006	2017551407	1959352809	1901154211	1842955613	1784757014	1726558416	1668359818	1610161219	1551962621	1493764023	1435565425	1377366826	1319168228	1260969630	1202771031
Projected Housing Stock	**Future housing**	No.		553	916	981	1469	2316	2418	2784	2128	1901	1641	1492	1244	1114	1184	1114	1054	*1000*	*900*
	CSH	Level		3			4	5				6									
	CSH	% reduction DER/TER		**25%**			**44%**	**100%**				**100%**									
	Future Elec	kWh		2369329	3924602	4203095	6120324	9361087	9773363	11252705	8601206	0	0	0	0	0	0	0	0	0	0
	Future Gas	kWh		3243345	5372340	5753565	6433045	6520003	6807154	7837517	5990746	0	0	0	0	0	0	0	0	0	0
		Sub total		5612674	9296942	9956660	12553369	15881090	16580516	19090222	14591951	0	0	0	0	0	0	0	0	0	0
	Future Elec	CO2 kg		1345779	2229174	2387358	3476344	5317097	5551270	6391537	4885485	0	0	0	0	0	0	0	0	0	0
	Future Gas	CO2 kg		629209	1042234	1116192	1248011	1264881	1320588	1520478	1162205	0	0	0	0	0	0	0	0	0	0
		Sub total		1974988	3271408	3503549	4724355	6581978	6871858	7912015	6047690	0	0	0	0	0	0	0	0	0	0
TOTAL	**Elec**	GWh	442	444	446	434	424	415	404	393	378	358	346	334	322	309	297	285	273	261	249
	Gas	GWh	1692	1695	1697	1651	1606	1560	1514	1469	1421	1369	1323	1277	1230	1184	1138	1092	1046	1000	954
	Total	GWh	2134	2140	2143	2086	2030	1975	1918	1862	1799	1727	1668	1610	1552	1494	1436	1377	1319	1261	1203
	Elec	CO2 kt	251	252	253	247	241	236	229	223	215	203	196	189	183	176	169	162	155	148	142
	Gas	CO2 kt	328	329	329	320	312	303	294	285	276	266	257	248	239	230	221	212	203	194	185
	Total	CO2 kt	579	581	583	567	552	539	523	508	491	469	453	437	421	406	390	374	358	342	327

Note: The trajectory of carbon dioxide emissions of 2-3% per annum reduction reflects compliance with government policy targets linked to the CfSH escalator averaged on a per annum basis.

A.2 Projected Industrial/Commercial Energy Consumption

			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Existing Industrial / Commercial stock	**Existing Elec**	kWh	174065458																		
	Existing Gas	kWh	327963642																		
		Sub total	502029100																		
	Existing Elec	CO2 kg	98869180																		
	Existing Gas	CO2 kg	63624947																		
		Sub total	162494127																		
	Existing CO2 ratio	Elec:Total	61%																		
	CO2 Reduction	%			**0%**	2%	4%	6%	8%	10%	12%	14%	16%	18%	**20%**	22%	24%	26%	28%	30%	32%
	Existing Energy	CO2 kg		162494127	162494127	159244244	155994362	152744479	149494597	146244714	142994831	139744949	136495066	133245184	129995301	126745419	123495536	120245654	116995771	113745889	110496006
	Existing Elec	CO2 kg		98869180	98869180	96891797	94914413	92937029	90959646	88982262	87004879	85027495	83050111	81072728	79095344	77117961	75140577	73163193	71185810	69208426	67231042
	Existing Gas	CO2 kg		63624947	63624947	62352448	61079949	59807450	58534951	57262452	55989953	54717454	53444955	52172456	50899957	49627458	48354959	47082460	45809962	44537463	43264964
	Existing Elec	kWh		174065458	174065458	170584149	167102840	163621531	160140221	156658912	153177603	149696294	146214985	142733676	139252366	135771057	132289748	128808439	125327130	121845821	118364511
	Existing Gas	kWh		327963642	327963642	321404369	314845096	308285823	301726551	295167278	288608005	282048732	275489459	268930186	262370914	255811641	249252368	242693095	236133822	229574549	223015277
		Sub total		502029100	502029100	491988518	481947936	471907354	461866772	451826190	441785608	431745026	421704444	411663862	401623280	391582698	381542116	371501534	361460952	351420370	341379788
Projected increasing Office stock	**Future floor area**	m2	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623	6623
	Assumed Reduction	% reduction DER/TER				**25%**			**44%**			**100%**			**100%**						
	Future Elec	kWh	629185	629185	629185	471889	471889	471889	352344	352344	352344	226507	226507	226507	0	0	0	0	0	0	0
	Future Gas	kWh	794760	794760	794760	596070	596070	596070	445066	445066	445066	286114	286114	286114	0	0	0	0	0	0	0
		Sub total	1423945	1423945	1423945	1067959	1067959	1067959	797409	797409	797409	512620	512620	512620	0	0	0	0	0	0	0
	Future Elec	CO2 kg	357377	357377	357377	268033	268033	268033	200131	200131	200131	128656	128656	128656	0	0	0	0	0	0	0
	Future Gas	CO2 kg	154183	154183	154183	115638	115638	115638	86343	86343	86343	55506	55506	55506	0	0	0	0	0	0	0
		Sub total	511561	511561	511561	383670	383670	383670	286474	286474	286474	184162	184162	184162	0	0	0	0	0	0	0
Projected declining Industrial stock	**Future floor area**	m2	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773	-773
	Assumed Reduction	N/A as stock declining																			
	Future Elec	kWh	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055	-27055
	Future Gas	kWh	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140	-139140
		Sub total	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195	-166195
	Future Elec	CO2 kg	-15367.24	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367	-15367
	Future Gas	CO2 kg	-26993.16	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993	-26993
		Sub total	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360	-42360
TOTAL	**Elec**	GWh	174	175	175	171	168	164	160	157	154	150	146	143	139	136	132	129	125	122	118
	Gas	GWh	328	329	329	322	315	309	302	295	289	282	276	269	262	256	249	243	236	229	223
	Total	GWh	502	503	503	493	483	473	462	452	442	432	422	412	401	391	381	371	361	351	341
	Elec	CO2 kt	99	99	99	97	95	93	91	89	87	85	83	81	79	77	75	73	71	69	67
	Gas	CO2 kt	64	64	64	62	61	60	59	57	56	55	53	52	51	50	48	47	46	45	43
	Total	CO2 kt	162	163	163	160	156	153	150	146	143	140	137	133	130	127	123	120	117	114	110

Note: The trajectory of carbon dioxide emissions of 2-3% per annum reduction associated with government policy targets linked to BREEAM.

A.3 Summarised Projected Energy Consumption

	Domestic						Industrial/Commercial						Sub Total				Total	
	Electricity		Gas		Sub Total		Electricity		Gas		Sub Total		Electricity		Gas			
Year	GWh	kt CO2	GWh	ktCO2	GWh	ktCO2	GWh	kt CO2	GWh	ktCO2	GWh	ktCO2	GWh	kt CO2	GWh	ktCO2	GWh	kt CO2
2007	442	251	1692	328	2134	579	174	99	328	64	502	162	616	350	2020	392	2636	742
2008	444	252	1695	329	2140	581	175	99	329	64	503	163	619	352	2024	393	2643	744
2009	446	253	1697	329	2143	583	175	99	329	64	503	163	621	353	2026	393	2647	746
2010	434	247	1651	320	2086	567	171	97	322	62	493	160	605	344	1973	383	2579	727
2011	424	241	1606	312	2030	552	168	95	315	61	483	156	592	336	1921	373	2513	709
2012	415	236	1560	303	1975	539	164	93	309	60	473	153	579	329	1869	363	2448	692
2013	404	229	1514	294	1918	523	160	91	302	59	462	150	564	320	1816	352	2380	673
2014	393	223	1469	285	1862	508	157	89	295	57	452	146	550	312	1764	342	2315	655
2015	378	215	1421	276	1799	491	154	87	289	56	442	143	532	302	1710	332	2242	634
2016	358	203	1369	266	1727	469	150	85	282	55	432	140	508	288	1651	320	2159	609
2017	346	196	1323	257	1668	453	146	83	276	53	422	137	492	279	1598	310	2090	590
2018	334	189	1277	248	1610	437	143	81	269	52	412	133	477	271	1546	300	2022	571
2019	322	183	1230	239	1552	421	139	79	262	51	401	130	461	262	1493	290	1953	551
2020	309	176	1184	230	1494	406	136	77	256	50	391	127	445	253	1440	279	1885	532
2021	297	169	1138	221	1436	390	132	75	249	48	381	123	430	244	1387	269	1817	513
2022	285	162	1092	212	1377	374	129	73	243	47	371	120	414	235	1335	259	1749	494
2023	273	155	1046	203	1319	358	125	71	236	46	361	117	399	226	1282	249	1680	475
2024	261	148	1000	194	1261	342	122	69	229	45	351	114	383	218	1229	238	1612	456
2025	249	142	954	185	1203	327	118	67	223	43	341	110	368	209	1176	228	1544	437

Appendix B

Assessment of Lewisham Renewable Energy Resources

B.1 Overview of Renewable Energy Technologies

B.1.1 Renewable energy (or Zero Carbon) technologies transform a renewable energy resource into useful heat, cooling, electricity or mechanical energy. A renewable energy resource is, in theory, one whose use does not affect its future availability. For example, using wind to provide electricity does not reduce the future supply of wind, however, exploitation of trees (also a renewable resource) can lead to a depleting supply of biomass for combustion. This should be kept in mind when choosing renewable energy technologies.

B.1.2 Clean energy (or Low Carbon) technologies include energy efficiency measures and methods for reducing the energy consumed in the provision of a good or service[32]. Systems such as heat recovery ventilation, combined heat and power of fossil fuels, and heat pump systems all fall into the Low Carbon category.

B.1.3 A number of renewable energy technologies and low carbon technologies have been assessed as to their suitability in urban areas. These are: solar thermal; solar photovoltaic; wind power; biomass boilers; heat pumps; small scale hydropower; and combined heat and power (CHP) plants. A brief description of each is given, as well as their general applicability in urban areas and to retro-fit applications. Furthermore, this chapter discusses the potential resource available to each technology in the Lewisham area. Please note that this is not an exhaustive list of possible technologies but rather a list of the most readily available solutions.

B.2 Solar Thermal

Overview/description

B.2.1 Solar thermal systems harness the heating potential of solar energy through by capturing energy from the sun. In the simplest solar thermal application, a discrete solar collector gathers solar energy to provide hot water to temperatures exceeding 50ºC for domestic, commercial or industrial use. The heated water can be used for space heating, domestic water heating, agricultural and commercial use and for the heating of swimming pools.

B.2.2 There are two main types of solar thermal collector - flat plate or evacuated tubes, and solar thermal systems can be classified as either being passive or active. Passive systems rely on natural convection to circulate the water through the collectors. An active system uses pumps and valves to control the circulation of the heat absorbing liquid. Active systems are more complex but provide greater flexibility of system layout and can operate all year without the risk of freezing.

B.2.3 Flat plate collectors use a black absorber plate with a specially developed coating to maximise the collection of solar energy whilst simultaneously limiting re-radiation of energy back to the atmosphere. The collector is usually covered with a transparent material, such as glass, and insulated behind to prevent heat losses. Heat is transferred to the water via pipes lying along the plate or through channels within the collector. They are a robust technology and generally less expensive than evacuated tube collectors.

B.2.4 Evacuated tube collectors use a series of evacuated glass tubes to enclose each absorber plate/pipe. Convection losses are almost eliminated by the vacuum in the tube, making this type of collector more efficient than the flat plate, especially in marginal weather conditions. There are a number of types of evacuated tube, for example heat pipes and concentric tubes, but all work under a vacuum. Although evacuated tube collectors provide higher efficiencies their manufacture tend to be more labour intensive and as a result are generally more expensive than flat plate.

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32 RETScreen International, “Clean Energy Project Analysis, RETScreen Engineering & Cases Textbook”, 3rd Ed., 2005, Natural Resources Canada

Applicability in Urban Areas

B.2.5 Solar thermal collectors are quite versatile and are suitable in any rural or urban environment which has access to direct sunlight. Urban areas generally contain a mixture of residential, commercial and leisure facilities and solar thermal systems are well suited to contributing to the thermal energy generation. Planning permission is not normally required for small scale solar thermal systems except for special circumstances such as listed buildings, and solar thermal is seen as a prime technology for Town Councils and private developers wishing to meet their renewable energy targets.

B.2.6 Domestic water heating is perhaps the best overall potential application for active solar heating in the UK. Domestic water heating demand continues all year round and still needs to be satisfied in the summer when the solar resource is at its peak. Solar thermal systems can also be used for space heating but the seasonal pattern of solar radiation for space heating applications shows that there is a mismatch between availability of solar radiation and the demand for heat.

B.2.7 Commercial systems have not received much attention in terms of solar water heating but hotels, beauty salons, bars and restaurants all have high demands for hot water and are well suited to the integration of this technology. Furthermore, swimming pools and leisure centres also have high hot water demand and large solar arrays on these types of buildings are growing in popularity.

B.2.8 The major advantages of solar thermal systems are their reliability and long life span (20-25 years if maintained). The systems are versatile and can be installed on a single building serving a single set of occupants or an entire multi-unit building serving multiple units via a central storage tank.

B.2.9

Lewisham Solar Resource

B.2.10 There is a widely held opinion that the British Isles do not have “enough sun” to make solar systems worthwhile. In fact parts of Britain have annual solar radiation levels equal to 60% of those experienced at the equator. Figure B-1 is a map of the UK and Ireland average annual solar irradiation[33].

33 Solar Trade, http://www.solar-trade.org.uk/solarenergy/ukresource.htm, Website cited 31-Mar-2009

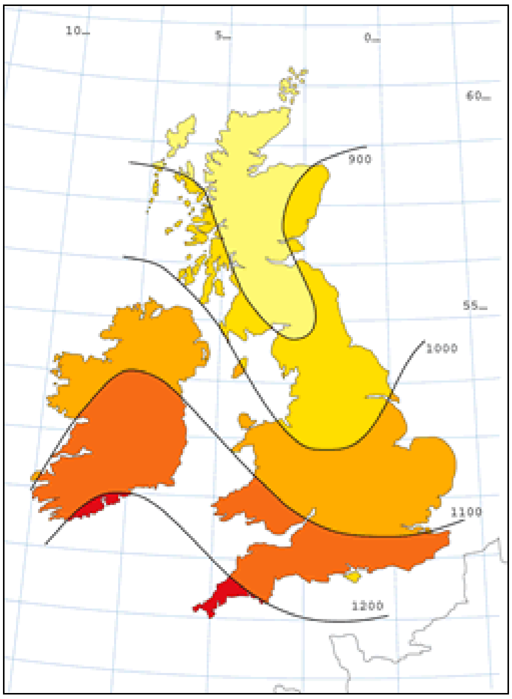

Figure B-1 UK solar irradiation, annual kWh/m^2

B.2.11 From the map it can be seen that the average annual solar irradiation for the Lewisham area is approximately 1100 kWh/m^2. This value correlates with NASA irradiation data for the southeast London area which is accessible through the RETScreen software package[34]. The value given for irradiation by NASA is 950 kWh/m^2 year. Please note that this is the level of resource available and not the energy delivered by a solar technology. Solar thermal systems would generally extract 40%-60% of this energy.

B.3 Solar Photovoltaic

Overview/description

B.3.1 Solar photovoltaic (PV) systems directly convert solar radiation into direct current electricity in a semiconductor device or cell. The potential energy produced through the utilisation of PV modules is dependent on the amount of sunshine hours. PV performs better in colder conditions, all other factors being equal. However, it is naturally inefficient in low sun and cloudy conditions, with efficiency likely to be reduced to 5-20% of its full solar output.

B.3.2 Three different types of PV system are available: amorphous silicon, poly-crystalline silicon and mono-crystalline silicon. The former is the cheaper, less efficient type of system; while the other two are progressively more efficient and expensive. Each can be used to provide electricity in the same manner:

1. Connected directly to the electrical grid network;
2. Connected to a battery system for stand-alone power supply;
3. A combination of 1 and 2 above.

34 RETScreen International, "RETScreen Clean Energy Project Analysis Software", Version 4, 19-11-2008, Natural Resources Canada

B.3.3 This has led to PV systems being used worldwide, from small solar powered calculators to large solar arrays covering hectares of ground supplying electricity to a large electrical transmission system.

Applicability in Urban Areas

B.3.4 Due to versatile nature of PV panels, their relative ease of integration into electrical systems and potential revenue source, PV technology is being considered more frequently for UK developments, both for new buildings and retrofits. Planning permission is not normally required for small scale systems except for special circumstances such as listed buildings.

B.3.5 The UK solar PV market is still relatively small, with paybacks generally in the region of 40-100 years (based on double ROC's), due to both the high capital cost of the equipment, and the relatively low annual hours of direct sunlight. Site specific constraints provide further barriers to implementation and revolve around the amount of suitable roof space available for the installation of solar PV panels.

B.3.6 However, it is a well established method of electricity generation and requires little or no maintenance when integrated into a larger network. The systems are very well suited to buildings with a daytime demand (offices, retail, etc.) and a summer load. When used to offset the electrical demand of a building and effectively "slow down the meter" they are very beneficial.

Lewisham Solar Resource

B.3.7 The solar PV resource is that as shown previously in Figure B-1. Similar to solar thermal technology this value shown on the map is not the quantity of energy delivered by a solar PV system. Industry average for solar PV system efficiencies range between 12 and 18 per cent although higher efficiency units are also available.

B.4 Wind Power

Overview/description

B.4.1 The extraction of power from the wind with modern turbines and energy conversion systems is a well established industry. Machines are manufactured with a capacity from tens of Watts to several Megawatts and rotor diameters of about 1 metre to more than 100 metres[35]. Large scale wind farms of 2MW or more are commonplace across the UK countryside and these systems usually integrate into the electrical transmission system whereby the electricity is transported to a load centre (city, town, industrial park, etc.). Similar large scale projects are built off-shore and the coasts of Ireland and the UK offer the largest wind resource in Europe.

B.4.2 Single wind turbine erections are becoming more popular as the best large scale wind farm sites have already been developed or investigated. These single (or sometimes twin) erections of a medium sized wind turbine supply electricity to small towns or large industrial sites, and can be located close to the load (pending planning permission).

B.4.3 Small wind technology in an urban location is relatively new, but turbines are becoming increasingly common at schools, service stations, offices etc. in the UK. These turbines can either be stand alone or building-mounted and the choice is normally determined by the available, space. Building mounted turbines are best located on gable ends, negating the need for extra

35 Twidell, J., Weir, T., "Renewable Energy Resources", 2nd Ed., 2006, Taylor & Francis, London

space, and often have access to a higher wind speed. However, the energy delivered from these units is small and stand-alone types are recommended if space is available.

