EB907

Carbon Reduction and Renewable Energy Assessment

Epping Forest District Council

Final Report

May 2013

Plan Design Enable

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This document has 218 pages including the cover.

Document history

Job number:			**Document ref:**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Draft	ED / PS	RA	RS	RS	15/11/12
Rev 2.0	2nd Draft	PS	RA	RS	RS	8/02/13
Rev 3.0	Final	PS	RA	RS	RS	30/04/13

Client signoff

Client	Epping Forest District Council
Project	Carbon Reduction and Renewable Energy Assessment
Document title	Draft Report
Job no.	5515889
Copy no.	1
Document reference	

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Executive summary

Study purpose

This study provides an evidence base on Carbon (CO_2) reduction and renewable energy that Epping Forest District Council (EFDC) can use to inform the Council's replacement Local Plan. The Council recognises the need to secure significant reductions in greenhouse gas emissions in order to mitigate the impacts of climate change and is determined to support low carbon measures and sustainable energy generation within Epping Forest District.

This study will be used by the Council to help to determine future potential for low carbon measures and renewable energy generation within Epping Forest District over the next plan period. Therefore, the aim of the study is to investigate the potential for, and make recommendations on, reducing greenhouse gas emissions and optimising renewable energy technologies throughout the District.

Policy context

There is a range of legislation and policy at the European (EU), national and local level related to carbon emissions reductions and the increased use of renewable energy. The United Kingdom has implemented EU directives and translated these into legislation and supporting regulations. There is also a range of national and local planning policy that will help to achieve the European and national objectives regarding carbon reduction and renewable energy generation. The relevant legislation and policy is summarised in the table below.

Level	Legislation or Policy	Key requirements
European Union	Climate and Energy Package	By 2020: • 20% reduction in EU greenhouse gas. • Increasing the share of EU energy consumption from renewable energy to 20%. • 20% improvement in energy efficiency.
	Renewable Energy Directive	Binding targets set for each Member state to raise the share of renewable energy as a share of the proportion of energy consumption. The UK target is 15%.
National	Climate change Act (2008)	Set legally binding targets for the UK: • 80% reductions in greenhouse gas emissions by 2050. • 34% reduction in carbon emissions by 2020. • Local authorities have not been set reduction targets.
	Planning and Energy Act (2008)	Allows local authorities to set requirements for energy use and energy efficiency in local plans. This allows local planning authorities to require a proportion of energy used in a development in their area to be from renewable sources, or low carbon sources.
	Energy Act 2011	Introduced the Green Deal. This is a financing mechanism to encourage and enable households and non-domestic occupiers (businesses etc) to improve energy efficiency (see chapter 9 for further details).
	Building Regulations Part L	Part L of the Building Regulations deals with 'Conservation of Fuel and Power'. It sets minimum thresholds for CO_2 emissions for all types of buildings. Part L was updated in 2010 and will be updated in 2013 and 2016 to incrementally improve the energy performance of buildings.
	Code for Sustainable Homes (CfSH)	A national standard for assessing sustainability of new homes against various categories of sustainable design. The energy and carbon requirements of the CfSH will become mandatory in stages up to 2016. This will be implemented through revisions to Part L of the Building Regulations, which will set progressively higher standards.
	BREEAM	The Building Research Establishment Environmental Assessment Method (BREEAM) addresses similar topics to the CfSH, for non residential buildings but the ratings are pass, good, very good, excellent and outstanding. This is a non statutory standard.

The National Planning Policy Framework (NPPF) makes it clear that the planning system has a significant role to play in delivering sustainable development and meeting the challenges of climate change. Local authorities are advised to plan for development in locations and ways that reduce greenhouse gas emissions, support energy efficiency improvements to existing buildings, and to set local sustainability requirements for buildings that are consistent with the Government's zero carbon buildings policy.

The NPPF also places an emphasis on local planning authorities increasing the use and supply of renewable and low carbon energy.