Applicability in Urban Areas

B.4.4 Wind turbines are designed to harness the kinetic energy of moving air, thus, the most important initial aspect to consider is wind resource. If a significant wind resource is not available in an area, the feasibility of installing wind power technology is greatly affected. However, if a substantial annual wind resource is available then this technology is commonly the most effective method for developers to meet their energy targets.

B.4.5 Electricity generated from a wind turbine can be integrated in similar ways to solar PV technology. For very large systems, as mentioned earlier, they are usually connected to the transmission systems. Medium sized units, or single turbines, are connected into the distribution network, and very small urban turbines are generally connected directly into the building electrical systems. Also, turbines can be integrated into battery systems to provide electricity in remote locations or to work alongside a large electrical network. Key concerns when planning wind turbine installations are noise emissions, impact on natural environment, grid connections and visual impacts.

B.4.6 The most cost-effective, reliable, and useful method is to erect one or more medium scale turbines which would be capable of generating enough electricity to supply base load demand during peak winds. The alternative would be to install multiple small scale turbines (either standalone or building mounted) but this leads to cumulatively higher installation costs, maintenance costs and it is likely the cumulative energy yield would be smaller than from a single medium scale unit.

Lewisham Wind Resource

B.4.7 Maps are available that give estimates of the mean wind speeds over the UK and many other countries. These maps were initially compiled using meteorological data, which tend to be located in places that are not appropriate for wind energy[36]. The Department for Business Enterprise & Regulatory Reform wind speed database contains estimates of the annual mean wind speed throughout the UK[37]. This may give an indication of average wind speed in different parts of the country. However it is very unlikely to give an accurate idea of wind speed at a proposed site for a small to medium wind system, particularly in urban or built up areas, as site wind speed is very much dependent on local site conditions (location of buildings, trees, hills, valleys, etc.) has been included give an indication of the wind speed available in the London Borough of Lewisham. This map was accessed from the British Wind Energy Association.

36 Boyle, G., "Renewable Energy – Power for a sustainable future", 2nd Ed.,2004, Oxford University Press, Milton Keynes

37 Department for Business Enterprise & Regulatory Reform, "Wind speed Database", www.berr.gov.uk, Website cited 2009-03-30

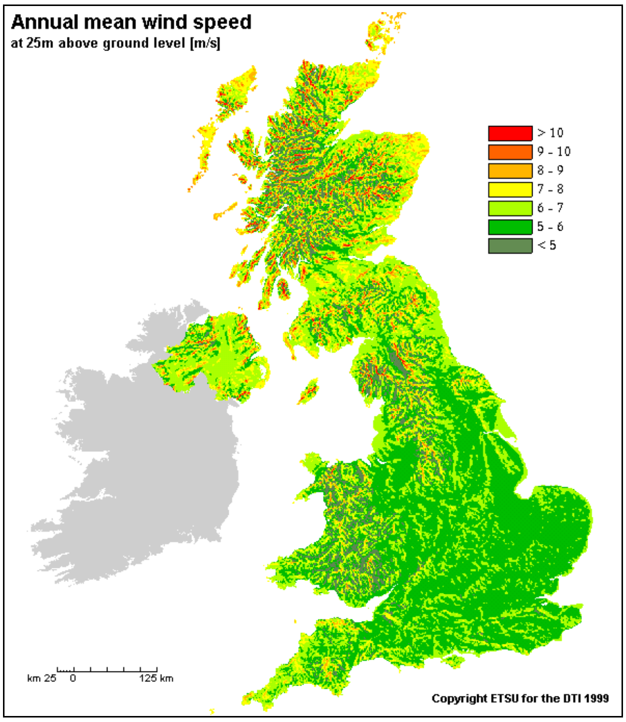

Figure B-2 UK annual mean wind speed map[38]

B.4.8 From the map it can be seen that the estimated annual mean wind speed in the London area at level of 25 metres above ground level, is approximately 5-6 metres per second. Utilising the Business Innovation and Skills (BIS) wind speed database[39], estimates of wind speed for particular areas within Lewisham were determined. The figures are shown in the table below.

Table B-1 BIS Wind speeds for London Borough of Lewisham

Location	Postcode	Location within Borough	Wind Speed m/s @ 10m	Wind Speed m/s @ 25m
University Hospital	SE13 6LH	Central	4.6	5.4
Surrey Quays Shopping Centre	SE16 7PW	Northeast	4.6	5.3
Catford Railway Station	SE6 4XT	South central	4.5	5.3
Grove Park Library	SE12 0BX	Southeast	4.9	5.7
Sydenham Library	SE26 5SE	Southwest	4.4	5.2

B.4.9 From the table above it could be deduced that Lewisham has a reasonable resource. However, local microclimate issues and the presence of multi storey buildings are likely to affect local wind conditions significantly which will affect the efficiency of equipment.

38 British Wind Energy Association, "Annual mean wind speed", www.bwea.com, Website cited 2009-03-30
39 Dept. for Business Innovation and Skills, "BIS Wind Speed Database", http://www.berr.gov.uk/energy/sources/renewables/explained/wind/windspeed-database/page27326.html, Website cited July 2009

B.4.10 The availability of land for freestanding wind turbines which is compatible with policy objectives relating to Conservation areas and Metropolitan Open Land is likely to be limited. The installation of freestanding wind turbines will also need to be compatible with adjoining land uses which may be difficult to achieve within a built up area such as Lewisham.

B.4.11 Therefore it is unlikely that wind power will make a significant contribution towards meeting overall renewables targets in the borough in many situations. However, this does not preclude wind from consideration as a potential resource where appropriate conditions exist.

B.5 Biomass Boilers

Overview/description

B.5.1 Biomass refers to any plant or animal derived matter. Biomass used for fuels falls into two main categories:

1. Woody biomass, including:
    a. Forest residues, e.g. from wood thinnings;
    b. Untreated wood waste, e.g. from sawmills;
    c. Crop residues, e.g. straw;
    d. Short Rotation Coppice (SRC), e.g. willow, miscanthus
2. Non-woody biomass, including:
    a. Animal wastes, e.g. slurry from cows, pigs, chickens
    b. Industrial and municipal waste
    c. High energy crops, e.g. rape, sugar, cane.

B.5.2 The most common biomass boiler fuels in the UK are the wood biomass fuels including wood chips and wood pellets both of which can be considered environmentally friendly fuels.

B.5.3 The combustion of biomass in a boiler is the simplest and most widely practiced technique to convert biomass to heat. Upon combustion, heat energy is released and is used to heat water. The by-products of combustion include carbon dioxide and water, plus other impurities, which are released in a flue gas.

B.5.4 The use of biomass is generally classed as a “carbon neutral” process because the carbon dioxide released during combustion to produce energy is taken up by plants during their growth and the cycle continues. Energy is required for the foresting, (including fertilisation), harvesting, any pre-treatment process (e.g. chipping) and transport, which results in carbon emissions. Hence energy from biomass is better described as “almost carbon neutral” or as a Low Carbon Technology.

B.5.5 Wood chips are made from trees, branch-wood or coppice products which are mechanically shredded by a chipping machine and then air dried. Wood chips are a bulky fuel so storage and delivery access need to be considered. Transport costs can be high for distances over of 20 miles, and therefore wood chips are most cost effective if locally sourced.

B.5.6 Pellets are made of compressed sawdust or wood shavings, giving a more concentrated form of fuel than wood chips. Pellets are cylindrical in shape, ranging in diameter from 6-8mm and approximately 20mmm long Consequently they can be transported further, need less storage space and are easier to handle, but are more expensive than chips due to production costs.

(a) (b) (c)

Figure B-3 Wood fuel types: (a) Logs; (b) Chips; (c) Pellets

B.5.7 Biomass heating is one of the few renewable technologies that require the regular delivery of fuel for input into the system. Regular deliveries of logs, wood chips or pellets need to be received, transported to boiler and stored on site, which requires space for storage and easy access for long vehicles to the site.

Applicability in Urban Areas

B.5.8 Biomass boilers can be integrated into developments in similar ways to conventional fossil fuel fired systems. Individual boilers can be installed into individual households which can be controlled by the individual occupier. Central building systems can be installed into flats, apartments, and commercial units whereby the boiler is operated and maintained by the building management and the individual domestic or commercial residents of the building pay for the heat consumed. Biomass systems are increasingly being used in whole district heating systems spread over a large area and interconnected with underground district heating pipe. Again, the boiler system is operated and maintained by a management company who sell the heat to the individual users.

B.5.9 This allows great versatility when planning for these systems, however, as mentioned previously, ample fuel storage is necessary for all installations and ease of access for large delivery vehicles is essential in the large biomass boiler installations (>100kW). Wood fuel storage can take many forms, but it must be located close to the boiler.

Lewisham Biomass Resource

B.5.10 One of the greatest barriers for biomass boiler technology deployment in the UK is the concern over fuel availability and security. For individual homeowners this should not be a prohibitive concern as the biomass fuel requirement is relatively meagre and ample supplies are available to supply the individual domestic market.

B.5.11 However, when considering the large energy demands for the Borough of Lewisham fuel availability and security is a major concern and needs to be investigated fully. Local supplies of timber would not only reduce delivery times and create local employment, but would also ensure the cost of the fuel remained competitive against the fluctuating price of imported oil and gas.

B.5.12 The Forestry Commission is the largest land manager in Britain and manages approximately one quarter of England's forests. The remaining three quarters of England's woodlands and forests are privately owned[40].

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40 Forestry Commission, "The Forestry Commission in England", http://www.forestry.gov.uk, Website cited 31-Mar-09

B.5.13 The Forestry Commission have been set the task by Government to work with the private sector and with local and regional partners to increase the amount of biomass made available through the wood fuel supply chain. The target is to bring an additional 2 million tonnes of wood fuel annually to the market by 2020[41].

B.5.14 According to the Forestry Commission there is a considerable biomass supply in London and surrounding areas, however, the supply chain to process and supply the wood is not to an acceptable standard. The Commission is working to promote supply lines and develop timber stations within London.

B.5.15 The potential for biomass heating and CHP in Lewisham requires careful consideration as its potential as a resource is influenced by establishing a sustainable feedstock resource and a sustainable means of transporting the resource into the Borough. In addition, it is important that the provision of biomass heating or biomass CHP does not have a significant adverse effect on local air quality or compromise local air quality management strategies. If these considerations can be addressed then it represents a useful renewable resource. These issues are likely to be optimised in connection with medium and larger scale facilities where the technology tends to be more efficient and emissions can be managed more effectively.

B.6 Heat Pumps

Overview/description

B.6.1 Heat Pumps utilise the principle of the third law of thermodynamics to ‘pump’ heat from one medium to another. The concept for the heat pump was discovered in the 1850’s and found its first commercially practical application in the refrigerator in the 1930’s. Heat pumps to provide heating rather than cooling have been steadily developed since the mid 1900’s and have become widespread in use in the USA and Europe since the 1990’s. Heat pumps generally use electricity to drive compressors, evaporators and pumps to ‘pump’ the heat from a low grade heat source to a higher grade heat output. For every 1 unit of electricity used they can typically pump between 2 and 5 units of useful heat. A heat pump uses a heat collector which can draw heat from a number of sources, including the ground, the air or from a suitable water source. The most common types used in heating systems are:

- Ground Source Heat Pump (GSHP)
- Air Source Heat Pump (ASHP)
- Water Source Heat Pump (WSHP)

B.6.2 The water source heat pumps can be highly efficient as the heat transfer from the water to the heat collector is significant, but because suitable nearby water sources, such as a lake, are required these systems are fairly rare. The next most efficient is the GSHP which draws heat from either vertical (via boreholes) or horizontal ground collectors. The least efficient but cheapest to install is the ASHP which resembles a large air conditioning unit and draws heat from the external air.

Applicability in Urban Areas

B.6.3 Heat pumps are more efficient when required to provide a low temperature heat output. Heat pump based heating systems therefore require larger heat emitters than conventional systems and work well with underfloor heating or possibly oversized radiators. For these reasons heat pumps are ideally suited to either new builds or major refurbishments where underfloor heating

41 Forestry Commission England, “A woodfuel strategy for England”, 2007, http://www.forestry.gov.uk/england, Website cited 31-Mar-09

can be installed. Heat pump systems can have even higher efficiencies if there is both a cooling and heating requirement in the same vicinity, where heat can be pumped from one area, providing cooling and directed to another area to provide heating. Supermarkets and leisure centres may provide such sources. Large heat pump systems can also share common collector and distribution systems to further increase the economic benefits.

Lewisham Resource

B.6.4 Limited ground space is available for horizontal ground loop collectors and it is therefore likely that vertical borehole based collector systems would be recommended. These are a standard form of GSHP collectors however borehole drilling can be prohibitively expensive dependent on the local ground conditions. However for large scale developments, multiple boreholes would need to be drilled leading to an economy of scale in terms of borehole drilling costs.

B.6.5 ASHP systems could be used extensively on the proposed new buildings; however, they are less efficient than GSHP's. ASHP units are similar in appearance to air conditioning units commonly seen on commercial building facades which can detract from the building aesthetics. However, for sensitive areas, the external ASHP units can be hidden from the public eye with suitable cladding, or clever building design.

B.6.6 There may also be a potential for utilising river water, for example the River Ravensbourne, to provide a suitable heat source for a WSHP system.

B.7 Small Scale Hydropower

Overview/description

B.7.1 Hydropower is a well-established method of power generation worldwide. Large-scale hydro (>10MW) is becoming a less attractive option due to socio-economic reasons. This has led to a renewed interest in small-scale hydropower (<10MW). Hydropower in the UK can be divided into two broad categories: Large scale hydropower facilities, which are plants with an installed capacity of greater than 10MW; and Small-scale hydropower (SHP), which is less than 10MW. SHP can be categorised further into Mini-hydro (100kW-1MW) and Micro-hydro (10kW-100kW)[42].

B.7.2 Hydropower facilities do not consume water; it is merely returned back into the hydrologic cycle and continues to be available. The natural hydrologic cycle is a continuous process with no beginning or end and relates to the processes of precipitation, evaporation, and transpiration[43].

B.7.3 Hydro turbines harness the kinetic energy of falling water and converts it into mechanical energy and then into electrical energy. The water does this when it strikes and turns the blades of a hydro turbine, which is attached to a generator by way of a shaft. The resultant rotational force converts the kinetic energy of the water into electrical energy at the generator output.

B.7.4 Micro hydro turbines can provide low cost power where there is natural resource normally including a pressure head i.e. a fall in height. Unlike large scale hydro-electric schemes, micro-hydro schemes are typically "run-of-river" and do not usually rely on a dam or man-made reservoir to provide water storage as these civil structures are too expensive to construct and maintain.

42 Fitzgerald, G.B., et al., "The analysis of fresh water rivers as an alternative source of energy in remote areas of Ireland", Environ 2006, Irish Environmental Researchers Colloquium, University College Dublin

43 Fitzgerald, G.B., et al., "The analysis of fresh water rivers as an alternative source of energy in remote areas of Ireland", 2006, Institute of Technology Tralee, Ireland

Applicability in Urban Areas

B.7.5 Hydropower is a very site specific technology and scheme configurations vary from site to site. This leads to the fact that every hydro site is unique with approximately 75% of the development cost dependent on location and site conditions. The remaining 25% is relatively fixed on the manufacture of electromechanical equipment[44].

B.7.6 Thus, a suitable river is key to a project success. Having a large river flowing through the heart of a town does not necessarily guarantee that power can be feasibly extracted and very often towns are built on mature or at the "old stage" of a river where the volume of water may be large but the height that it falls through may be relatively flat. This does not necessarily mean that power cannot be extracted, but it can be costly to do so and requires careful design.

B.7.7 Another option to harness the energy of moving water is through waste water treatment systems, and water supply networks. Hydroelectric turbines can be integrated into these systems with the benefit being that the generated electricity can offset the electricity consumed by the waste water and water supply pumps.

B.7.8 If a suitable river is located nearby a town level development then these schemes are certainly worth investigating as the electricity generated is reliable, predictable (unlike other renewable energy sources such as wind), and has a long lifespan (up to 50 years if well maintained).

Lewisham Hydro Resource

B.7.9 The River Ravensbourne is a tributary of the River Thames and flows through the south London including the Lewisham neighbourhoods of Deptford, Lewisham, and Catford. Although in theory this water course could support a micro-hydro scheme, it would present specific difficulties. As mentioned previously, useful power can only be extracted with the presence of "head" (pressure gained from height difference) and volumetric water flow. The National River Flow Archive (NRFA) provides stewardship for, and access to, records from over 1300 gauging stations throughout the UK[45]. The data derived for the River Ravensbourne is shown in the following table.

Table B-2 Hydrometric data for River Ravensbourne[46]

River Ravensbourne	
Grid Reference:	51 (TQ) 372 372
Operator:	EA
Local number:	4370
Catchment Area:	120.4 km^2
Level of Station:	14.5 mOD
Max. Altitude:	124.0 mOD
Mean flow:	0.42 m^3s^{-1}
95% exceedance (Q95):	0.118 m^3s^{-1}
10% exceedance (Q10):	0.828 m^3s^{-1}
61-90 Av. Ann. Rainfall:	718 mm

44 Ramos, H., "Guidelines for the Design of Small Hydropower Plants", 2000, Belfast, Western Regional Energy Agency & Network.

45 National River Flow Archive, http://www.ceh.ac.uk/data/nrfa/index.html, Website cited 31-Mar-09

46 NRFA, "26004-Ravensbourne at Catford Hill", http://www.nwl.ac.uk/ih/nrfa/station_summaries/039/056.html, Website cited 31-Mar-2009, Centre for Ecology and Hydrology

B.7.10 From Table B-2 it can be seen that the catchment area is quite large (120.4 km^2) but the mean flow has been recorded at low figure of 0.42m^3/s.

B.7.11 To accurately assess the water resource available on-site hydrologic evaluations would need to undertaken. The purpose of hydrologic evaluations is to provide accurate values for stream discharge. The values of stream discharge have to be taken over a long enough period of time to represent the natural flow regime. A minimum record of flow should be available for a least one year and preferable for three years or more[47]. However, based on the mean flow figure quoted in the table and an estimated head of 10m, the estimated capacity of system that could be installed is a mere 25kW. Thus, it is not recommended that further investigations be carried out at this time.

B.8 Combined Heat & Power

Overview/description

Gas Fired CHP

B.8.1 Combined heat and power (CHP), sometimes referred to as cogeneration, involves the simultaneous generation of electrical energy and heat energy in the form of low-pressure steam or hot water. By utilising the heat produced in an electricity generation system, CHP units can have typical efficiencies of approximately 80%. CHP provides an efficient, reliable source of electricity and useable heat at the point of use. Cooling can also be provided via an absorption chiller.

B.8.2 Small-scale gas CHP systems incorporate either a gas turbine or reciprocating engine. From the simple block diagram of a gas fired CHP system shown in Figure B-4 it can be seen that the resultant hot exhaust gases emitted from the turbine or engine are then passed through a heat exchanger for the production of hot water or steam. In this way valuable heat is recovered from the combustion process which can be used on-site, be re-directed to a nearby industrial site, or used in a community heating scheme. Reciprocating engines are commonly used for units with up to about 2MW power output. It becomes more economical and efficient to use a gas turbine above 2MW.

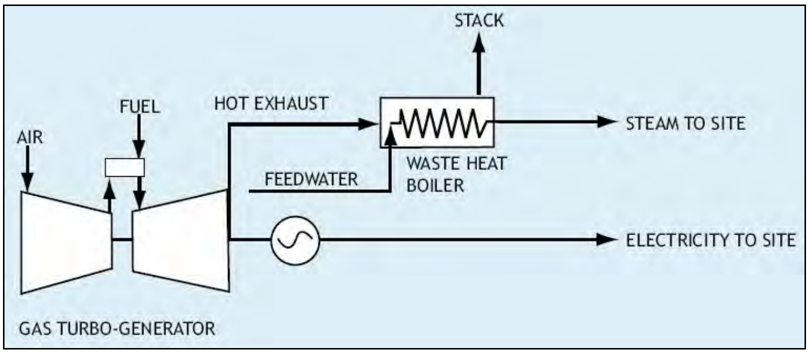

Figure B-4 Simple block diagram of a Gas fired CHP system

B.8.3 CHP from gas is clearly not renewable; however, it is a much more sustainable form of energy generation than grid supplied electricity from centralised power plants. The overall efficiency of small-scale CHP systems can exceed 80% compared with 35% for a typical coal fired power station in the UK.

[47] Ackers, P., et al., “Weirs and flumes for flow measurement”. 1978, Chichester: John Wiley & Sons.

Biomass CHP

B.8.4 Small-scale biomass-fired CHP technology is much less mature than gas-fired systems but there are commercial units available on the market. The most well-established, commercially available technology options include a gasifier plus reciprocating engine or a boiler/combustion chamber with a steam turbine.

B.8.5 A relatively new, but proven technology is biomass CHP utilising the organic Rankine cycle. This uses a steam turbine, but instead of using water in the steam cycle, an organic medium such as a refrigerant or hydrocarbon is used. Since the system requires a lower boiling point, it is regarded as safer (lower pressure than conventional steam), cheaper at a small scale, and more efficient overall than conventional steam plant.

B.8.6 A downdraught gasifier with reciprocating engine tends to be the most common small-scale biomass CHP technology. In the UK, this technology has just reached commercial operation, but it is well proven in Scandinavia and Austria. The most significant technical challenge with this particular technology is in "refining" the gas produced in the gasifier to a standard that can be combusted in a gas reciprocating engine.

B.8.7 Any small-scale biomass CHP system would be more expensive to install and run than an equivalent size gas CHP system and would require more maintenance than gas CHP plants, particularly for the solids handling components and filters. A biomass CHP system also requires considerably more space for the plant equipment and biomass storage bunker.

B.8.8 The smaller the differential between electricity and gas or biomass prices, the less economically attractive a CHP system can be. This is known as the "spark spread." It is vital that the lifecycle costs of a CHP system are closely examined. Economic viability of a CHP scheme requires high annual running hours and full utilisation of the heat and power either on-site or exported locally, which in the case of electricity means exported to the grid.

Applicability in Urban Areas

B.8.9 There is little evidence of large scale CHP systems operating in a town level development within the UK. There are ample examples of a single CHP system supplying heat and power to a small number of buildings within a town centre (such as the Birmingham International Convention Centre and Birmingham Hyatt Hotel system). These work well as summer heat loads are provided by a swimming pool which allows the CHP system to operate all year round. If there is no summer heat load then it is unfeasible to operate the CHP system as there is no useful location to 'dump' the heat generated. This is often the case in developments with large quantities of residential space.

B.8.10 Thus, the greatest potential of CHP systems for town level developments is within individual units which have high all year round electrical and heating or cooling loads.

Lewisham Resource

B.8.11 Depending on the type of CHP installed, either gas or biomass, an investigation into the size of system is required to assess the quantity of fuel required. Security and availability of future gas supplies are debatable and this report does not wish to speculate on this subject.

B.8.12 Lewisham biomass resource has already been discussed in an earlier section and is applicable here.

Appendix C

Renewable energy generation and costings by typology, technology and % contribution.

C.1 Individual dwelling detached/semi-detached

Individual dwelling detached/semi-detached

Declared Assumptions from RE_Scoping worksheet

Development size m²	160 m2
Total kWh for development	22788 kWh/yr
kWh thermal	11678 kWh/yr
Carbon Emissions/yr	8.1 tonnes
RE Contribution %	10%
RE required kWh	2279 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	3.04	1.30	0.47	3.13	10.00	1.93	3.00	0.57	0.61
RE m2 required	22.00			5.00					
Max kWh from system	2332	2279	2279	2375	11678	6760	10512	2279	2279
% RE provided of total energy	10%	10%	10%	10%	51%	30%	46%	10%	10%
tCO2 saved per annum	1.3	1.2	1.2	0.4	2.2	1.3	1.9	0.7	0.7
% CO2 saved per annum	15%	15%	15%	5%	27%	15%	24%	8%	8%
Install Cost	£24,307	£3,902	£3,784	£3,751	£8,000	£2,315	£3,600	£1,025	£4,254
cost m² building	£151.92	£24.39	£23.65	£23.44	£50.00	£14.47	£22.50	£6.41	£26.59

RE Contribution %	20%
RE required kWh	4558 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	6.08	2.60	0.95	6.25	10.00	3.86	7.07	1.14	1.22
RE m2 required	43.00			10.00					
Max kWh from system	4558	4558	4558	4750	11678	11678	11678	4558	4558
% RE provided of total energy	20%	20%	20%	21%	51%	51%	51%	20%	20%
tCO2 saved per annum	2.4	2.4	2.4	0.9	2.2	2.2	2.2	1.4	1.4
% CO2 saved per annum	30%	30%	30%	11%	27%	27%	27%	17%	17%
Install Cost	£48,615	£7,804	£7,568	£7,502	£8,000	£4,630	£8,485	£2,051	£8,508
cost m² building	£303.84	£48.78	£47.30	£46.89	£50.00	£28.94	£53.03	£12.82	£53.17

RE Contribution %	30%
RE required kWh	6836 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	9.12	3.90	1.42	9.38	10.00	5.79	10.61	0.57	0.61
RE m2 required	65.00			14.00					
Max kWh from system	6890	6836	6836	6650	11678	11678	11678	2279	2279
% RE provided of total energy	30%	30%	30%	29%	51%	51%	51%	10%	10%
tCO2 saved per annum	3.7	3.7	3.7	1.2	2.2	2.2	2.2	0.7	0.7
% CO2 saved per annum	46%	45%	45%	15%	27%	27%	27%	8%	8%
Install Cost	£72,922	£11,706	£11,351	£11,253	£8,000	£6,945	£12,727	£1,025	£4,254
cost m² building	£455.76	£73.16	£70.95	£70.33	£50.00	£43.41	£79.54	£6.41	£26.59

RE Contribution %	40%
RE required kWh	9115 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	12.15	5.20	1.89	12.50	11.78	7.72	14.14	2.28	2.43
RE m2 required	87.00			19.00					
Max kWh from system	9222	9115	9115	9025	11678	11678	11678	9115	9115
% RE provided of total energy	40%	40%	40%	40%	51%	51%	51%	40%	40%
tCO2 saved per annum	5.0	4.9	4.9	1.7	2.2	2.2	2.2	2.8	2.8
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£97,229	£15,608	£15,135	£15,005	£9,428	£9,261	£16,970	£4,102	£17,015
cost m² building	£607.68	£97.55	£94.60	£93.78	£58.92	£57.88	£106.06	£25.64	£106.34

RE Contribution %	50%
RE required kWh	11394 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	15.19	6.50	2.36	15.63	14.73	9.65	17.68	2.85	3.04
RE m2 required	109.00			24.00					
Max kWh from system	11554	11394	11394	11400	11678	11678	11678	11394	11394
% RE provided of total energy	51%	50%	50%	50%	51%	51%	51%	50%	50%
tCO2 saved per annum	6.2	6.1	6.1	2.1	2.2	2.2	2.2	3.4	3.4
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£121,536	£19,510	£18,919	£18,756	£11,784	£11,576	£21,212	£5,127	£21,269
cost m² building	£759.60	£121.94	£118.24	£117.22	£73.65	£72.35	£132.57	£32.05	£132.93

C.2 Individual dwelling terrace

Individual dwelling terrace

Declared Assumptions from RE_Scoping worksheet

Development size m²	105 m2
Total kWh for development	14955 kWh
kWh thermal	7664 kWh/yr
Carbon Emissions/yr	5.3 tonnes
RE Contribution %	10%
RE required kWh	1495 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1.99	0.85	0.31	2.05	1.93	1.27	3.00	0.37	0.40
RE m2 required	14.24			3.00					
Max kWh from system	1510	1495	1495	1425	6775	4436	7664	1495	1495
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	0.8	0.8	0.8	0.3	1.3	0.8	1.4	0.5	0.5
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£15,952	£2,561	£2,483	£2,462	£1,547	£1,519	£3,600	£673	£2,792
cost m² building	£151.92	£24.39	£23.65	£23.44	£14.73	£14.47	£34.29	£6.41	£26.59

RE Contribution %	20%
RE required kWh	2991 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	3.99	1.71	0.62	4.10	3.87	2.53	4.64	0.75	0.80
RE m2 required	28.00			6.00					
Max kWh from system	2968	2991	2991	2850	7664	7664	7664	2991	2991
% RE provided of total energy	20%	20%	20%	19%	51%	51%	51%	20%	20%
tCO2 saved per annum	1.6	1.6	1.6	0.5	1.4	1.4	1.4	0.9	0.9
% CO2 saved per annum	30%	30%	30%	10%	27%	27%	27%	17%	17%
Install Cost	£31,903	£5,121	£4,966	£4,923	£3,093	£3,039	£5,568	£1,346	£5,583
cost m² building	£303.84	£48.78	£47.30	£46.89	£29.46	£28.94	£53.03	£12.82	£53.17

RE Contribution %	30%
RE required kWh	4486 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	5.98	2.56	0.93	6.15	5.80	3.80	6.96	1.12	1.20
RE m2 required	43.00			9.00					
Max kWh from system	4558	4486	4486	4275	7664	7664	7664	4486	4486
% RE provided of total energy	30%	30%	30%	29%	51%	51%	51%	30%	30%
tCO2 saved per annum	2.4	2.4	2.4	0.8	1.4	1.4	1.4	1.4	1.4
% CO2 saved per annum	46%	45%	45%	15%	27%	27%	27%	25%	25%
Install Cost	£47,855	£7,682	£7,449	£7,385	£4,640	£4,558	£8,352	£2,019	£8,375
cost m² building	£455.76	£73.16	£70.95	£70.33	£44.19	£43.41	£79.54	£19.23	£79.76

RE Contribution %	40%
RE required kWh	5982 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	7.98	3.41	1.24	8.21	7.73	5.06	9.28	1.50	1.60
RE m2 required	57.00			13.00					
Max kWh from system	6042	5982	5982	6175	7664	7664	7664	5982	5982
% RE provided of total energy	40%	40%	40%	41%	51%	51%	51%	40%	40%
tCO2 saved per annum	3.2	3.2	3.2	1.1	1.4	1.4	1.4	1.8	1.8
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£63,807	£10,243	£9,933	£9,847	£6,187	£6,077	£11,136	£2,692	£11,166
cost m² building	£607.68	£97.55	£94.60	£93.78	£58.92	£57.88	£106.06	£25.64	£106.34

RE Contribution %	50%
RE required kWh	7477 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	9.97	4.27	1.55	10.26	9.67	6.33	11.60	1.87	1.99
RE m2 required	71.00			16.00					
Max kWh from system	7526	7477	7477	7600	7664	7664	7664	7477	7477
% RE provided of total energy	50%	50%	50%	51%	51%	51%	51%	50%	50%
tCO2 saved per annum	4.0	4.0	4.0	1.4	1.4	1.4	1.4	2.3	2.3
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£79,758	£12,804	£12,416	£12,309	£7,734	£7,597	£13,920	£3,365	£13,958
cost m² building	£759.60	£121.94	£118.24	£117.22	£73.65	£72.35	£132.57	£32.05	£132.93

C.3 Individual dwelling flat conversion

Individual dwelling flat conversion

Declared Assumptions from RE_Scoping worksheet

Development size m²	65	m2
Total kWh for development	9258	kWh
kWh thermal	4744	kWh/yr
Carbon Emissions/yr	3.3	tonnes
RE Contribution %	10%	
RE required kWh	926	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1.23	0.53	0.19	1.27	1.20	0.78	3.00	0.23	0.25
RE m2 required	9.00			2.00					
Max kWh from system	954	926	926	950	4194	2746	4744	926	926
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	0.5	0.5	0.5	0.2	0.8	0.5	0.9	0.3	0.3
% CO2 saved per annum	16%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£9,875	£1,585	£1,537	£1,524	£957	£941	£3,600	£417	£1,728
cost m² building	£151.92	£24.39	£23.65	£23.44	£14.73	£14.47	£55.38	£6.41	£26.59

RE Contribution %	20%	
RE required kWh	1852	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	2.47	1.06	0.38	2.54	2.39	1.57	2.87	0.46	0.49
RE m2 required	18.00			4.00					
Max kWh from system	1908	1852	1852	1900	4744	4744	4744	1852	1852
% RE provided of total energy	21%	20%	20%	21%	51%	51%	51%	20%	20%
tCO2 saved per annum	1.0	1.0	1.0	0.4	0.9	0.9	0.9	0.6	0.6
% CO2 saved per annum	31%	30%	30%	11%	27%	27%	27%	17%	17%
Install Cost	£19,750	£3,170	£3,074	£3,048	£1,915	£1,881	£3,447	£833	£3,456
cost m² building	£303.84	£48.78	£47.30	£46.89	£29.46	£28.94	£53.03	£12.82	£53.17

RE Contribution %	30%	
RE required kWh	2777	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	3.70	1.59	0.58	3.81	3.59	2.35	4.31	0.69	0.74
RE m2 required	26.00			6.00					
Max kWh from system	2756	2777	2777	2850	4744	4744	4744	2777	2777
% RE provided of total energy	30%	30%	30%	31%	51%	51%	51%	30%	30%
tCO2 saved per annum	1.5	1.5	1.5	0.5	0.9	0.9	0.9	0.8	0.8
% CO2 saved per annum	45%	45%	45%	16%	27%	27%	27%	25%	25%
Install Cost	£29,624	£4,756	£4,612	£4,572	£2,872	£2,822	£5,170	£1,250	£5,184
cost m² building	£455.76	£73.16	£70.95	£70.33	£44.19	£43.41	£79.54	£19.23	£79.76

RE Contribution %	40%	
RE required kWh	3703	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	4.94	2.11	0.77	5.08	4.79	3.14	5.74	0.93	0.99
RE m2 required	35.00			8.00					
Max kWh from system	3710	3703	3703	3800	4744	4744	4744	3703	3703
% RE provided of total energy	40%	40%	40%	41%	51%	51%	51%	40%	40%
tCO2 saved per annum	2.0	2.0	2.0	0.7	0.9	0.9	0.9	1.1	1.1
% CO2 saved per annum	60%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£39,499	£6,341	£6,149	£6,096	£3,830	£3,762	£6,894	£1,666	£6,912
cost m² building	£607.68	£97.55	£94.60	£93.78	£58.92	£57.88	£106.06	£25.64	£106.34

RE Contribution %	50%	
RE required kWh	4629	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	6.17	2.64	0.96	6.35	5.98	3.92	7.18	1.16	1.23
RE m2 required	44.00			10.00					
Max kWh from system	4664	4629	4629	4744	4744	4744	4744	4629	4629
% RE provided of total energy	50%	50%	50%	51%	51%	51%	51%	50%	50%
tCO2 saved per annum	2.5	2.5	2.5	0.9	0.9	0.9	0.9	1.4	1.4
% CO2 saved per annum	76%	75%	75%	27%	27%	27%	27%	42%	42%
Install Cost	£49,374	£7,926	£7,686	£7,620	£4,787	£4,703	£8,617	£2,083	£8,640
cost m² building	£759.60	£121.94	£118.24	£117.22	£73.65	£72.35	£132.57	£32.05	£132.93

C.4 Development of dwellings 10-50 flats

Development of dwellings 10-50 flats

Declared Assumptions from RE_Scoping worksheet

Development size m²	930 m2
Total kWh for development	132456 kWh
kWh thermal	67878 kWh/yr
Carbon Emissions/yr	47.2 tonnes
RE Contribution %	10%
RE required kWh	13246 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	17.66	7.56	2.75	18.17	17.12	11.21	20.55	3.31	3.53
RE m2 required	126.00			28.00					
Max kWh from system	13356	13246	13246	13300	60003	39294	67878	13246	13246
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	7.2	7.1	7.1	2.5	11.1	7.3	12.6	4.0	4.0
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£114,795	£15,120	£15,120	£17,261	£13,699	£11,214	£17,467	£4,967	£19,427
cost m² building	£123.44	£16.26	£16.26	£18.56	£14.73	£12.06	£18.78	£5.34	£20.89

RE Contribution %	20%
RE required kWh	26491 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	35.32	15.12	5.50	36.34	34.25	22.43	41.10	6.62	7.06
RE m2 required	252.00			56.00					
Max kWh from system	26712	26491	26491	26600	67878	67878	67878	26491	26491
% RE provided of total energy	20%	20%	20%	20%	51%	51%	51%	20%	20%
tCO2 saved per annum	14.3	14.2	14.2	4.9	12.6	12.6	12.6	8.0	8.0
% CO2 saved per annum	30%	30%	30%	10%	27%	27%	27%	17%	17%
Install Cost	£229,590	£30,241	£30,241	£34,522	£27,399	£22,428	£34,933	£9,934	£38,854
cost m² building	£246.87	£32.52	£32.52	£37.12	£29.46	£24.12	£37.56	£10.68	£41.78

RE Contribution %	30%
RE required kWh	39737 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	52.98	22.68	8.25	54.51	51.37	33.64	61.65	9.93	10.60
RE m2 required	378.00			84.00					
Max kWh from system	40068	39737	39737	39900	67878	67878	67878	39737	39737
% RE provided of total energy	30%	30%	30%	30%	51%	51%	51%	30%	30%
tCO2 saved per annum	21.5	21.3	21.3	7.4	12.6	12.6	12.6	12.0	12.0
% CO2 saved per annum	46%	45%	45%	16%	27%	27%	27%	25%	25%
Install Cost	£344,384	£45,361	£45,361	£51,784	£41,098	£33,642	£52,400	£14,901	£58,280
cost m² building	£370.31	£48.78	£48.78	£55.68	£44.19	£36.17	£56.34	£16.02	£62.67