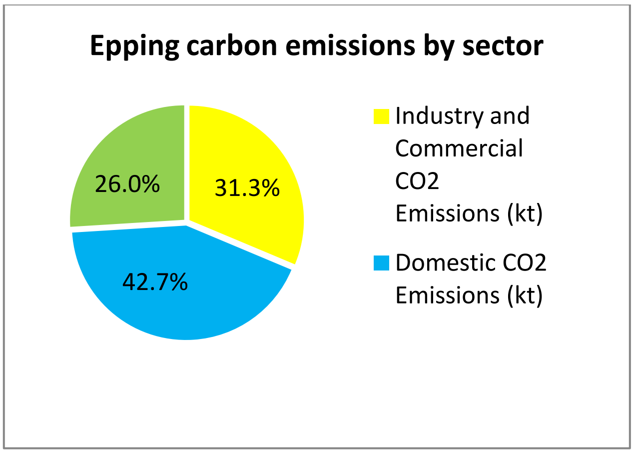
The Council's Local Plan includes various policies that will assist in: improving energy efficiency; reducing greenhouse gas emissions; supporting renewable energy; and supporting low carbon transport modes. However, the Council is in the process of reviewing the Local Plan, the emerging planning policies will need to take account of the requirements of the NPPF and the policies will need to be strengthened to ensure that the Council can help to achieve carbon reductions through positive planning.

Key findings

Energy use and carbon emissions

The study has assessed the District's current energy use and existing carbon emissions in order to set a baseline from which targets for renewables and carbon reduction can be set.

- Electricity –
  - 90% of electricity consumption is from non-domestic users.
  - Domestic electricity use is above the regional average, but has been declining.
- Gas –
  - Average domestic gas consumption is above the regional average, but has been declining.
  - Non-domestic gas consumption is below the regional average, but has been rising.
- Carbon emissions
  - In absolute terms emissions from industry, domestic properties and road transport are all above the County average, although the average emissions per capita by sector are all below the County average.
  - Emissions per capita in the District have been falling (10% reduction in the period 2005 – 2010).
  - Domestic properties make up the biggest proportion of carbon emissions (see figure below). As such actions to reduce carbon emissions from existing and new homes will be crucial to District achieving carbon reductions over the plan period.



Potential for large scale low carbon and renewable technologies

This study has considered the potential for large scale (over 1 MW of capacity) low carbon and renewable energy generation capacity in the District (see chapter 4). Renewable energy technologies convert a renewable energy resource into heat, cooling or electricity. Low carbon energy generation use technologies that produce low levels of carbon emissions in the provision of heat or electricity.

The technologies assessed include:

Technology	Description
Solar Photovoltaic (PV)	PV systems convert solar radiation into direct current electricity in a semiconductor device or cell.
Wind Power	Wind turbines convert power from the wind into electricity.
Combined Heat and Power (CHP)	CHP involves the simultaneous generation of electrical energy and heat energy in the form of low-pressure steam or hot water.
Biomass	Biomass refers to any plant or animal derived matter (this is known as feedstock). Biomass can either be used to generate heat in a heat only plant or in a combined heat and power (CHP) plant

N.B hydro-electric power is not considered viable in the District as there are no rivers with sufficient head height. Small scale technologies such as solar thermal systems have been considered in chapter 5 and Appendix A

Existing low carbon and renewable energy generation in the District is limited to four gas fired CHP plants.

There is sufficient wind and solar resource (i.e. wind is sufficient speed and there is sufficient solar radiation) in the District to make both these technologies suitable in the District. However, given the landscape and policy constraints large scale wind or solar farms are unlikely to be suitable in the District. There may be some potential for single wind turbines to power new or existing developments subject to policy constraints.

Potential for biomass is limited by the lack of biomass feedstock in the District. Also the District does not have a sufficiently large enough area of unmanaged woodland that could be used to support a large scale biomass CHP. Therefore any large scale biomass CHP would have to be fuelled by feedstock sourced from outside the District.

Potential for CHP has been tested for the glasshouse industry. If CHP were introduced throughout the glasshouse industry there is potential for carbon savings of 146,000 CO_2 tonnes per annum. However, because of the relative price of gas at present, gas fired CHP is likely to be unattractive to the industry at present.