RE Contribution %	40%
RE required kWh	52982 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	70.64	30.24	11.00	72.68	68.50	44.86	82.20	13.25	14.13
RE m2 required	505.00			112.00					
Max kWh from system	53530	52982	52982	53200	67878	67878	67878	52982	52982
% RE provided of total energy	40%	40%	40%	40%	51%	51%	51%	40%	40%
tCO2 saved per annum	28.7	28.5	28.5	9.8	12.6	12.6	12.6	16.0	16.0
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£459,179	£60,482	£60,482	£69,045	£54,797	£44,856	£69,867	£19,868	£77,707
cost m² building	£493.74	£65.03	£65.03	£74.24	£58.92	£48.23	£75.13	£21.36	£83.56

RE Contribution %	50%
RE required kWh	66228 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	88.30	37.80	13.75	90.85	85.62	56.07	102.75	16.56	17.66
RE m2 required	631.00			139.00					
Max kWh from system	66886	66228	66228	66025	67878	67878	67878	66228	66228
% RE provided of total energy	50%	50%	50%	50%	51%	51%	51%	50%	50%
tCO2 saved per annum	35.9	35.6	35.6	12.2	12.6	12.6	12.6	20.0	20.0
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£573,974	£75,602	£75,602	£86,306	£68,497	£56,070	£87,333	£24,835	£97,134
cost m² building	£617.18	£81.29	£81.29	£92.80	£73.65	£60.29	£93.91	£26.70	£104.45

ATKINS

C.5 Housing/Mixed use site >50-200 units

Housing/Mixed use site >50-200 units

Declared Assumptions from RE_Scoping worksheet

Development size m²	5065 m2
Total kWh for development	721384 kWh
kWh thermal	369677 kWh/yr
Carbon Emissions/yr	257.3 tonnes
RE Contribution %	10%
RE required kWh	72138 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£600	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	96.18	41.17	14.97	98.96	93.26	61.07	111.91	18.03	19.24
RE m2 required	687.00	0.00	0.00	152.00	0.00	0.00	0.00	0	0
Max kWh from system	72822	72138	72138	72200	326791	214004	369677	72138	72138
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	39.1	38.7	38.7	13.4	60.5	39.6	68.4	21.8	21.8
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£625,200	£82,350	£82,350	£94,009	£55,957	£61,074	£95,128	£27,052	£105,803
cost m² building	£123.44	£16.26	£16.26	£18.56	£11.05	£12.06	£18.78	£5.34	£20.89

RE Contribution %	20%
RE required kWh	229194 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	192.37	82.35	29.95	197.91	186.52	122.15	223.83	36.07	38.47
RE m2 required	1,374.00	0.00	0.00	304.00	0.00	0.00	0.00	0	0
Max kWh from system	145644	144277	144277	144400	369677	369677	369677	144277	144277
% RE provided of total energy	20%	20%	20%	20%	51%	51%	51%	20%	20%
tCO2 saved per annum	78.2	77.5	77.5	26.7	68.4	68.4	68.4	43.6	43.6
% CO2 saved per annum	30%	30%	30%	10%	27%	27%	27%	17%	17%
Install Cost	£1,250,399	£164,700	£164,700	£188,017	£149,220	£122,148	£190,255	£54,104	£211,606
cost m² building	£246.87	£32.52	£32.52	£37.12	£29.46	£24.12	£37.56	£10.68	£41.78

RE Contribution %	30%
RE required kWh	343791 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£600	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	288.55	123.52	44.92	296.87	279.79	183.22	335.74	54.10	57.71
RE m2 required	2,061.00	0.00	0.00	456.00	0.00	0.00	0.00	0	0
Max kWh from system	218466	216415	216415	216600	369677	369677	369677	216415	216415
% RE provided of total energy	30%	30%	30%	30%	51%	51%	51%	30%	30%
tCO2 saved per annum	117.3	116.2	116.2	40.1	68.4	68.4	68.4	65.4	65.4
% CO2 saved per annum	46%	45%	45%	16%	27%	27%	27%	25%	25%
Install Cost	£1,875,599	£247,049	£247,049	£282,026	£167,872	£183,222	£285,383	£81,156	£317,409
cost m² building	£370.31	£48.78	£48.78	£55.68	£33.14	£36.17	£56.34	£16.02	£62.67

RE Contribution %	40%
RE required kWh	458387 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	384.74	164.70	59.89	395.83	373.05	244.30	447.66	72.14	76.95
RE m2 required	2,748.00	0.00	0.00	607.00	0.00	0.00	0.00	0	0
Max kWh from system	291288	288554	288554	288325	369677	369677	369677	288554	288554
% RE provided of total energy	40%	40%	40%	40%	51%	51%	51%	40%	40%
tCO2 saved per annum	156.4	155.0	155.0	53.3	68.4	68.4	68.4	87.2	87.2
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£2,500,799	£329,399	£329,399	£376,035	£298,440	£244,297	£380,510	£108,208	£423,212
cost m² building	£493.74	£65.03	£65.03	£74.24	£58.92	£48.23	£75.13	£21.36	£83.56

RE Contribution %	50%
RE required kWh	572984 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£600	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	480.92	205.87	74.86	494.78	466.31	305.37	559.57	90.17	96.18
RE m2 required	3,435.00	0.00	0.00	759.00	0.00	0.00	0.00	0	0
Max kWh from system	364110	360692	360692	360525	369677	369677	369677	360692	360692
% RE provided of total energy	50%	50%	50%	50%	51%	51%	51%	50%	50%
tCO2 saved per annum	195.5	193.7	193.7	66.7	68.4	68.4	68.4	109.1	109.1
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£3,125,999	£411,749	£411,749	£470,043	£279,787	£305,371	£475,638	£135,260	£529,015
cost m² building	£617.18	£81.29	£81.29	£92.80	£55.24	£60.29	£93.91	£26.70	£104.45

C.6 Housing/Mixed use site >200-500 units

Housing/Mixed use site >200-500 units

Declared Assumptions from RE_Scoping worksheet

Development size m²	16355	m2
Total kWh for development	2345721	kWh
kWh thermal	1193697	kWh/yr
Carbon Emissions/yr	839.5	tonnes
RE Contribution %	10%	
RE required kWh	234572	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	312.76	133.89	48.69	321.78	303.26	198.59	363.91	58.64	62.55
RE m2 required	2,234.00			494.00					
Max kWh from system	236804	234572	234572	234650	1062625	695875	1193697	234572	234572
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	127.2	126.0	126.0	43.4	196.6	128.7	220.8	70.9	70.9
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	26%	8%	8%
Install Cost	£1,563,814	£133,888	£146,060	£225,243	£121,304	£158,876	£181,956	£70,372	£250,210
cost m² building	£95.62	£8.19	£8.93	£13.77	£7.42	£9.71	£11.13	£4.30	£15.30

RE Contribution % 20%
RE required kWh 469144 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	625.53	267.78	97.37	643.55	606.52	397.19	727.83	117.29	125.11
RE m2 required	4,468.00			988.00					
Max kWh from system	473608	469144	469144	469300	1193697	1193697	1193697	469144	469144
% RE provided of total energy	20%	20%	20%	20%	51%	51%	51%	20%	20%
tCO2 saved per annum	254.3	251.9	251.9	86.8	220.8	220.8	220.8	141.8	141.8
% CO2 saved per annum	30%	30%	30%	10%	26%	26%	26%	17%	17%
Install Cost	£3,127,628	£267,776	£292,120	£450,487	£242,609	£317,751	£363,913	£140,743	£500,421
cost m² building	£191.23	£16.37	£17.86	£27.54	£14.83	£19.43	£22.25	£8.61	£30.60

RE Contribution % 30%
RE required kWh 703716 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	938.29	401.66	146.06	965.33	909.78	595.78	1,091.74	175.93	187.66
RE m2 required	6,702.00			1,482.00					
Max kWh from system	710412	703716	703716	703950	703716	703716	703716	703716	703716
% RE provided of total energy	30%	30%	30%	30%	30%	30%	30%	30%	30%
tCO2 saved per annum	381.5	377.9	377.9	130.2	130.2	130.2	130.2	212.8	212.8
% CO2 saved per annum	45%	45%	45%	16%	16%	16%	16%	25%	25%
Install Cost	£4,691,443	£401,665	£438,180	£675,730	£363,913	£476,627	£545,869	£211,115	£750,631
cost m² building	£286.85	£24.56	£26.79	£41.32	£22.25	£29.14	£33.38	£12.91	£45.90

RE Contribution % 40%
RE required kWh 938289 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1,251.05	535.55	194.75	1,287.10	1,213.04	794.38	1,455.65	234.57	250.21
RE m2 required	8,936.00			1,975.00					
Max kWh from system	947216	938289	938289	938125	938289	938289	938289	938289	938289
% RE provided of total energy	40%	40%	40%	40%	40%	40%	40%	40%	40%
tCO2 saved per annum	508.7	503.9	503.9	173.6	173.6	173.6	173.6	283.7	283.7
% CO2 saved per annum	61%	60%	60%	21%	21%	21%	21%	34%	34%
Install Cost	£6,255,257	£535,553	£584,239	£900,973	£485,217	£635,502	£727,826	£281,487	£1,000,841
cost m² building	£382.47	£32.75	£35.72	£55.09	£29.67	£38.86	£44.50	£17.21	£61.19

RE Contribution % 50%
RE required kWh 1172861 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1,563.81	669.44	243.43	1,608.88	1,516.30	992.97	1,819.56	293.22	312.76
RE m2 required	11,170.00			2,469.00					
Max kWh from system	1184020	1172861	1172861	1172775	1172861	1172861	1172861	1172861	1172861
% RE provided of total energy	50%	50%	50%	50%	50%	50%	50%	50%	50%
tCO2 saved per annum	635.8	629.8	629.8	217.0	217.0	217.0	217.0	354.6	354.6
% CO2 saved per annum	76%	75%	75%	26%	26%	26%	26%	42%	42%
Install Cost	£7,819,071	£669,441	£730,299	£1,126,217	£606,521	£794,378	£909,782	£351,858	£1,251,051
cost m² building	£478.08	£40.93	£44.65	£68.86	£37.08	£48.57	£55.63	£21.51	£76.49

C.7 Housing/Mixed use site >500 units (excluding CHP)

Housing/Mixed use site >500 units (excluding CHP)

Declared Assumptions from RE_Scoping worksheet

Development size m²	100300	m2
Total kWh for development	16945816	kWh
Total kWh thermal	8981932	kWh/yr
Carbon Emissions/yr	5938.4	tonnes
RE Contribution %	10%	
RE required kWh	1694582	kWh

Total Development

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	2,259	967	352	2,325	2,191	1,435	2,629	424	452
RE m2 required total	16,139	-	-	3,568	-	-	-	-	-
Max kWh from system	1710734	1694582	1694582	1694800	7676553	5027097	8981932	1694582	1694582
% RE provided of total energy	10%	10%	10%	10%	45%	30%	53%	10%	10%
tCO2 saved per annum	918.7	910.0	910.0	313.5	1420.2	930.0	1661.7	512.3	512.3
% CO2 saved per annum	15%	15%	15%	5%	24%	16%	28%	9%	9%
Install Cost	£11,297,211	£967,227	£1,055,157	£1,627,189	£876,319	£1,147,739	£1,314,478	£508,374	£1,807,554
cost m² building	£112.63	£9.64	£10.52	£16.22	£8.74	£11.44	£13.11	£5.07	£18.02

Residential

CO2 emissions residential 4231 tonnes/yr

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
RE kW required Residential	1,582	677	246	1,627	1,534	1,004	1,841	297	316
Max RE kWh Residential	1186403	1186403	1186403	1186403	1186403	1186403	1186403	1186403	1186403
tCO2 saved/yr Residential	637	637	637	219	219	219	219	358.7	358.7
% CO2 saved Residential	15%	15%	15%	5%	5%	5%	5%	8%	8%
RE install cost Residential	£7,909,354	£677,171	£738,732	£1,139,220	£613,525	£803,550	£920,287	£355,921	£1,265,497
RE cost/m2 Residential	£95	£8	£9	£14	£7	£10	£11	£4	£15

Non-Residential

CO2 emissions non-residential 1707 tonnes/yr

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
RE kW required Non-residential	678	290	105	697	657	430	788	127	136
Max RE kWh Non-residential	508179	508179	508179	508179	508179	508179	508179	508179	508179
tCO2 saved/yr Non-residential	273	273	273	94	94	94	94	153.6	153.6
% CO2 saved Non-residential	16%	16%	16%	6%	6%	6%	6%	9%	9%
RE install cost Non-residential	£3,387,857	£290,056	£316,425	£487,969	£262,794	£344,189	£394,192	£152,454	£542,057
RE cost/m2 Non-residential	£199	£17	£19	£29	£15	£20	£23	£9	£32

RE Contribution %	20%	
RE required kWh	3389163	kWh

Total Development

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	4,519	1,934	703	4,649	4,382	2,869	5,258	847	904
RE m2 required total	32,278	-	-	7,135	-	-	-	-	-
Max kWh from system	3421468	3389163	3389163	3389125	8981932	8981932	8981932	3389163	3389163
% RE provided of total energy	20%	20%	20%	20%	53%	53%	53%	20%	20%
tCO2 saved per annum	1837.4	1820.0	1820.0	627.0	1661.7	1661.7	1661.7	1024.7	1024.7
% CO2 saved per annum	31%	31%	31%	11%	28%	28%	28%	17%	17%
Install Cost	£22,594,421	£1,934,454	£2,110,313	£3,254,378	£1,752,638	£2,295,478	£2,628,957	£1,016,749	£3,615,107
cost m² building	£225.27	£19.29	£21.04	£32.45	£17.47	£22.89	£26.21	£10.14	£36.04

Residential

CO2 emissions residential 4231 tonnes/yr

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
RE kW required Residential	3,164	1,354	492	3,255	3,068	2,009	3,681	593	633
Max RE kWh Residential	2372806	2372806	2372806	2372806	2372806	2372806	2372806	2372806	2372806
tCO2 saved/yr Residential	1274	1274	1274	439	439	439	439	717.4	717.4
% CO2 saved Residential	30%	30%	30%	10%	10%	10%	10%	17%	17%
RE install cost Residential	£15,818,707	£1,354,341	£1,477,463	£2,278,441	£1,227,049	£1,607,100	£1,840,574	£711,842	£2,530,993
RE cost/m2 Residential	£190	£16	£18	£27	£15	£19	£22	£9	£30

Non-Residential

CO2 emissions non-residential 1707 tonnes/yr

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
RE kW required Non-residential	1,355	580	211	1,394	1,314	860	1,577	254	271
Max RE kWh Non-residential	1016357	1016357	1016357	1016357	1016357	1016357	1016357	1016357	1016357
tCO2 saved/yr Non-residential	546	546	546	188	188	188	188	307.3	307.3
% CO2 saved Non-residential	32%	32%	32%	11%	11%	11%	11%	18%	18%
RE install cost Non-residential	£6,775,714	£580,113	£632,850	£975,937	£525,589	£688,378	£788,383	£304,907	£1,084,114
RE cost/m2 Non-residential	£399	£34	£37	£57	£31	£40	£46	£18	£64

RE Contribution % 30%
RE required kWh 5083745 kWh

Total Development

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	6,778	2,902	1,055	6,974	6,572	4,304	7,887	1,271	1,356
RE m2 required total	48,417	-	-	10,703	-	-	-	-	-
Max kWh from system	5132202	5083745	5083745	5083925	8981932	8981932	8981932	5083745	5083745
% RE provided of total energy	30%	30%	30%	30%	53%	53%	53%	30%	30%
tCO2 saved per annum	2756.1	2730.1	2730.1	940.5	1661.7	1661.7	1661.7	1537.0	1537.0
% CO2 saved per annum	46%	46%	46%	16%	28%	28%	28%	26%	26%
Install Cost	£33,891,632	£2,901,681	£3,165,470	£4,881,567	£2,628,957	£3,443,217	£3,943,435	£1,525,123	£5,422,661
cost m² building	£337.90	£28.93	£31.56	£48.67	£26.21	£34.33	£39.32	£15.21	£54.06

Residential

CO2 emissions residential 4231 tonnes/yr

RE kW required Residential	4,746	2,032	739	4,882	4,601	3,013	5,522	890	949
Max RE kWh Residential	3559209	3559209	3559209	3559209	3559209	3559209	3559209	3559209	3559209
tCO2 saved/yr Residential	1911	1911	1911	658	658	658	658	1076.1	1076.1
% CO2 saved Residential	45%	45%	45%	16%	16%	16%	16%	25%	25%
RE install cost Residential	£23,728,061	£2,031,512	£2,216,195	£3,417,661	£1,840,574	£2,410,650	£2,760,860	£1,067,763	£3,796,490
RE cost/m2 Residential	£285	£24	£27	£41	£22	£29	£33	£13	£46

Non-Residential

CO2 emissions non-residential 1707 tonnes/yr

RE kW required Non-residential	2,033	870	316	2,091	1,971	1,291	2,365	381	407
Max RE kWh Non-residential	1524536	1524536	1524536	1524536	1524536	1524536	1524536	1524536	1524536
tCO2 saved/yr Non-residential	819	819	819	282	282	282	282	460.9	460.9
% CO2 saved Non-residential	48%	48%	48%	17%	17%	17%	17%	27%	27%
RE install cost Non-residential	£10,163,571	£870,169	£949,275	£1,463,906	£788,383	£1,032,567	£1,182,575	£457,361	£1,626,171
RE cost/m2 Non-residential	£598	£51	£56	£86	£46	£61	£70	£27	£96

RE Contribution % 40%
RE required kWh 6778326 kWh

Total Development

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	9,038	3,869	1,407	9,298	8,763	5,739	10,516	1,695	1,808
RE m2 required total	64,555	-	-	14,270	-	-	-	-	-
Max kWh from system	6842830	6778326	6778326	6778250	8981932	8981932	8981932	6778326	6778326
% RE provided of total energy	40%	40%	40%	40%	53%	53%	53%	40%	40%
tCO2 saved per annum	3674.7	3640.1	3640.1	1254.0	1661.7	1661.7	1661.7	2049.4	2049.4
% CO2 saved per annum	62%	61%	61%	21%	28%	28%	28%	35%	35%
Install Cost	£45,188,843	£3,868,908	£4,220,627	£6,508,756	£3,505,275	£4,590,956	£5,257,913	£2,033,498	£7,230,215
cost m² building	£450.54	£38.57	£42.08	£64.89	£34.95	£45.77	£52.42	£20.27	£72.09