The potential for CHP in the District's industrial areas has been tested. There are currently no "anchor" tenants with a sufficient heat demand to make investment in a retrofit CHP or district energy scheme a viable option for the District's industrial areas. There are no large scale industrial developments currently planned in the District that include a large "anchor" tenant with high heat demand that would make a CHP scheme viable.

The assessment of the potential for large scale renewable energy technologies shows that there is limited potential in the District at present. Therefore no percentage target for carbon emissions savings is identified for large scale renewables.

Carbon reduction in new residential development

The study has assessed the viability of new residential development in the District complying with the Code for Sustainable Homes (CfSH) standards and to adopt renewable and / or low carbon technologies to achieve these standards. The viability assessment in the study has tested the cost of complying with the whole of the CfSH (not just the mandatory requirements).

The CfSH has 6 levels with CfSH Level 6 being the most sustainable home. Only the energy and carbon requirements of the CfSH are mandatory at present. The Building Regulations Part L are changing over time to align with levels of energy performance set out in CfSH with a target of "net zero CO_2 emissions" by 2016, in order to meet the Government definition of Zero Carbon Homes. The Government clarified the definition of Zero Carbon Homes with a clearer concept of what this would mean from 2016 onwards. The definition is based around a hierarchical approach to achieving zero carbon that includes: ensuring an energy efficient approach to building design; reducing CO_2 emissions on-site via low and zero carbon technologies and connected heat networks; and mitigating the remaining carbon emissions with a selection of allowable solutions.

Allowable solutions aim to give developers an economical way of compensating for the CO_2 emissions reductions that are difficult to achieve through normal design and construction. Allowable solutions will therefore mean developers make a payment into a fund that invests in approved carbon saving projects off-site.

The study has tested viability by using six development appraisal case studies set out below:

- 2 – 15 units – testing impact of rural affordable housing threshold
- 15-50 units – testing urban affordable housing threshold
- 50 -150 units – testing on-site technology threshold
- 150 - 500 units – two case studies testing different densities
- 500+ units (including 10,000 sq.m commercial floorspace) – testing large scale mixed development

The case studies have been developed taking information from the EFDC's Strategic Land Availability Assessment 2012 (SLAA). The development appraisal framework is consistent with assumptions in the SLAA. The case studies considered other policy requirements such as affordable housing, planning obligations and density and how this would impact on the ability to comply with CfSH and deliver renewable / low carbon energy.

There is a 45% price variation across the housing market in the District, which means that for the purpose of assessing viability the District has been classified into Hot, Moderate and Cold housing markets which were defined by their average price points in each post code area. This differed by housing type and hence was incorporated within the case studies.

Market viability assessment

No case studies in Cold markets are currently viable, at any level of the CfSH. Case studies in Hot and Moderate housing markets, were viable when achieving up to CfSH Level 4 standards in 2013 and Level 5 Zero Carbon Homes compliance in 2016 based on future projections pricing and costs. This aligns with the Government's agenda of adopting Zero Carbon Home standards by 2016 in a stepped manner. (The study does not project to the local plan end date as because the Government intention is for compliance with zero carbon by 2016).

In the current market scenario (i.e. 2012 market pricing) only Hot housing markets were able to achieve CfSH Level 5 Zero Carbon Homes with the 40% affordable housing provision, and should be encouraged to adopt this higher standard. The case studies in Moderate markets were feasible to achieve CfSH Level 4 standards only in 2013 with a 40% affordable housing provision and could be encouraged to adopt higher standards through support. In Cold markets feasibility is significantly impacted by the 40% affordable housing provision, which affects viability when seeking to achieve CfSH compliance.

Low carbon and renewable technology choice

The choice of low and zero carbon technologies that can be used to provide energy in new residential development would depend on the types of housing in each development. This decision would be dependent on a range of factors which are site specific (cost, density, thermal or power demand, physical constraints and design). The case studies were tested for selection of technologies (i.e. solar PV, solar thermal and CHP); as these tested the lowest cost and highest cost options. While solar PV was the most expensive, it was also the most effective in terms of carbon emission reduction.