Residential

CO2 emissions residential 4231 tonnes/yr

RE kW required Residential	6,327	2,709	985	6,510	6,135	4,018	7,362	1,186	1,265
Max RE kWh Residential	4745612	4745612	4745612	4745612	4745612	4745612	4745612	4745612	4745612
tCO2 saved/yr Residential	2548	2548	2548	878	878	878	878	1434.8	1434.8
% CO2 saved Residential	60%	60%	60%	21%	21%	21%	21%	34%	34%
RE install cost Residential	£31,637,414	£2,708,683	£2,954,927	£4,556,882	£2,454,098	£3,214,200	£3,681,147	£1,423,684	£5,061,986
RE cost/m2 Residential	£380	£33	£35	£55	£29	£39	£44	£17	£61

Non-Residential

CO2 emissions non-residential 1707 tonnes/yr

RE kW required Non-residential	2,710	1,160	422	2,788	2,628	1,721	3,154	508	542
Max RE kWh Non-residential	2032714	2032714	2032714	2032714	2032714	2032714	2032714	2032714	2032714
tCO2 saved/yr Non-residential	1092	1092	1092	376	376	376	376	614.6	614.6
% CO2 saved Non-residential	64%	64%	64%	22%	22%	22%	22%	36%	36%
RE install cost Non-residential	£13,551,429	£1,160,225	£1,265,700	£1,951,874	£1,051,177	£1,376,756	£1,576,766	£609,814	£2,168,229
RE cost/m2 Non-residential	£797	£68	£74	£115	£62	£81	£93	£36	£128

RE Contribution % 50%
RE required kWh 8472908 kWh

Total Development

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	11,297	4,836	1,759	11,623	10,954	7,173	13,145	2,118	2,259
RE m2 required total	80,694	-	-	17,838	-	-	-	-	-
Max kWh from system	8553564	8472908	8472908	8473050	8981932	8981932	8981932	8472908	8472908
% RE provided of total energy	50%	50%	50%	50%	53%	53%	53%	50%	50%
tCO2 saved per annum	4593.4	4550.1	4550.1	1567.5	1661.7	1661.7	1661.7	2561.7	2561.7
% CO2 saved per annum	77%	77%	77%	26%	28%	28%	28%	43%	43%
Install Cost	£56,486,053	£4,836,135	£5,275,783	£8,135,945	£4,381,594	£5,738,695	£6,572,391	£2,541,872	£9,037,769
cost m² building	£563.17	£48.22	£52.60	£81.12	£43.68	£57.22	£65.53	£25.34	£90.11

Residential

CO2 emissions residential 4231 tonnes/yr

RE kW required Residential	7,909	3,386	1,231	8,137	7,669	5,022	9,203	1,483	1,582
Max RE kWh Residential	5932015	5932015	5932015	5932015	5932015	5932015	5932015	5932015	5932015
tCO2 saved/yr Residential	3186	3186	3186	1097	1097	1097	1097	1793.5	1793.5
% CO2 saved Residential	75%	75%	75%	26%	26%	26%	26%	42%	42%
RE install cost Residential	£39,546,768	£3,385,853	£3,693,658	£5,696,102	£3,067,623	£4,017,750	£4,601,434	£1,779,605	£6,327,483
RE cost/m2 Residential	£475	£41	£44	£68	£37	£48	£55	£21	£76

Non-Residential

CO2 emissions non-residential 1707 tonnes/yr

RE kW required Non-residential	3,388	1,450	527	3,485	3,285	2,151	3,942	635	678
Max RE kWh Non-residential	2540893	2540893	2540893	2540893	2540893	2540893	2540893	2540893	2540893
tCO2 saved/yr Non-residential	1365	1365	1365	470	470	470	470	768.2	768.2
% CO2 saved Non-residential	80%	80%	80%	28%	28%	28%	28%	45%	45%
RE install cost Non-residential	£16,939,286	£1,450,281	£1,582,125	£2,439,843	£1,313,972	£1,720,945	£1,970,958	£762,268	£2,710,286
RE cost/m2 Non-residential	£996	£85	£93	£144	£77	£101	£116	£45	£159

Appendix D
Renewable Energy Delivery Vehicles

D.1 Delivery Vehicles – Commercial and technical Considerations (Energy Service Companies and Contract Energy Management Companies)

INTRODUCTION

D.1.1 There is no one tailor-made solution to the delivery of sustainability and each project will need detailed technical review and assessment of the appropriate structure to manage the business risk, which will affect the amount and type of funding available, obligations of the organisation and the sources of the funds. It is possible that different models will be more appropriate for different developments.

D.1.2 There are a number of business models that might be applicable for the implementation of area-wide renewable energy solution – although all are ultimately about managing business risk and capital investment.

D.1.3 Traditional models that maybe effective are the Energy Service Company (ESCO) that typically delivers energy efficiencies and the Contract Energy Management Company (CEM) that typically generates heat and power. These models are undergoing resurgence throughout Europe [source: *Energy End-Use Efficiency and Energy Services* ("Energy Services Directive")].

DEFINITION OF AN ESCO & CEM COMPANY

D.1.4 The European Parliament Directive 2006/32/EC and the report for the Council entitled *Energy End-Use Efficiency and Energy Services* ("Energy Services Directive") define the energy service companies as follows:

- **"energy service company"** ("ESCO"): a natural or legal person that delivers energy services and/or energy efficiency improvements measures in the end-user facility or premises and accepts some degree of the financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements.
- **"contract energy management"** ("CEM"): a service provided under a legal contract to the end-user which includes generation of electricity and useful heat for use at the end-user facility or premises.

D.1.5 The report comments that both ESCOs and CEMs are seen as tools to enhance the sustainable use of energy through promoting energy efficiencies and very efficient renewable energy generation. The corporate structure translates the uncertainty of managing an efficiency or sustainable generation project into a defined business risk that can be quantified, operated and managed over the long term.

COMPANY STRUCTURE

D.1.6 The company structure of both an ESCO and CEM is determined by the benefits to be delivered and the risks to be mitigated and designed to serve the long-term aspirations of the stakeholders. Organisations can be formed as co-operatives, not-for-profit and limited by guarantee or as a company limited by shareholder equity and third party debt. In all cases the corporate entity will have stakeholders and will require access to funding, and are typically owned by the parties taking the initial risk. The corporate structure may affect the sources and types of funding available.

D.1.7 ESCOs and CEMs help to overcome financial constraints to investment in the energy sectors and typically seek to repay initial costs, at least in part, by taking their reward directly from the financial savings from the energy efficiencies or delivery of the power and heat for on-site use. The benefit to the end user is reduced costs and $_{CO2}$ whilst the ESCO and CEM can utilise market drivers to realise the value of the efficiencies.

PURPOSE OF AN ESCO and CEM

D.1.8 Traditionally the purpose of the ESCO is to identify and drive energy efficiencies at the point of use on behalf of an interest group. The mechanism translates the uncertainty of managing an energy efficiency initiative into a business risk that can be quantified, operated and managed over time. Typically the ESCO funds the capital investment in the efficiency measures and recovers the investment by a revenue charge usually based on the savings achieved over time.

D.1.9 Traditionally in the UK the purpose of the CEM is to build, manage and operate an energy centre that generates high-efficiency sustainable electricity and heat for use at the end-user site. The heart of the Energy Centre is the Combined Heat and Power generator (CHP) which generates electricity and heat at the same time in a predetermined ratio. The CEM also requires complex distribution controls and a connection to the point of use and potentially the distribution grid: thus the CEM requires: capital, connections to distribute the power and heat and the commercial capability to realise the benefits of the renewable energy and heat. There is an additional technical constraint that the available heat is directly linked to the type of generator and the amount of power generated.

SOURCES OF FUNDS

D.1.10 The financing options for the Combined Heat and Power (CHP) generating equipment can be divided into two key groups.

Possible Funding Methods for CHP Projects	
Capital Purchase or 'on balance sheet' financing	Operating Lease or 'off balance sheet' financing
Financed by: • Internal funds • Debt finance • Leasing	Financed by: • Equipment supplier • Energy services company (ESCO) • Other sources of funding

Source: DECC CHP Focus; http://chp.defra.gov.uk/cms/

Internal Funds

D.1.11 CEM retains full ownership of the assets and bears the full technical, financial and commercial risk – which can vary with the type of installation chosen and the contract structure.

Debt Financing

D.1.12 CEM matches appropriate source of capital to a specific project and timescale, repayment schedule being from the CEM cash flow – the cost of the finance depends on the trade off between the perceived risk and returns.

Leasing

D.1.13 Two main types of arrangement:

- hire purchase; the CEM becomes the legal owner of the assets once all payments have been made
- finance lease ('full payout'); the CEM does not own the asset although it appears on the balance sheet whilst the rental payments are made – at the end of the primary period the asset is sold or a new lease is sought

Equipment Supplier Finance

D.1.14 Leasing package as an alternative to outright purchase where the supplier designs, installs, maintains, and operates the CHP, the technical risk is transferred into the equipment supplier, the price risk is with the CEM – typically the supplier will purchase the fuel, account for the $_{CO2}$, buy the heat and power and may supply the CEM at a discounted energy price.

Energy Services Company (ESCO)

D.1.15 Wide varieties of contracts where the ESCO typically design, install, finance, operate and maintain a CHP plant on the end-user site. The entire risk including the CHP plant capital and operating costs, together with all technical and operating risks of the CHP is transferred into the ESCO. The CEM savings will normally be less than under a capital purchase arrangement – unless the plant is "oversized" for the immediate end-user allowing the surplus electricity and heat to be sold to other end-users.

Other Sources of Funds

D.1.16 There maybe opportunities to meet the capital cost through a combination of funding types, access to which may depend on the leading beneficial owner and the corporate structure – for example interest-free short-term loans maybe available to statutory bodies through DECC Salix funding or through CESP finance initiatives.

FOOTPRINT AND IMPACT

D.1.17 Footprint of a typical CHP engine is dependant on the size and type of the engine, the feedstock and manufacturer and the heat exchangers. The typical engine and controls for a smaller CHP unit will fit in to a space approx 15m long by 3m wide and high. Additional space is required for the "day storage" and controls, feedstock deliveries, the heat exchangers and heat export connections, long term storage and feedstock handling.

D.1.18 The flue stack and potential noise is subject to environmental regulation and atmospheric conditions. In practice the building line will be similar to the housing stock and flue height is typically 10m above the roof line. Energy centres may be housed in re-fitted existing building space – the typical total footprint of a larger energy centre of 2.0MW electricity is between 0.5 and10. acre and depends on feedstock and storage, smaller units maybe housed in temporary containers.

INDICATIVE CAPITAL COSTS

D.1.19 Capital costs for the CEM will be determined by the feasibility study and refined by the project development process. Indicative capital costs for bio-fuel generation; are in the order of:

- CHP reciprocating gas £ 1,000 per kW of electricity
- Bio-fuel wood premium £ 500 per kW of electricity

D.1.20 Other site specific charges such as corporate & legal & professional fees, way-leaves, civil engineering, electricity grid connection, way-leaves, metering at the houses and regulatory charges, heat main and network are all excluded from the examples given below

Source: CHPA: July 2009

CONSIDERATIONS AND BENEFICIARIES OF WIDE AREA DEVELOPMENTS WITHIN LEWISHAM

D.1.21 The proposed developments areas within the Deptford and New Cross are predominantly larger-scale residential or mixed use schemes, whilst Lewisham Gateway and Catford are predominantly commercial or retail developments with some housing.

D.1.22 Area wide sustainable generation requires the technical capability to generate, alongside the commercial capability to utilise the renewable energy and distribute the power and/or heat to ensure that all available incentives and grants are effectively realised. Within the Deptford and New Cross developments it is likely that sustainable power generation will be connected directly to the existing grid whilst the heat will require a newly built dedicated heat distribution network, which maybe limited to the individual development area or be connected to other additional development areas by larger heat mains.

D.1.23 Energy efficiency and local generation companies require the ability to capitalise the equipment cost, quantify the savings and charge the business unit over time: in addition, there may be an incentive to identify and realise new savings opportunities. The risk and benefits may be placed under the control of an ESCO or CEM and fall into the following four main categories

- The householder or commercial occupier takes delivery of the efficiency equipment and makes the savings at the point of use which are quantified in some way and for which the ESCO receives the reward
- The householder or commercial occupier receives the sustainable electricity through the existing distribution grid (which maybe extended in the normal way for new developments) under a standard “green” electricity supply contract, measured by an electricity meter and is invoiced – the CEM is rewarded through the sale of the sustainable electricity into the electricity distribution grid
- The householder or commercial occupier receives the useful heat through a new heat distribution network and receives the benefit at the point of use. Typically the heat displaces natural gas as a heating fuel and may require different boilers and controls within the house, which is easiest in new build developments. The CEM or an ESCO will receive the rewards.
- The ESCO(s) need to:

  Identify and quantify energy efficiencies and savings opportunities

  Source the capital to procure and deploy the equipment

  Deliver the equipment

  Realise the savings and receive reward

  Operate in accordance with BS EN 15900

D.1.24 The opportunities maybe in a new build or in a retro-fit environment and, within the Deptford and New Cross area, will be focused on residential and mixed use areas, Lewisham Gateway and Catford is office and shopping centres with some housing and schools. There is the potential to add other opportunities such as heat networks and efficiency projects either to existing or new ESCOs, for example Building Schools for the Future and other local iconic sites such as Goldsmith’s College, Lewisham College and Lewisham Hospital.

7.126 In the wide area configuration the CEM(s) needs to:

- Generate from a local energy management plant
- Distribute and charge the end-users for the heat, which requires a new heat distribution network with heat meters at the point of use and a contract to charge for the benefit of the heat.
- Deliver the power into the local grid and, within the Deptford and New Cross developments, this will be a connection to the local grid governed by the Distribution Network Operator ("DNO") and an industry-standard electricity meter.
- Contract with and invoice a licensed electricity supplier to receive the sustainable electricity delivered into the grid – it is for the licensed electricity supplier to offer to supply the local occupiers under their standard end-user electricity supply contract.
- Access to the new heat distribution network and initially it is envisaged that the CEM will be physically located within a new development area.
- Access the electricity distribution grid through a sub station which maybe physically located within the development area and will be under the control of the local Distribution Network Operator ("DNO").

D.1.25 Other opportunities to establish CEMs will occur and this model allows additional plant to be brought into existing CEMs or new CEMs to be established depending on the technology and stakeholder requirements, for example Building Schools for the Future and other local iconic sites such as Goldsmith's College, Lewisham College and Lewisham Hospital might benefit from a CEM and a feasibility should be encouraged.

DEPTFORD AND NEW CROSS

D.1.26 There is a potential role for both classes of enterprises within the area where:

- the new development areas will require the energy infrastructure such as the heat network and the electricity grid wires and metering to the residential and commercial end-users.
- the new developments will receive the benefits of green energy alongside the opportunity to offer sustainable electricity to existing residential and commercial end-users in Lewisham (or indeed elsewhere in England and Wales).
- energy efficiencies can be used to reduce energy demand in existing homes and businesses and maybe delivered by an ESCO.

Option 1 - SELCHP providing 40MW of thermal energy .

- SELCHP build, fund, maintain and operate a heat main and distribution network to the new homes and commercial facilities on major development areas at Surrey Canal Road, Oxestalls Road, Cannons Wharf and Convoys Wharf, and recover the cost over time as a charge to the individual end-users.
- No new sustainable power generation is built within the Borough.
- No energy centre is required, hence no footprint in the Lewisham. The heat main plus heat networks within development areas is estimated to make an indicative saving of 6,627 tonnes of CO2 per annum at an indicative cost of between £1.5 - £2.2m, with the normal exclusions and must be subject to a full appraisal, survey and feasibility and complex trenching and finishing costs.

Option 2 - Centralised biomass CHP - 2.7 MW of electricity with additional heat network, supplying the northern development zones

- Single reciprocating-engine CHP of 2.7MW of sustainable electricity output delivered into the national grid at a location to be determined (potentially Oxestalls Road development area) and with a direct connection into a local heat distribution system in Oxestalls Road and to the Convoys Wharf and Cannons Wharf development areas.
- The heat is transferred from the CEM to the ESCO at an agreed transfer price. The profits attributable to the ESCO and CEM will be distributed in accordance with the corporate structure and agreements between the stakeholders. The CEM will sell the power to a licensed supplier at a grid connection point and receiving a share of the sustainable power benefits.
- Finance for the CEM and generation equipment may be separated from the ESCO that finances the heat network and metering and invoices consumers.
- The capital cost (with the normal exclusions) is estimated at £18.5m and is expected to save 14,865 tonnes of CO2 per annum, subject to a full feasibility study and refinement during the project design and specification process.
- This option allows for expansion and a potential connection to SELCHP or other units through a heat main extension, linking the development areas along the route of the Surrey Canal or alternative continuous routes.

Option 3 - Single CHP 2.7 MWe with solar PV and solar thermal

- The centralised CHP size is reduced to 1.3MW of electricity with associated heat network supplemented by solar PV and solar thermal installations on the new build housing within the Convoys Wharf, Oxestalls Road and Cannons Wharf development areas. The solar PV and thermal offering can be extended to include existing housing if additional financing is made available.
- This option, if downsized, is particularly attractive to the Community Energy Saving Programme (‘CESP’) financing scheme, currently in consultation where the suppliers adopt a “whole house” approach “in areas with high levels of low incomes” in order reduce CO2 emissions using measures which specifically includes district heating as an option.
- Finance for the CEM and generation equipment may be separated from the ESCO that finances the heat network and metering and invoices consumers and the additional renewable electricity generation equipment. An additional ESCO maybe required to deliver and manage the solar PV and the solar thermal installations.
- The capital cost (with the normal exclusions) is estimated at £47.9m and is expected to save 13,711 tonnes of CO2 per annum, subject to a full feasibility study and refinement during the project design and specification process. The additional cost is due to the amount of renewable generation equipment for the houses.

Option 4 - Multiple CHP units - cumulative value of 2.8MWe and heat network

- This option proposes a number of smaller CHP units each scaled for the heat demand on each new development and connected by a heat main between the new development areas, with a total of 2.8MW of electricity.
- The series of smaller CHP plants simplifies the connection to the grid, requires a much smaller engine and storage footprint and reduces the number of road deliveries of bio-fuel feedstock. The

number of CHP engines and Energy Centres will increase the total costs as there are multiple connections to the grid and to the heat network.

- Option 4 is scalable and will provide a robust network and the ability to plan maintenance and offer multiple bio-fuel feedstocks such as oil and wood chip.
- Finance for the CHP maybe through a single CEM with many centres or a CEM per energy centre. The ESCO finances the heat network and metering and invoices consumers. The heat network and biomass option are facilitated by the close proximity of the houses.
- The capital cost (with the normal exclusions) is estimated at £19.1m and is expected to save 17,606 tonnes of CO_2 per annum, subject to a full feasibility study and refinement during the project design and specification process.

Option 5 Oversized CHPs with a total of 3.2MW of electricty and heat network

- This option, like option 4, proposes a number of smaller CHP units each scaled for the maximum heat demand on each new development and connected by a heat main between the new development areas, with a total of 3.2 MW of electricity.
- The series of smaller CHP plants simplifies the connection to the grid, requires a much smaller engine and storage footprint and reduces the number of road deliveries of bio-fuel feedstock. The number of CHP engines and Energy Centres will increase the total costs as there are multiple connections to the grid and to the heat network.
- Option 5 is scalable and will provide a robust network and the ability to plan maintenance and offer multiple bio-fuel feedstocks such as oil and wood chip.
- Finance for the CHP maybe through a single CEM with many centres or a CEM per energy centre. The CEM will be able to demonstrate a larger revenue stream than in option 4 from the sales of increased sustainable power and a more attractive option to sources of third party finance.
- The ESCO finances the heat network and metering and invoices consumers and may provide the bio-fuel feedstock to the CEM. The heat network and biomass option are facilitated by the close proximity of the houses.
- The capital cost (with the normal exclusions) is estimated at £21.8m and is expected to save 20,781 tonnes of CO2 per annum, subject to a full feasibility study and refinement during the project design and specification process.

LEWISHAM GATEWAY DEVELOPMENT

D.1.27 The smallest CEM requirements as currently defined but the potential to act as a link between the heat networks proposed at Deptford and New Cross and Catford. There are significant future opportunities from it's proximity to the Loampit Vale leisure centre development and the Prendergast School should the energy strategies allow for connection.

D.1.28 To meet the expected demand from the development area there are a number of CEM and ESCO options all of which are small, but could accommodate additional sustainable generation and heat networks in the future. The options considered for the current development area are:

- Option 1, supplying the demand within the defined development area through a sustainable CEM with a CHP of 0.4 MW of electricity and an ESCO to distribute the heat and possibly provide the feedstock, has an indicative capital cost (with the normal exclusions) estimated at £2.82m and is expected to save 2,234 tonnes of CO2 per annum, subject to a full feasibility study and refinement during the project design and specification process.

- Option 2, supplying the demand within the defined development area through a very small sustainable CHP of 0.1MW of electricity and significant on-site solar PV and thermal installations will require an existing CEM. A local ESCO maybe used to distribute the heat and possibly provide the feedstock. The option has an indicative capital cost (with the normal exclusions) estimated at £5.0m and is expected to save 1,649 tonnes of CO2 per annum, subject to a full feasibility study and refinement during the project design and specification process.
- Option 3, is to over-size the CHP by 20% to meet the maximum heat demand and to export surplus sustainable electricity into the local grid would be run by a CEM and potentially an ESCO to manage the heat network and potentially provide the bio-fuel feedstock has an indicative capital cost (with the normal exclusions) estimated at £3.3m and is expected to save 2,681 tonnes of CO2 per annum, subject to a full feasibility study and refinement during the project design and specification process. This option has the potential to save up to 72% of the expected CO2 emissions associated with the development area.

CATFORD DEVELOPMENT AREA – Potential for Thought Leadership

D.1.29 There is a potential role for both a CEM and an ESCO within this development area which includes the re-development of a residential and retail area alongside building new council offices and other council offices nearby which together can serve as an iconic development to demonstrate the effectiveness of the CEM and ESCO model in reducing carbon emissions whilst demonstrating a robust and cost effective commercial case. The high-specification offices may include mechanical winter heating and summer cooling which can be accommodated by a single CEM and ESCO.

D.1.30 The technical simplicity and speed with which this development is planned to take place makes it particularly attractive to third parties and a wide spectrum of funding sources.

- Option 1 is the supply of sustainable heat and power to the new build offices, retail and residential in the Catford Development Area and requires a very small CHP plant that could be located on site at an indicative capital cost of £ 2.6m with a reduction in carbon emissions by 1,466 tonnes of CO2 per annum.
- Option 2 requires a larger CHP plant of 0.8MW of electricity and would serve the new and existing council offices at an indicative capital cost of £6.4m (subject to the normal exclusions and confirmation from the feasibility study and project specification) and reduce the carbon emissions by 4,707 tonnes of CO2 per annum.
- Option 3 is a very small CHP and provides the majority of the sustainable power and heat through solar PV and solar thermal installations which is expected to save 1,851 tonnes of CO2 per annum and has an indicative capital cost of £11.6m (subject to the normal exclusions) which should be confirmed by a full feasibility study and refined during the project design and specification process.
- Option 4 is to over-size the CHP by 20% to 1.0 MW electricity is expected to provides summer cooling through absorption chilling as well as the winter heating into the HVAC systems, and provides excess sustainable power which is sold into the grid by the CEM and reduces the CO2 emissions by 5.645 tonnes per annum at an indicative capital cost of £7.4m (subject to the normal exclusions) which should be confirmed by a full feasibility study and refined during the project design and specification process.

OTHER POTENTIAL DEVELOPMENT OPPORTUNITIES – Potential for Partnerships

D.1.31 There is a potential leadership and partnership role for both a CEM and an ESCO within the London Borough of Lewisham to promote energy efficiencies and sustainable generation at iconic sites and developments. Significant savings in CO_2 emissions and fuel costs are available from improving existing housing stock within the Borough. The ESCO and CEM can be established with a remit to source the available funds and deliver those savings through retro-fitting efficiency measures and making sustainable local electricity available as a realistic option. Key iconic sites might include:

- Lewisham Hospital
- Goldsmiths College
- Deptford Creek re-development

Appendix E

Viability Assessment Assumptions

E.1 Viability Assessment Assumptions

E.1.1 Developer's Return: Comparison between 35% Affordable Housing and 50% Affordable Housing Provision (Including SHW technology)

Case Study	Lewisham High street		50- 200 Hindsley Place and Perry Vale		200-500 72 - 78 Conington road		500+ Oxestalls Road	
Number of Residential Units	49		71		270		900	
	Flats		Flats		Flats		Flats	
Total Residential Floorspace	3,140 m2		4,980 m2		16,355 m2		67,500 m2	
Commercial Element	Retail Unit		1 A3 / 1 A1 / 1 B1		3 Commercial Units		Office	
Total Commercial Floorspace	50 m2		260 m2		150 m2		17,000 m2	
Total Floorspace	3,190 m2		5,240 m2		16,505 m2		84,500 m2	
Affordable Housing Component (%)	35%	50%	35%	50%	35%	50%	35%	50%
S106 Contribution	WITH PRI S106 & GRAN	WITH PRI S106 & GRAN	WITH PRI S106 & GRANT	WITH PRI S106 & GRANT	WITH PRI S106 & GRANT	WITH PRI S106 & GRANT	WITH PRI S106 & GRANT	WITH PRI S106 & GRANT
BNP Paribas Sales Change	Up 10%		Up 10%		Up 10%		Up 10%	
Gross Development Value	£10,899,900	£10,073,800	£13,876,500	£13,085,600	£62,101,600	£56,447,600	£138,095,833	£122,178,355
BNP Paribas Cost Reduction	Down 5%		Down 5%		Down 5%		Down 5%	
Costs of the Scheme	£6,189,000	£5,865,000	£9,271,000	£8,855,000	£37,432,000	£35,447,000	£76,342,763	£70,545,369
	£5,879,550	£5,571,750	£8,807,450	£8,412,250	£35,560,400	£33,674,650	£72,525,625	£67,018,101
Residual Value	**£5,020,350**	**£4,502,050**	**£5,069,050**	**£4,673,350**	**£26,541,200**	**£22,772,950**	**£65,570,208**	**£55,160,254**
Developer's Return	**81%**	**77%**	**54.7%**	**53%**	**70.91%**	**64%**	**90%**	**82%**
Code for Sustainable Housing	4		4		4		4	
	£207,144		£333,073		£1,078,930		£4,452,938	
BREEAM Rating for Commercial Developemt	VERY GOOD		VERY GOOD		VERY GOOD		VERY GOOD	
	£2,452		£11,061		£9,975		£396,499	
Residual Value	**£4,810,754**	**£4,292,454**	**£4,724,916**	**£4,329,216**	**£25,452,294**	**£21,684,044**	**£60,720,772**	**£50,310,818**
Developer's Return	**81.8%**	**77.0%**	**53.6%**	**51.5%**	**71.6%**	**64.4%**	**83.7%**	**75.1%**

	Lewisham High street			50- 200 Hindsley Place and Perry Vale			200-500 72 - 78 Conington road			500+ Oxestalls Road		
Proposed Amount of Renewable Energy Technology	twenty percent			twenty percent			twenty percent			twenty percent		
	Power	Heat	CHP	Power	Heat	CHP	Power	Heat	CHP	Power	Heat	CHP
Renewables Technology	PV	SHW	CHP	PV	SHW	CHP	PV	SHW	CHP	PV	SHW	CHP
	OFF	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
	£ -	£ 34,522	£ -	£ -	£ 188,017	£ -	£ -	£ 450,487	£ -	£ -	£ 3,254,378	£ -
	Wind1	BB	BCHP	Wind1	BB	BCHP	Wind1	BB	BCHP	Wind1	BB	BCHP
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
	SHP	GSHP		SHP	GSHP		SHP	GSHP		SHP	GSHP	
	OFF	OFF		OFF	OFF		OFF	OFF		OFF	OFF	
	£ -	£ -		£ -	£ -		£ -	£ -		£ -	£ -	
		ASHP			ASHP			ASHP			ASHP	
		OFF			OFF			OFF			OFF	
		£ -			£ -			£ -			£ -	
	£0	**£34,522**	**£0**	**£0**	**£188,017**	**£0**	**£0**	**£450,487**	**£0**	**£0**	**£3,254,378**	**£0**

	Lewisham High street		50- 200 Hindsley Place and Perry Vale		200-500 72 - 78 Conington road		500+ Oxestalls Road	
	35%	50%	35%	50%	35%	50%	35%	50%
Residual Value	**£4,776,232**	**£4,257,932**	**£4,536,899**	**£4,141,199**	**£25,001,808**	**£21,233,558**	**£57,466,394**	**£47,056,440**
Developer's Return	**81.2%**	**76.4%**	**51.5%**	**49.2%**	**70.3%**	**63.1%**	**79.2%**	**70.2%**

E.2 Area Wide Options

Area Wide Options	Lewisham Gateway				Catford				Deptford and Cross				
Housing/mixed use site >500+ units (excluding CHP)	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3	Option 4	Option 5
Code 3	24.7%	22.4%	24.2%	27.6%	24.9%	21.0%	15.5%	19.9%	25.9%	8.4%	-22.2%	7.7%	4.9%
Total Carbon Savings (t/yr)	2,234 t/yr	1,649 t/yr	2,681 t/yr	0 t/yr	1,466 t/yr	4,704 t/yr	1,851 t/yr	5,645 t/yr	6,627 t/yr	14,865 t/yr	13,711 t/yr	17,606 t/yr	20,781 t/yr
Total Carbon Savings (%)	72%	53%	72%	0%	35%	48%	44%	48%	23%	51%	47%	60%	59%
Code 4	42.8%	40.3%	42.2%	45.9%	43.0%	38.8%	33.1%	37.7%	44.0%	25.6%	-6.6%	24.9%	21.9%
Total Carbon Savings (t/yr)	2,234 t/yr	1,649 t/yr	2,681 t/yr	0 t/yr	1,466 t/yr	4,704 t/yr	1,851 t/yr	5,645 t/yr	6,627 t/yr	14,865 t/yr	13,711 t/yr	17,606 t/yr	20,781 t/yr
Total Carbon Savings (%)	72%	53%	72%	0%	35%	48%	44%	48%	23%	51%	47%	60%	59%

E.3 Developer's Return based on Individual Renewable Technology Targets at Code 3 & BREEAM: Good

Developer's Return at Code 3 & BREEAM Rating: Good Proposed Amount of Renewable Energy Technology (% Energy Requirement)		10%									20%									30%								
Development Typology	Without Technology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Individual Semi-detached/ detached	83.8%	72.1%	81.9%	82.2%	81.5%	78.7%	79.0%	81.5%	83.8%	83.8%	60.5%	80.0%	80.7%	79.3%	78.7%	79.0%	78.4%	83.8%	83.8%	48.9%	78.2%	79.2%	77.0%	78.7%	79.0%	75.7%	78.0%	83.8%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		11.7%	1.9%	1.6%	2.3%	5.1%	4.8%	2.3%	0.0%	0.0%	23.3%	3.8%	3.1%	4.5%	5.1%	4.8%	5.4%	0.0%	0.0%	34.9%	5.6%	4.6%	6.8%	5.1%	4.8%	8.1%	5.8%	0.0%
Individual Terrace	57.0%	46.5%	55.3%	55.6%	55.0%	50.0%	49.1%	53.9%	57.0%	57.0%	36.0%	53.6%	54.3%	53.0%	50.0%	49.1%	52.1%	57.0%	57.0%	25.5%	52.0%	52.9%	50.9%	50.0%	49.1%	49.7%	49.1%	57.0%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		10.5%	1.7%	1.4%	2.0%	7.0%	7.9%	3.1%	0.0%	0.0%	21.0%	3.4%	2.7%	4.0%	7.0%	7.9%	4.9%	0.0%	0.0%	31.5%	5.0%	4.1%	6.1%	7.0%	7.9%	7.3%	7.9%	0.0%
Individual Flat Conversion	34.2%	22.9%	32.4%	32.8%	32.1%	22.1%	20.6%	28.8%	34.2%	34.2%	11.6%	30.6%	31.3%	29.9%	22.1%	20.6%	29.0%	34.2%	34.2%	0.3%	28.8%	29.8%	27.7%	22.1%	20.6%	26.4%	34.2%	34.2%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		11.3%	1.8%	1.4%	2.1%	12.1%	13.6%	5.4%	0.0%	0.0%	22.6%	3.6%	2.9%	4.3%	12.1%	13.6%	5.2%	0.0%	0.0%	33.9%	5.4%	4.4%	6.5%	12.1%	13.6%	7.8%	0.0%	0.0%
Small development circa 10-50 units/flats	58.1%	56.2%	57.8%	57.8%	57.8%	57.8%	57.9%	57.8%	58.0%	58.1%	54.4%	57.6%	57.6%	57.5%	57.6%	57.7%	57.5%	58.1%	58.1%	52.5%	57.3%	57.3%	57.2%	57.4%	57.5%	57.2%	58.1%	58.1%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		1.9%	0.3%	0.3%	0.3%	0.3%	0.2%	0.3%	0.1%	0.0%	3.7%	0.5%	0.5%	0.6%	0.5%	0.4%	0.6%	0.0%	0.0%	5.6%	0.8%	0.8%	0.9%	0.7%	0.6%	0.9%	0.0%	0.0%
Housing/mixed use site >50-200 units	33.9%	27.1%	33.0%	33.0%	32.8%	33.3%	33.2%	32.8%	33.6%	33.9%	20.4%	32.1%	32.1%	31.8%	32.2%	32.5%	31.8%	33.3%	33.9%	13.6%	31.2%	31.2%	30.8%	32.0%	31.9%	30.8%	33.0%	33.9%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		6.8%	0.9%	0.9%	1.1%	0.6%	0.7%	1.1%	0.3%	0.0%	13.5%	1.8%	1.8%	2.1%	1.7%	1.4%	2.1%	0.6%	0.0%	20.3%	2.7%	2.7%	3.1%	1.9%	2.0%	3.1%	0.9%	0.0%
Housing/mixed use site >200-500 units	49.0%	44.9%	48.7%	48.7%	48.5%	48.7%	48.6%	48.6%	48.9%	48.4%	40.7%	48.4%	48.3%	47.9%	48.4%	48.2%	48.1%	48.7%	47.7%	36.5%	48.0%	47.9%	47.3%	48.1%	47.8%	47.6%	48.5%	47.1%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		4.1%	0.3%	0.3%	0.5%	0.3%	0.4%	0.4%	0.1%	0.6%	8.3%	0.6%	0.7%	1.1%	0.6%	0.8%	0.9%	0.3%	1.3%	12.5%	1.0%	1.1%	1.7%	0.9%	1.2%	1.4%	0.5%	1.9%
Housing/mixed use site >500+ units (excluding CHP)	60.8%	46.0%	59.5%	59.4%	58.6%	59.6%	59.3%	59.1%	60.8%	60.8%	31.2%	58.2%	58.0%	56.5%	58.5%	57.8%	57.3%	60.8%	60.8%	16.4%	57.0%	56.6%	54.4%	57.3%	56.3%	55.6%	60.8%	60.8%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		14.8%	1.3%	1.4%	2.2%	1.2%	1.5%	1.7%	0.0%	0.0%	29.6%	2.6%	2.8%	4.3%	2.3%	3.0%	3.5%	0.0%	0.0%	44.4%	3.8%	4.2%	6.4%	3.5%	4.5%	5.2%	0.0%	0.0%

Developer's Return based on Individual Renewable Technology Targets at Code 3 & BREEAM: Good (Continued)

40%									50%								
PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
22.1%	73.8%	83.8%	74.2%	77.8%	83.8%	73.0%	83.8%	83.8%	6.6%	71.4%	83.8%	71.8%	76.3%	76.4%	70.3%	83.8%	83.8%
61.7%	10.0%	0.0%	9.6%	6.0%	0.0%	10.8%	0.0%	0.0%	77.2%	12.4%	0.0%	12.0%	7.5%	7.4%	13.5%	0.0%	0.0%
1.2%	57.0%	57.0%	48.4%	57.0%	57.0%	47.3%	57.0%	57.0%	-12.7%	57.0%	57.0%	46.3%	57.0%	50.4%	44.8%	57.0%	57.0%
55.8%	0.0%	0.0%	8.6%	0.0%	0.0%	9.7%	0.0%	0.0%	69.7%	0.0%	0.0%	10.7%	0.0%	6.6%	12.2%	0.0%	0.0%
34.2%	34.2%	34.2%	34.2%	34.2%	34.2%	23.8%	34.2%	34.2%	34.2%	34.2%	34.2%	34.2%	34.2%	34.2%	21.2%	34.2%	34.2%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	13.0%	0.0%	0.0%
50.6%	57.1%	57.1%	56.9%	57.2%	57.3%	56.9%	58.1%	58.1%	48.8%	56.8%	56.8%	56.7%	57.0%	57.2%	56.7%	58.1%	58.1%
7.5%	1.0%	1.0%	1.2%	0.9%	0.8%	1.2%	0.0%	0.0%	9.3%	1.3%	1.3%	1.4%	1.1%	0.9%	1.4%	0.0%	0.0%
6.9%	30.3%	30.3%	29.8%	30.6%	31.2%	29.8%	32.7%	33.9%	0.1%	29.4%	29.4%	28.8%	30.8%	30.6%	28.7%	32.4%	33.9%
27.0%	3.6%	3.6%	4.1%	3.3%	2.7%	4.1%	1.2%	0.0%	33.8%	4.5%	4.5%	5.1%	3.1%	3.3%	5.2%	1.5%	0.0%
32.4%	47.6%	47.5%	46.7%	47.8%	47.4%	47.1%	48.3%	46.4%	28.2%	47.3%	47.1%	46.1%	47.4%	46.9%	46.6%	48.1%	45.7%
16.6%	1.4%	1.5%	2.3%	1.2%	1.6%	1.9%	0.7%	2.6%	20.8%	1.7%	1.9%	2.9%	1.6%	2.1%	2.4%	0.9%	3.3%
1.6%	55.7%	55.3%	52.3%	56.2%	54.8%	53.9%	60.8%	60.8%	-13.2%	54.4%	53.9%	50.1%	55.0%	52.2%	52.2%	60.8%	60.8%
59.2%	5.1%	5.5%	8.5%	4.6%	6.0%	6.9%	0.0%	0.0%	74.0%	6.4%	6.9%	10.7%	5.8%	8.6%	8.6%	0.0%	0.0%