Impact of development density

The case studies have been used to explore contrasting development densities to evaluate whether higher developer returns and higher carbon standards could be achieved with higher densities. Developer returns and CfSH were similar for both higher and lower density case studies and hence the higher demand on energy created through the higher density scheme created no clear advantage. However, it is expected that higher density schemes may be more efficient in some areas in supporting public transport and will have resultant savings in carbon emissions.

There is no clearly definable advantage to encouraging or discouraging an increase in housing densities. Higher densities do not necessarily increase the range of renewable / low carbon technologies that are viable, as although the increased density increases the Gross Development Value (GDV) for the developer it would also increase the energy demands of the scheme and would require additional renewable / low carbon technologies to compensate that may be constrained by physical space (i.e. insufficient roof area for solar PV).

Carbon savings

The projection of CO2e from new build demonstrated a potential annual saving of almost 10 kt CO_2e from complying with the CfSH Level 5 minimum compliance Building Regulations that are expected in 2016 and actively promoting micro-generation from renewable and low carbon technologies. This would make a significant contribution towards the District carbon savings.

Carbon savings from retrofit of existing domestic buildings

The study assessed the potential opportunity for CO_2 savings through retrofit of existing domestic stock. Retrofit includes the installation of energy efficiency measures and small scale renewable energy technologies.

The introduction of the Green Deal (through the Energy Act 2011) is expected to support the acceleration of retrofit energy efficiency improvements. The Green Deal is a new framework to enable businesses to offer consumers energy efficiency improvements to their homes, community spaces and businesses at no upfront cost, and recoup payments through a charge in instalments on the energy bill.

The study estimates that there are 4,703 homes without loft insulation, 17,495 without cavity wall insulation and 7,349 without double glazing (this includes owner occupied homes, social rented and privately rented homes.

The opportunity for CO_2e reduction through retrofit of various energy saving measures across the District's existing housing stock is as follows:

- Central heating – 1.08 kt CO_2 per annum
- Loft insulation – 2.7 kt CO_2 per annum
- Cavity wall insulation – 7.7 kt CO_2 per annum
- Double glazing – 4.84 kt CO_2 per annum
- Solid Wall Insulation – 8.7 kt CO_2 per annum

This is total potential carbon saving of 25.02 Kt CO_2 per annum, or approximately 8% of 2010 domestic carbon emissions.

The current, Solar PV penetration within the District is below the national average and the Green deal is expected to encourage the take up of retrofit renewable and low carbon technologies.

Potential to reduce transport emissions

The study has considered current road transport emissions in Epping Forest District. Overall surface transport emissions in the District are high, representing the highest level of emissions from a single authority in Essex. However, motorway traffic accounts for over two-thirds of transport emissions. Local transport emissions (i.e. excluding motorway emissions) have been declining in the District.

Future emissions levels will be influenced by a wide range of factors this includes: demand for travel; the level of travel by different modes of transport (car, bike etc); transport measures (e.g. developing in locations that reduce the need to travel by car); and influences on average emissions rate (European and national action will promote reductions in emission from new vehicles and a move to low carbon vehicles).

Carbon savings from moving towards low carbon vehicles (electric vehicles) will be largely dependent on the type of energy technology used to produce energy for the national grid. If the Country continues to rely largely on fossil fuels for energy generation, the impact in terms of carbon emissions reductions of switching to electric vehicles will be reduced. These issues are beyond the control of EFDC.

Local actions that can be promoted by EFDC include: promotion of car clubs; support for low carbon vehicles; land use planning that encourages mixed use development (therefore reducing the number of car trips generated); and land use planning that encourages a shift to walking and cycling. With these measures in place the study analysis suggests that carbon emissions reductions in the order of 10% on 2010 levels could be achieved.

Policy recommendations

Bringing together the findings of the study the overall carbon savings that could be achieved in the District up to 2033 as a result of actions related to new development, retrofitting of existing buildings and through sustainable transport measures would result in carbon savings of 51.40 kt per annum, which is approximately 7% of 2010 emissions.