E.4 Developer’s Return based on Individual Renewable Technology Targets at Code 4 & BREEAM: Very Good

Code 4 & BREEAM Rating: Very Good																												
Proposed Amount of Renewable Energy Technology (% Energy Reuirement)		10%									20%									30%								
Development Typology	Without Technology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Individual Semi-detached/ detached	**110.4%**	98.2%	108.5%	108.8%	108.1%	105.1%	105.4%	108.0%	110.4%	110.4%	86.0%	106.5%	107.2%	105.7%	105.1%	105.4%	104.8%	110.4%	110.4%	73.7%	104.5%	105.6%	103.3%	105.1%	105.4%	101.9%	104.4%	110.4%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		12.2%	1.9%	1.6%	2.3%	5.3%	5.0%	2.4%	0.0%	0.0%	24.4%	3.9%	3.2%	4.7%	5.3%	5.0%	5.6%	0.0%	0.0%	36.7%	5.9%	4.8%	7.1%	5.3%	5.0%	8.5%	6.0%	0.0%
Individual Terrace	**79.7%**	68.6%	77.9%	78.2%	77.6%	72.3%	71.4%	76.4%	79.7%	79.7%	57.6%	76.1%	76.8%	75.4%	72.3%	71.4%	74.6%	79.7%	79.7%	46.5%	74.4%	75.3%	73.3%	72.3%	71.4%	72.0%	71.4%	79.7%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		11.1%	1.8%	1.5%	2.1%	7.4%	8.3%	3.3%	0.0%	0.0%	22.1%	3.6%	2.9%	4.3%	7.4%	8.3%	5.1%	0.0%	0.0%	33.2%	5.3%	4.4%	6.4%	7.4%	8.3%	7.7%	8.3%	0.0%
Individual Flat Conversion	**53.2%**	41.3%	51.3%	51.6%	50.9%	40.4%	38.8%	47.4%	53.2%	53.2%	29.4%	49.4%	50.0%	48.6%	40.4%	38.8%	47.7%	53.2%	53.2%	17.5%	47.4%	48.5%	46.3%	40.4%	38.8%	44.9%	53.2%	53.2%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		11.9%	1.9%	1.6%	2.3%	12.8%	14.4%	5.8%	0.0%	0.0%	23.8%	3.8%	3.2%	4.6%	12.8%	14.4%	5.5%	0.0%	0.0%	35.7%	5.8%	4.7%	6.9%	12.8%	14.4%	8.3%	0.0%	0.0%
Small development circa 10-50 units/flats	**81.8%**	79.9%	81.6%	81.6%	81.5%	81.6%	81.6%	81.5%	81.7%	81.8%	77.9%	81.3%	81.3%	81.2%	81.4%	81.4%	81.2%	81.8%	81.8%	76.0%	81.1%	81.1%	80.9%	81.1%	81.2%	80.9%	81.8%	81.8%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		1.9%	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%	0.1%	0.0%	3.9%	0.5%	0.5%	0.6%	0.4%	0.4%	0.6%	0.0%	0.0%	5.8%	0.7%	0.7%	0.9%	0.7%	0.6%	0.9%	0.0%	0.0%
Housing/mixed use site >50-200 units	**53.6%**	46.5%	52.7%	52.7%	52.6%	53.0%	53.0%	52.6%	53.3%	53.6%	39.4%	51.8%	51.8%	51.5%	52.0%	52.3%	51.5%	53.0%	53.6%	32.4%	50.8%	50.8%	50.4%	51.7%	51.6%	50.4%	52.7%	53.6%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		7.1%	0.9%	0.9%	1.0%	0.6%	0.6%	1.0%	0.3%	0.0%	14.2%	1.8%	1.8%	2.1%	1.6%	1.3%	2.1%	0.6%	0.0%	21.2%	2.8%	2.8%	3.2%	1.9%	2.0%	3.2%	0.9%	0.0%
Housing/mixed use site >200-500 units	**71.6%**	67.2%	71.2%	71.2%	70.9%	71.2%	71.1%	71.1%	71.4%	70.9%	62.8%	70.8%	70.8%	70.3%	70.9%	70.7%	70.6%	71.2%	70.2%	58.4%	70.4%	70.3%	69.7%	70.6%	70.2%	70.0%	71.0%	69.5%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		4.4%	0.4%	0.4%	0.7%	0.4%	0.5%	0.5%	0.2%	0.7%	8.8%	0.8%	0.8%	1.3%	0.7%	0.9%	1.0%	0.4%	1.4%	13.2%	1.2%	1.3%	1.9%	1.0%	1.4%	1.6%	0.6%	2.1%
Housing/mixed use site >500+ units (excluding CHP)	**83.7%**	68.1%	82.4%	82.3%	81.5%	82.5%	82.1%	81.9%	83.7%	83.7%	52.6%	81.1%	80.8%	79.2%	81.3%	80.6%	80.1%	83.7%	83.7%	37.0%	79.7%	79.4%	77.0%	80.1%	79.0%	78.3%	83.7%	83.7%
Developer's Return Compared with Part C Building Regulations, No on-site renewable energy		15.6%	1.3%	1.4%	2.2%	1.2%	1.6%	1.8%	0.0%	0.0%	31.1%	2.6%	2.9%	4.5%	2.4%	3.1%	3.6%	0.0%	0.0%	46.7%	4.0%	4.3%	6.7%	3.6%	4.7%	5.4%	0.0%	0.0%

Developer's Return based on Individual Renewable Technology Targets at Code 4 & BREEAM: Very Good (Continued)

40%									50%								
PV	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**	**PV**	**Wind**	**SHP**	**SHW**	**BB**	**GSHP**	**ASHP**	**CHP**	**BCHP**
45.5%	100.0%	110.4%	100.4%	104.1%	110.4%	99.1%	110.4%	110.4%	29.2%	97.4%	110.4%	97.9%	102.6%	102.7%	96.3%	110.4%	110.4%
64.9%	10.4%	0.0%	10.0%	6.3%	0.0%	11.3%	0.0%	0.0%	81.2%	13.0%	0.0%	12.5%	7.8%	7.7%	14.1%	0.0%	0.0%
21.0%	79.7%	79.7%	70.6%	79.7%	79.7%	69.4%	79.7%	79.7%	6.3%	79.7%	79.7%	68.4%	79.7%	72.7%	66.9%	79.7%	79.7%
58.7%	0.0%	0.0%	9.1%	0.0%	0.0%	10.3%	0.0%	0.0%	73.4%	0.0%	0.0%	11.3%	0.0%	7.0%	12.8%	0.0%	0.0%
53.2%	53.2%	53.2%	53.2%	53.2%	53.2%	42.1%	53.2%	53.2%	53.2%	53.2%	53.2%	53.2%	53.2%	53.2%	39.4%	53.2%	53.2%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	13.8%	0.0%	0.0%
74.0%	80.8%	80.8%	80.6%	80.9%	81.1%	80.6%	81.8%	81.8%	72.1%	80.5%	80.5%	80.4%	80.7%	80.9%	80.3%	81.8%	81.8%
7.8%	1.0%	1.0%	1.2%	0.9%	0.7%	1.2%	0.0%	0.0%	9.7%	1.3%	1.3%	1.4%	1.1%	0.9%	1.5%	0.0%	0.0%
25.3%	49.9%	49.9%	49.4%	50.3%	50.9%	49.3%	52.4%	53.6%	18.2%	49.0%	49.0%	48.3%	50.5%	50.2%	48.2%	52.1%	53.6%
28.3%	3.7%	3.7%	4.2%	3.3%	2.7%	4.3%	1.2%	0.0%	35.4%	4.6%	4.6%	5.3%	3.1%	3.4%	5.4%	1.5%	0.0%
54.0%	70.1%	69.9%	69.0%	70.2%	69.8%	69.5%	70.8%	68.8%	49.6%	69.7%	69.5%	68.4%	69.9%	69.3%	69.0%	70.6%	68.1%
17.6%	1.5%	1.7%	2.6%	1.4%	1.8%	2.1%	0.8%	2.8%	22.0%	1.9%	2.1%	3.2%	1.7%	2.3%	2.6%	1.0%	3.5%
21.4%	78.4%	77.9%	74.7%	78.9%	77.4%	76.5%	83.7%	83.7%	5.8%	77.1%	76.4%	72.5%	77.7%	74.7%	74.7%	83.7%	83.7%
62.3%	5.3%	5.8%	9.0%	4.8%	6.3%	7.2%	0.0%	0.0%	77.9%	6.6%	7.3%	11.2%	6.0%	9.0%	9.0%	0.0%	0.0%

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E.5 Carbon Savings based on Individual Renewable Technology

Carbon Savings	10%								
	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Individual Semi-detached/ detached									
Total Carbon Savings (t/yr)	1.3	1.2	1.2	0.4	2.2	1.3	1.9	0.7	0.7
Total Carbon Savings (%)	15%	15%	15%	5%	27%	15%	24%	8%	8%
Individual Terrace									
Total Carbon Savings (t/yr)	0.8 t/yr	0.8 t/yr	0.8 t/yr	0.3 t/yr	1.3 t/yr	0.8 t/yr	1.4 t/yr	0.5 t/yr	0.5 t/yr
Total Carbon Savings (%)	15%	15%	15%	5%	23%	15%	27%	8%	8%
Individual Flat Conversion									
Total Carbon Savings (t/yr)	0.5 t/yr	0.5 t/yr	0.5 t/yr	0.2 t/yr	0.8 t/yr	0.5 t/yr	0.9 t/yr	0.3 t/yr	0.3 t/yr
Total Carbon Savings (%)	16%	15%	15%	5%	23%	15%	27%	8%	8%
Small development circa 10-50 units/flats									
Total Carbon Savings (t/yr)	7.2 t/yr	7.1 t/yr	7.1 t/yr	2.5 t/yr	11.1 t/yr	7.3 t/yr	12.6 t/yr	4.0 t/yr	4.0 t/yr
Total Carbon Savings (%)	15%	15%	15%	5%	23%	15%	27%	8%	8%
Housing/mixed use site >50-200 units									
Total Carbon Savings (t/yr)	62.1 t/yr	61.5 t/yr	61.5 t/yr	21.2 t/yr	96.0 t/yr	62.9 t/yr	115.2 t/yr	34.6 t/yr	34.6 t/yr
Total Carbon Savings (%)	18%	18%	18%	6%	29%	19%	34%	10%	10%
Housing/mixed use site >200-500 units									
Total Carbon Savings (t/yr)	127.2 t/yr	126.0 t/yr	126.0 t/yr	43.4 t/yr	196.6 t/yr	128.7 t/yr	220.8 t/yr	70.9 t/yr	68.0 t/yr
Total Carbon Savings (%)	15%	15%	15%	5%	23%	15%	26%	8%	8%
Housing/mixed use site >500+ units (excluding CHP)									
Total Carbon Savings (t/yr)	918.7 t/yr	910.0 t/yr	910.0 t/yr	313.5 t/yr	1,420.2 t/yr	930.0 t/yr	1,661.7 t/yr	512.3 t/yr	512.3 t/yr
Total Carbon Savings (%)	15%	15%	15%	5%	24%	16%	28%	9%	9%

Carbon Savings	20%								
	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Individual Semi-detached/ detached									
Total Carbon Savings (t/yr)	2.4	2.4	2.4	0.9	2.2	2.2	2.2	1.4	1.4
Total Carbon Savings (%)	30%	30%	30%	11%	27%	27%	27%	17%	17%
Individual Terrace									
Total Carbon Savings (t/yr)	1.6 t/yr	1.6 t/yr	1.6 t/yr	0.5 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr	0.9 t/yr	0.9 t/yr
Total Carbon Savings (%)	30%	30%	30%	10%	27%	27%	27%	17%	17%
Individual Flat Conversion									
Total Carbon Savings (t/yr)	1.0 t/yr	1.0 t/yr	1.0 t/yr	0.4 t/yr	0.9 t/yr	0.9 t/yr	0.9 t/yr	0.6 t/yr	0.6 t/yr
Total Carbon Savings (%)	31%	30%	30%	11%	27%	27%	27%	17%	17%
Small development circa 10-50 units/flats									
Total Carbon Savings (t/yr)	14.3 t/yr	14.2 t/yr	14.2 t/yr	4.9 t/yr	12.6 t/yr	12.6 t/yr	12.6 t/yr	8.0 t/yr	8.0 t/yr
Total Carbon Savings (%)	30%	30%	30%	10%	27%	27%	27%	17%	17%
Housing/mixed use site >50-200 units									
Total Carbon Savings (t/yr)	124.3 t/yr	123.1 t/yr	123.1 t/yr	42.4 t/yr	146.9 t/yr	125.8 t/yr	146.9 t/yr	69.3 t/yr	69.3 t/yr
Total Carbon Savings (%)	37%	37%	37%	13%	44%	37%	44%	21%	21%
Housing/mixed use site >200-500 units									
Total Carbon Savings (t/yr)	254.3 t/yr	251.9 t/yr	251.9 t/yr	86.8 t/yr	220.8 t/yr	220.8 t/yr	220.8 t/yr	141.8 t/yr	141.8 t/yr
Total Carbon Savings (%)	30%	30%	30%	10%	26%	26%	26%	17%	17%
Housing/mixed use site >500+ units (excluding CHP)									
Total Carbon Savings (t/yr)	1,837.4 t/yr	1,820.0 t/yr	1,820.0 t/yr	627.0 t/yr	1,661.7 t/yr	1,661.7 t/yr	1,661.7 t/yr	1,024.7 t/yr	1,024.7 t/yr
Total Carbon Savings (%)	31%	31%	31%	11%	28%	28%	28%	17%	17%

Carbon Savings	30%								
	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Individual Semi-detached/ detached									
Total Carbon Savings (t/yr)	3.7	3.7	3.7	1.2	2.2	2.2	2.2	0.7	0.7
Total Carbon Savings (%)	46%	45%	45%	15%	27%	27%	27%	8%	8%
Individual Terrace									
Total Carbon Savings (t/yr)	2.4 t/yr	2.4 t/yr	2.4 t/yr	0.8 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr
Total Carbon Savings (%)	46%	45%	45%	15%	27%	27%	27%	25%	25%
Individual Flat Conversion									
Total Carbon Savings (t/yr)	1.5 t/yr	1.5 t/yr	1.5 t/yr	0.5 t/yr	0.9 t/yr	0.9 t/yr	0.9 t/yr	0.8 t/yr	0.8 t/yr
Total Carbon Savings (%)	45%	45%	45%	16%	27%	27%	27%	25%	25%
Small development circa 10-50 units/flats									
Total Carbon Savings (t/yr)	21.5 t/yr	21.3 t/yr	21.3 t/yr	7.4 t/yr	12.6 t/yr	12.6 t/yr	12.6 t/yr	12.0 t/yr	12.0 t/yr
Total Carbon Savings (%)	46%	45%	45%	16%	27%	27%	27%	25%	25%
Housing/mixed use site >50-200 units									
Total Carbon Savings (t/yr)	186.4 t/yr	184.6 t/yr	184.6 t/yr	63.6 t/yr	146.9 t/yr	146.9 t/yr	146.9 t/yr	103.9 t/yr	103.9 t/yr
Total Carbon Savings (%)	55%	55%	55%	19%	44%	44%	44%	31%	31%
Housing/mixed use site >200-500 units									
Total Carbon Savings (t/yr)	381.5 t/yr	377.9 t/yr	377.9 t/yr	130.2 t/yr	130.2 t/yr	130.2 t/yr	130.2 t/yr	212.8 t/yr	212.8 t/yr
Total Carbon Savings (%)	45%	45%	45%	16%	16%	16%	16%	25%	25%
Housing/mixed use site >500+ units (excluding CHP)									
Total Carbon Savings (t/yr)	2,756.1 t/yr	2,730.1 t/yr	2,730.1 t/yr	940.5 t/yr	1,661.7 t/yr	1,661.7 t/yr	1,661.7 t/yr	1,537.0 t/yr	1,537.0 t/yr
Total Carbon Savings (%)	46%	46%	46%	16%	28%	28%	28%	26%	26%

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Carbon Savings based on Individual Renewable Technology (Continued)

40%								
PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
5.0	4.9	4.9	1.7	2.2	2.2	2.2	2.8	2.8
61%	60%	60%	21%	27%	27%	27%	34%	34%
3.2 t/yr	3.2 t/yr	3.2 t/yr	1.1 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr	1.8 t/yr	1.8 t/yr
61%	60%	60%	21%	27%	27%	27%	34%	34%
2.0 t/yr	2.0 t/yr	2.0 t/yr	0.7 t/yr	0.9 t/yr	0.9 t/yr	0.9 t/yr	1.1 t/yr	1.1 t/yr
60%	60%	60%	21%	27%	27%	27%	34%	34%
28.7 t/yr	28.5 t/yr	28.5 t/yr	9.8 t/yr	12.6 t/yr	12.6 t/yr	12.6 t/yr	16.0 t/yr	16.0 t/yr
61%	60%	60%	21%	27%	27%	27%	34%	34%
248.5 t/yr	246.2 t/yr	246.2 t/yr	84.8 t/yr	146.9 t/yr	146.9 t/yr	146.9 t/yr	138.6 t/yr	138.6 t/yr
74%	73%	73%	25%	44%	44%	44%	41%	41%
508.7 t/yr	503.9 t/yr	503.9 t/yr	173.6 t/yr	173.6 t/yr	173.6 t/yr	173.6 t/yr	283.7 t/yr	283.7 t/yr
61%	60%	60%	21%	21%	21%	21%	34%	34%
3,674.7 t/yr	3,640.1 t/yr	3,640.1 t/yr	1,254.0 t/yr	1,661.7 t/yr	1,661.7 t/yr	1,661.7 t/yr	2,049.4 t/yr	2,049.4 t/yr
62%	61%	61%	21%	28%	28%	28%	35%	35%

50%								
PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
6.2	6.1	6.1	2.1	2.2	2.2	2.2	3.4	3.4
76%	75%	75%	26%	27%	27%	27%	42%	42%
4.0 t/yr	4.0 t/yr	4.0 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr	1.4 t/yr	2.3 t/yr	2.3 t/yr
76%	75%	75%	26%	27%	27%	27%	42%	42%
2.5 t/yr	2.5 t/yr	2.5 t/yr	0.9 t/yr	0.9 t/yr	0.9 t/yr	0.9 t/yr	1.4 t/yr	1.4 t/yr
76%	75%	75%	27%	27%	27%	27%	42%	42%
35.9 t/yr	35.6 t/yr	35.6 t/yr	12.2 t/yr	12.6 t/yr	12.6 t/yr	12.6 t/yr	20.0 t/yr	20.0 t/yr
76%	75%	75%	26%	27%	27%	27%	42%	42%
310.6 t/yr	307.7 t/yr	307.7 t/yr	106.0 t/yr	146.9 t/yr	146.9 t/yr	146.9 t/yr	173.2 t/yr	173.2 t/yr
93%	92%	92%	32%	44%	44%	44%	52%	52%
635.8 t/yr	629.8 t/yr	629.8 t/yr	217.0 t/yr	217.0 t/yr	217.0 t/yr	217.0 t/yr	354.6 t/yr	354.6 t/yr
76%	75%	75%	26%	26%	26%	26%	42%	42%
4,593.4 t/yr	4,550.1 t/yr	4,550.1 t/yr	1,567.5 t/yr	1,661.7 t/yr	1,661.7 t/yr	1,661.7 t/yr	2,561.7 t/yr	2,561.7 t/yr
77%	77%	77%	26%	28%	28%	28%	43%	43%

Appendix F
Glossary

F.1 Renewable Energy and Climate Change Glossary

A

Anaerobic Digestion (AD)
A treatment process breaking down biodegradable, particularly waste, material in the absence of oxygen. Produces a methane-rich biogas that can be used as a substitute for fossil fuels.