The chapter has set out a series of policy recommendations that will help the Council to achieve carbon reductions over the lifetime of the Local Plan. These policies include

- **Sustainable buildings** policies that recommend the implementation of CfSH for residential developments of over 15 units (where viable), and implementation of BREEAM standards for non-residential buildings over 1,000 sq.m.
- **Green House Gas reduction target** (as set out above), this should identify mechanisms for implementation including: carbon savings from new development; encouragement of retrofit for existing buildings; sustainable transport measures and supporting appropriate stand-alone renewable energy or low carbon projects.
- **Renewable energy targets** could be set for residential or non-residential development. However, it is not recommended that a renewable energy target is set given that sustainable buildings standards (CfSH and BREEM) would require some level of renewable energy to meet the carbon reduction targets anyway. The policy focus should be on carbon reduction, the level of which can be identified in the Carbon Budget Statement (see below).
- **Energy Hierarchy policy** that sets out a preference to use technologies at the top of the following hierarchy: non-energy fabric provision (energy efficiency of the building); CHP; other low and zero carbon technology (e.g. PV, solar thermal etc); allowable solutions.
- **Decentralised energy networks and renewable energy schemes** policy that provide support for these where appropriate. 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
- **Carbon Budget Statement** policy that introduces a requirement to submit a statement alongside planning applications for large schemes (15+ residential units and over 1,000 sq.m for other developments). The Carbon Budget Statement is a way of establishing what carbon emissions reductions can be achieved in a scheme through building performance and deployment of low and zero carbon technologies.
- **Sustainable transport** policy that incorporates explicit reference to the measures and opportunities to secure reductions in greenhouse gas emissions from the transport sector (as set out above).

In the future the Council's Annual Monitoring Report (AMR) should collate information on carbon reduction and renewable energy matters. Indicators should be linked to those which are monitored through national and regional databases. 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 in the District.

Implementation and delivery

The study considered the funding and delivery mechanisms that could be used to implement the approaches outlined in the study. This included the Council's approach to Green Deal, making use of planning obligations and potential for establishing an Energy Service Company (ESCO).

An ESCO delivers energy services and/or energy efficiency improvement 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. A Contract Energy Management Company (CEM) is 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.

Decentralised energy networks provide a good opportunity for carbon reduction savings particularly in new residential areas (this will be the key opportunity in Epping). To implement these networks there is a need to put in place a business model. There are various business models that can be applied. The two traditional models that have been used to achieve this are ESCOs and CEMs. ESCO typically deliver energy efficiencies and the CEM that typically generates heat and power. There could potentially be one or two larger urban extensions in the District that are developed over the plan period. These have some potential for area wide sustainable energy generation. Where this is the case ESCOs could be an appropriate model for funding and delivering the area wide sustainable energy generation.

The implementation of Green Deal in the District will promote energy efficiency and renewable retrofit for homes and businesses. This could help to achieve substantial carbon savings. The Council could help to implement the Green Deal by taking on an active role in delivery of the scheme. However, there are various models for Green Deal Delivery and the model that EFDC choose to follow will depend on the degree to which the Council wants to actively engage with the Green Deal; the Council’s aspirations on carbon reduction and fuel poverty and the Council’s attitude to risk. The potential models for delivery include:

- **Council as Provider** – The Council would become a Green Deal Provider (GDP) raising finance (either on its own or as a group of authorities) and would deliver the Green Deal to local residents and businesses.
- **Council as Partner** – The Council would act as a partner to one or more commercial GDPs.
- **Council as Promoter** – The Council would help to facilitate the Green Deal in its area. This could be providing support to Green Deal providers or helping to channel consumers to the Green Deal provider.

In some circumstances it might not be possible to meet low carbon requirements on-site without recourse to allowable solutions off-site. The allowable solutions element of a zero carbon building is likely to take the form of a contribution to off-site energy infrastructure. The Council will have a crucial role to play in identifying what infrastructure will be funded by developer contributions for allowable solutions and delivering them. These contributions could be held in a green energy fund and used to fund energy efficiency improvements in existing homes. Those measures that are most cost effective and would have the greatest benefit in terms of total CO_2 savings include loft insulation (2.7 kt CO_2 per annum) and cavity wall insulation (7.7 kt CO_2 per annum).

Chapter 1: Introduction

Chapter purpose

- To introduce the study purpose
- To set out the study approach
- To set out the report structure

1. Introduction

Study purpose

1.1. Atkins was appointed by Epping Forest District Council in September 2012 to prepare a Carbon (CO_2) Reduction and Renewable Energy Assessment.

1.2. The Council is currently preparing its evidence base to support the preparation it's Local Plan. The evidence base will provide the information that will be required to formulate the Council's planning policies. The Council recognises the need to secure significant reductions in greenhouse gas emissions in conjunction with new development and through improvements to existing buildings. There are also potential opportunities for the establishment of standalone renewable energy and low carbon facilities in the District.

1.3. This study will be used by the Council to help to determine future potential for low carbon measures and renewable energy generation within Epping Forest District over the next plan period. Therefore, the aim of the study is to investigate the potential for, and make recommendations on, reducing greenhouse gas emissions and optimising renewable energy technologies throughout the District.

1.4. Other objectives for the study identified within the study brief include:

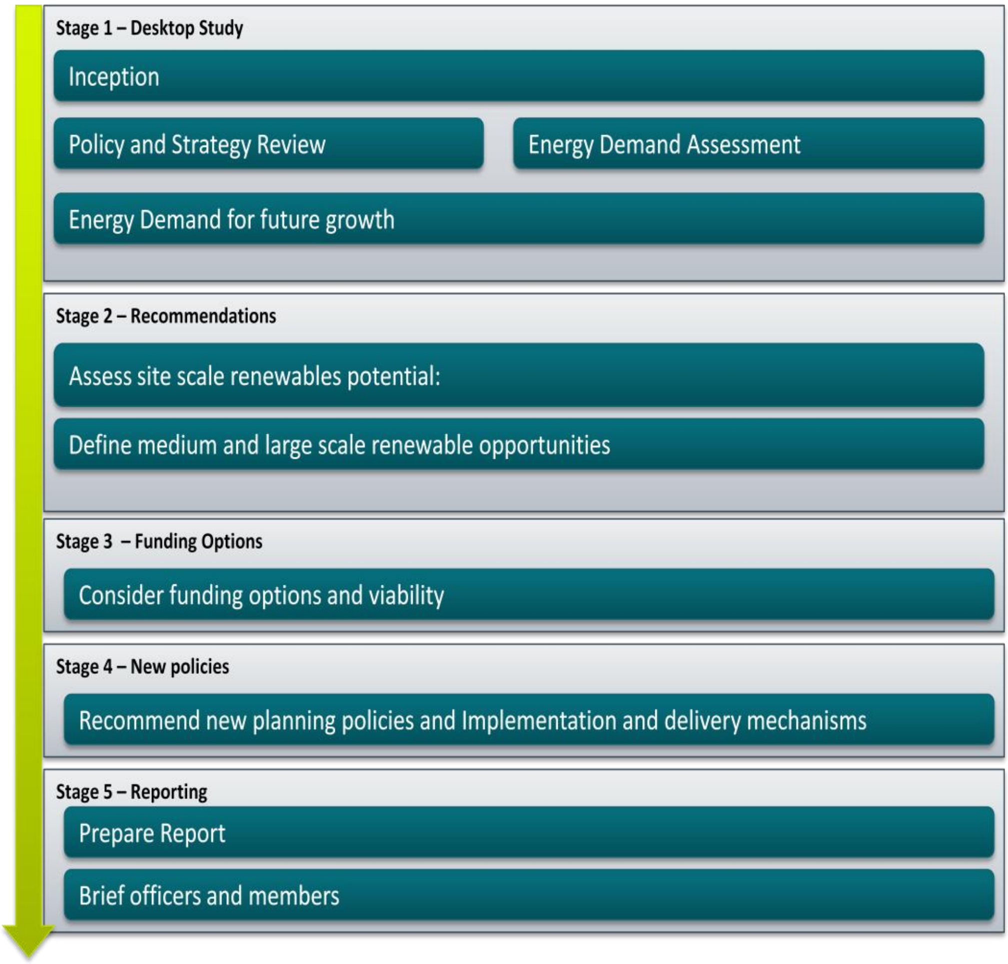
- Identify the sources of renewable and low carbon energy which are most appropriate and financially viable for new and existing development in the District.
- Identify which sources of renewable and low carbon energy are inappropriate for the area, stating the reasons why.
- The study should consider the existing and potential renewable and low carbon energy within the District.
- Analyse how renewable and low carbon energy could be exploited in new developments.
- Assess the feasibility of setting on-site CO_2 reduction targets (from decentralised renewable and low carbon energy sources), including looking at the scale of development where these technologies can be cost effective.
- Compare likely renewable generation and carbon reduction that could be achieved from widespread small scale schemes as oppose to individual large schemes.
- Consider the proposed growth within the District based on the Community Choices (Issues and Options) Document and highlight any sites that may be preferable as they have opportunity for the incorporation of renewable or low carbon technologies.
- Consider the potential for agricultural diversification and woodland coppicing for biomass production.
- Assess the potential opportunities for the production of renewable energy and the use of combined heat and power facilities in the glasshouse industry.
- Assess the feasibility of reducing carbon emissions from transportation within the District.
- Assess the feasibility of reducing carbon emissions from water use within domestic and commercial property.
- Assess the feasibility of making land allocations for large scale renewable or low carbon energy schemes, providing recommendations for where these could be located.
- Assess how the Council can utilise the measures within the Green Deal for the Council's own buildings and encourage wider take up.
- Identify funding available to members of the public, developers and public bodies for carbon reduction.
- Examine the financial viability of options identified in the study.
- Assess the effect that potential changes to Building Regulations could have on the private and social housing sectors.
- Make recommendations on policies for the Local Plan to assist in achieving renewable energy production and achieving carbon reductions, and policies suggesting what technologies should be incorporated in growth areas.
- Identify mechanisms for implementing the proposed policies.