Achievable Emissions Intensity
The minimum average annual emissions intensity that could be acheived in a given year, given the installed capacity, projected demand and the projected profile of that demand.

B

Best Available Technology
The latest stage of development of a particular technology (e.g. a process or operating method) that is practically suitable for deployment.

Biofuel
A fuel derived from recently dead biological material and used to power vehicles (can be liquid or gas). Biofuels are commonly derived from cereal crops but can also be derived from dead animals, trees and even algae. Blended with petrol and diesel biofuels can be used in conventional vehicles.

Biogas
A fuel derived from recently dead biological material which can be burned in a generator or a CHP plant, or upgraded to biomethane for injection into the gas grid.

Biomass
Biological material that can be used as fuel or for industrial production. Includes solid biomass such as wood and plant and animal products, gases and liquids derived from biomass, industrial waste and municipal waste.

C

Cap and trade schemes
Cap and trade schemes establish binding controls on the overall amount of emissions from participants. Within this quantity ceiling, participants in the scheme can choose where best to deliver emission reductions by trading units which correspond to quantities of abatement.

Carbon dioxide equivalent (CO_2e) concentration
The concentration of carbon dioxide that would give rise to the same level of radiative forcing as a given mixture of greenhouse gases.

Carbon dioxide equivalent (CO_2e) emission
The amount of carbon dioxide emission that would give rise to the same level of radiative forcing, integrated over a given time period, as a given amount of well-mixed greenhouse gas emission. For an individual greenhouse gas species, carbon dioxide equivalent is calculated by multiplying the mass emitted by the Global Warming Potential over the given time period for that species. Standard international reporting processes use the time period of 100 years.

Carbon Emissions Reductions Target (CERT)
CERT is an obligation on energy supply companies to implement measures in homes that will reduce emissions (such as insulation, efficient lightbulbs and appliances, etc). (See Supplier obligation).

Carbon sink
An absorber of carbon (usually in the form of carbon dioxide). Natural carbon sinks include forests and oceans.

Central Heating (Gas)

A central heating system provides warmth to the whole interior of a building (or portion of a building) from one point to multiple rooms. When combined with other systems in order to control the building climate, the whole system may be a HVAC (heating, ventilation and air conditioning) system.

Climate
The climate can be described simply as the 'average weather', typically taken over a period of 30 years. More rigorously, it is the statistical description of variables such as temperature, rainfall, snow cover, or any other property of the climate system.

Carbon Change Levy (CCL)
A levy charged on the industrial and commercial supply of electricity, natural gas, coal and coke for lighting, heating and power.

Climate sensitivity
The response of global mean temperatures to increased concentrations of carbon dioxide in the atmosphere. It is typically defined as the temperature increase that would occur at equilibrium after a doubling of carbon dioxide concentration above pre-industrial levels.

Combined Cycle Gas Turbine
A gas turbine generetor that generates electricty. Waste heat is used to make steam to generate additional electricity via a steam turbine, thereby increasing the efficiency of the plant.

Combined Heat and Power (CHP) The simultaneous generation of heat and power, putting to use heat that would normally be wasted. This results in a highly efficient way to use both fossil and renewable fuels. Technologies range from small units similar to domestic gas boilers, to large scale CCGT or biomass plants which supply heat for major industrial processes.

D

Display Energy Certificate (DEC)
The certificate shows the actual energy usage of a building and must be produced every year for public buildings larger than 1,000m^2.

E

Electricity production
The total amount of electricity generated by a power plant. It includes own-use electricity and transmission and distribution losses.

Energy Perfomance Certificate (EPC)
The certificate provides a rating for residential and commercial buildings, showing thier energy efficiency based on the performance of the building itself and its services (such as heating and lighting). EPC's are required whenever a building is built, sold or rented out.

Emissions Performance Standard
A CO_2emissions performance standard that would entail regulation to set a limit on emissions per unit of energy output. This limit could be applied at plant level, or to the average emissions intensity of a power company's output.

Energy Intensity
A measure of total primary energy use per unit of gross domestic product.

Energy Efficiency Commitment (EEC)
The predecessor of CERT, and a type of supplier obligation.

European Union Allowance (EU A)
Units corresponding to one tonne of CO_2 which can be traded in the EU ETS.

European Union Emissions Trading Scheme (EU ETS)
Cap and trade system covering the power sector and energy intensive industry in the EU.

F

Feed-in-tariffs
A type of support scheme for electrictiy generation, whereby renewable generators obtain a long-term guaranteed price for the output they deliver to the grid.

Fuel poverty
A fuel-poor household is one that needs to spend in excess of 10% of household income on all fuel use in order to maintain a satisfactory heating regime.

G

Gas Condensing Boiler

Condensing boilers get their name because they enter what is called "condensing mode" periodically. In other words, they start to extract heat from the exhaust gases that would otherwise escape through the flue, in the process turning water vapour from the gas back into liquid water or condensate.

Global Warming Potential
A metric for comparing the climate effect of different greenhouse gases, all of which have different lifetimes in the atmosphere and differing abilities to absorb radiation. The GWP is calculated as the intergrated radiative forcing of a given gas over a given time period, relative to that of carbon dioxide. Standard international reporting processes use a time period of 100 years.

Greenhouse gas (GHG)
Any atmospheric gas (either natural or anthropogenic in origin) which absorbs thermal radiation emitted by the Earth's surface. This traps heat in the atmosphere and keeps the surface at a warmer temperature than would otherwise be possible, hence it is commonly called the Greenhouse Effect.

Gross Domestic Product (GDP)
A measure of the total economic activity occurring in the UK.

Gross Value Added (GVA)
The difference between output and *intermediate consumption* for any given sector/industry.

GWh (Gigawatt hour)
A measure of energy equal to 1000MWh.

H

Heat pumps
Can be an air source or ground source heat pump to provide heating for buildings. Working like a ‘fridge in reverse’, heat pumps use compression and expansion of gases or liquid to draw heat from the natural energy stored in the ground or air.

Heavy good vehicle (HGV)
A truck over 3.5 tonnes (articulated or rigid).

I

Infrastructure Planning Commission
A new body established by the Plannig Act (2008) tp take decisions on planning appications for major infrastructure projects.

Intergrated Gasification Combined-Cycle (IGCC)
A technology in which a solid or liquid fuel (coal, heavy oil or biomass) is gasified, followed by use for eletricity generation in a combined-cycle power plant. It is widely considered a promising electricity generation technology, due to its potential to achieve high efficiencies and low emissions.

K

kWh (Kilowatt hour)
A measure of energy equal to 1000 Watt hours. A convenient unit for consumption at the household level.

kWp (Kilowatt peak)
A measure of the peak output of a photovoltaic system under test conditions.

L

Levelised Cost
Lifetime costs and output of electricity generation technologies are discounted back to their present values to produce estimates of cost per unit of output (e.g. p/kWh).

Life-cycle
Life-cycle assessment tracks emissions generated and materials consumed for a product system over its entire life-cycle, from cradle to grave, including material production, product manufacture, product use, product maintenance and disposal at end of life. This includes biomass, where the CO_2 released on combustion was absorbed by the plant matter during its growing lifetime.

Light Goods Vehicle
A van (weight up to 3.5 tonnes; classification N1 vehicle).

M

Mitigation
Action to reduce the sources (or enhance the sinks) of factors causing climate change, such as greenhouse gases.

$MtCO_2$
Million tonnes of carbon dioxide (CO_2).

MWh (Megawatt hour)
A measure of energy equal to 1000 kWh.

O

Ofgem (Office of Gas and Electricity Markets)
The regulator for electricity and downstream gas markets.

P

Passive Design

Passive design is design that does not require mechanical heating or cooling. Homes that are passively designed take advantage of natural climate to maintain thermal comfort.

R

Renewables
Energy resources, where energy is derived from natural processes that are replenished constantly. They include geothermal, solar, wind, tide, wave, hydropower, biomass and biofuels.

Renewable Energy Strategy (RES)
Government strategy aiming to increase the use of renewable energy in the UK, as part of the overall strategy for tackling climate change and to meet the UK’s share of the EU target to source 20% of the EU's energy from renewable sources by 2020. Draft strategy was published for consultation in 2008.

Renewable Heat Incentive (RHI)
Will provide financial assistance to producers (households and businesses) of renewable heat when implemented in April 2011.

Renewables Obligation Certificate (ROC)
A certificate issued to an accredited electricity generator for eligible renewable electricity generated within the UK. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated.

Retrofit

Retrofitting refers to the addition of new technology or features to older systems.

S

Smart meters
Advanced metering technology that allows suppliers to remotely record customers' gas and electricity use. Customers can be provided with real-time information that could encourage them to use less energy (e.g. through display units).

Smarter Choices
Smarter Choices are techniques to influence people's travel behaviour towards less carbon intensive alternatives to the car such as public transport, cycling and walking by providing targeted information and opportunities to consider alternative modes.

Social tariff
An energy tariff where vulnerable or poorer customers pay a lower rate.

Solar photovoltaics (PV)
Solar technology which use the sun's energy to create electricity.

Solar Thermal
Solar technology which uses the warmth of the sun to heat water to supply hot water to buildings.

Solar water heating
Solar technology which uses the warmth of the sun to heat water to supply hot water in buildings.

Standard Assessment Procedure
UK Government's recommended method for measuring the energy rating of residential dwellings. The rating is on a scale of 1 to 120.

Supplier Obligation
An obligation that the Government places on energy suppliers, to help householders reduce their carbon footprint. The current policy is the Carbon Emissions Reductions Commitment (CERT) running from April 2008 to 2011.

T

Technical potential
The theoretical maximum amount of emissions reduction that is possible from a particular technology (e.g. What would be achieved if every cavity wall were filled). This measure ignores constraints on delivery and barriers to firms and consumers
that may prevent up take.

Total final consumption (TFC)
The sum of consumption by the different end use-sectors.TFC is broken down into energy demand in the following sectors:

- Industry, transport, other (includes agriculture, residential, commercial and public services) and non-energy uses.
- Industry includes manufacturing, construction and mining industries. In final consumption, petrochemical feedstocks appear under industry use. Other non-energy uses are shown under non-energy use.

TWh (Terawatt hour)
A measure of energy equal to 1000 GWh or 1 billion kWh. Suitable for measuring very large quantities of energy – e.g. annual UK electricity generation.

Appendix G
Renewables Ready Reckoner

G.1 Renewables Ready Reckoner

G.1.1 A ready reckoner has been prepared to enable the Council to make an initial assessment of the cost of potential renewables solutions for different residential led schemes for different renewable energy targets. It also provides an estimate of the likely scale of carbon dioxide emissions reductions which may be achieved from renewables.

G.1.2 The tool can be used during pre-application discussions and to scope out potential renewables options prior to the completion of a full sustainability statement and energy statement. It can also be used to verify statements provided to the Council. If there is significant variance then there may be a need to challenge applicants on their assumptions made or undertake a more detailed assessment of the options.

G.1.3 An overview and key assumptions included within the tool is set out below. It utilises information established as part of the study provided within Appendix C.

Stage 1: Proposed Development Scheme Assumptions

G.1.4 The tool allows the user to insert the number of units for a particular scheme and determine the total gross floor space for residential and non-residential development. The user can provide their own floor space measurement or apply the tool's default settings for floor space. The tool will subsequently provide the demands of electrical and thermal energy for both the residential and non-residential elements of the scheme, as well as the corresponding carbon emissions (Appendix C).

G.1.5 The demands for residential floor space are based on the assumption that new homes will be built to at least Level 4 of the Code for Sustainable Homes. For the non-residential demands, an average energy consumption figure has been derived based upon consideration of uses commonly included within residential mixed use schemes in the Borough and using energy benchmarks available from CIBSE.

Stage 2: Suitability Assessment

G.1.6 Stage 2 allows the user to identify the individual renewable technology(s) chosen for the scheme, and whether the scheme can be connected to a Local Energy Network. Users should consult the Mayor of London's design guide on sustainable design and construction to determine the choice of the individual renewable technology.

Stage 3: Scenario Definition and Output

G.1.7 At Stage 3, the user can initially state the total percentage of energy to be supplied by on site renewables and connected energy networks. The user can then allocate a proportion of the total amount of energy produced to the individual technologies.

G.1.8 The individual technologies provide either electric or thermal (heat) energy, with the exception of the Combined Heat and Power plants which provide a combination of the both heat and electricity. The type of energy provided by each technology is portrayed in the "Energy Type" column within Stage 3. According to the analysis conducted for this report, electrical and thermal energy consist of 48.8% and 51.2% of the total kWh requirements for a development, respectively. As such, a single renewable energy technology would not be able to provide the total amount of energy required for a scheme alone.

Stage 4: Assessment Outputs

G.1.9 Stage 4 reveals the assessment outputs of the various selections from the preceding stages. The outputs are categorised into columns separately showing the total amount of energy generated from renewable sources (kWh), the total installation cost of each technology, the total carbon savings (tonnes/ annum) and the percentage of carbon savings.

Sample Ready Reckoner output –50 terraced houses, 100 flats and 2,500 commercial floorspace.

LEWISHAM RENEWABLES STUDY READY RECKONER

STAGE 1
Proposed Development Scheme Assumptions

Development type	No. units	Average Unit size	User defined	Total Gross Floorspace
Detached/Semi Detached	0	Default	200.0 m2	0.0 m2
Terrace	50	Default	157.6 m2	5,250.0 m2
Apartments	100	User Defined	83.7 m2	8,365.0 m2
Flat conversion	0	Default		0.0 m2
Total Residential	**150 Units**			**13,615.0 m2**
Non Residential Floorspace				**2,500.0 m2**
Total Floorspace				**16,115.0 m2**

Projected Energy Consumption		**2,740,158.9 kWh**
kWh Electrical	Residential	966,722.8 kW/h
	Non-Residential	320,000.0 kW/h
kWh Thermal	Residential	1,026,036.2 kW/h
	Non-Residential	427,500.0 kW/h
Baseline CO2 T/ year		**960.4 T/ yr**
CO2 T/year Electrical	Residential	520.9 T/ yr
	Non-Residential	172.5 T/ yr
CO2 T/year Thermal	Residential	187.0 T/ yr
	Non-Residential	80.0 T/ yr

STAGE 2
Suitability Assessment

Potential to connect to Local energy Network	**Deptford New Cross**

Site suitability for individual Technologies	**Potential technologies**
Photovoltaics	Yes
Wind Power	Yes
Small Hydro Power	Yes
Solar Hot Water	Yes
Biomass Boiler	Yes
Ground Source Heat Pump	Yes
Air Source Heat Pump	Yes
Micro CHP	Yes
Biomass CHP	Yes

STAGE 3
Scenario definition and outputs

	%
Energy to be supplied by On site Renewables and Connected heat %	20%
Renewable Energy requirement	548,031.79 kW/h

Technology Mix Scenario

Technology	% of total energy required	Energy Type
Photovoltaics	10%	Electric
Wind Power		Electric
Small Hydro Power		Electric
Solar Hot Water	10%	Heat
Biomass Boiler		Heat
Ground Source Heat Pump		Heat
Air Source Heat Pump		Heat
Micro CHP		Mixed
Biomass CHP		Mixed
Local Energy Network		Mixed
Total Renewable Energy Contribution	**20%**	

STAGE 4
Assessment Outputs

Technology	Energy Generation KW/H	Installation Cost £	CO2 Saving t/Annum	% CO2 Saving
Photovoltaics	274,015.9 kW/h	£2,096,999	138.9 T/ yr	14.5%
Wind Power	0.0 kW/h	Not Included	Not Included	Not Included
Small Hydro Power	0.0 kW/h	Not Included	Not Included	Not Included
Solar Hot Water	274,015.9 kW/h	£316,383	47.4 T/ yr	4.9%
Biomass Boiler	0.0 kW/h	Not Included	Not Included	Not Included
Ground Source Heat Pump	0.0 kW/h	Not Included	Not Included	Not Included
Air Source Heat Pump	0.0 kW/h	Not Included	Not Included	Not Included
Micro CHP	0.0 kW/h	Not Included	Not Included	Not Included
Biomass CHP	0.0 kW/h	Not Included	Not Included	Not Included
Local Energy Network	0.0 kW/h	Not Included	Not Included	Not Included
Total	**548,031.8 kW/h**	**£2,413,382**		

Printed on Revive Pure White Uncoated a recycled grade containing 100% post consumer waste and manufactured at a mill accredited with ISO 14001 environmental management standard.

The pulp used in this product is bleached using an Elemental Chlorine Free process (ECF).

NB Reference to this product's FSC certification can only be made by holders of the FSC Chain of Custody certificate.