Approach

1.5. A blended team undertook the study including town planners, energy specialists and transport planners.

1.6. Figure 1 sets out the approach which was taken to completing the study including the key study stages and tasks:

Figure 1. Study approach



1.7. This report summarises the key findings from the study as follows:

- Chapter 2 provides a review of the legislative background underpinning the study including national planning policy guidance, current and emerging local planning policies and other guidance, research reports and consultation documents which are relevant to the study.
- Chapter 3 provides the energy use and carbon dioxide emissions baseline.
- Chapter 4 provides an assessment of existing installed low carbon and renewable energy capacity in the District. It then considers the potential for large scale renewable and low carbon energy in the District. This chapter also considers the potential for carbon reductions in the agriculture and horticulture sectors (the glasshouse industry) and existing employment areas.
- Chapter 5 provides an assessment of the feasibility and economic viability of delivering low carbon development including micro-generation in conjunction with new development. The assessment considers the interaction with other policy goals including affordable housing, planning obligations and the relationship between renewable energy targets and the Code for Sustainable Homes. The chapter projects the potential carbon savings and how this will be affected by policy options.

- Chapter 6 considers the approach which could be taken towards retrofit of the existing residential stock and provides a strategy for targeting future action to reduce CO_2 emissions in the District. The chapter also considers how carbon dioxide emissions from the existing domestic building stock can be reduced over the plan period.
- Chapter 7 assesses the potential carbon dioxide emissions reductions from the transport sector. It covers existing transport emissions and considers the measures that could help to reduce emissions and the cost effectiveness of these measures.
- Chapter 8 draws together the conclusions of the study. It recommends the approach which should be taken within the Local Plan with regard to targets for on-site and near site renewable energy generation and carbon reduction targets. 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.
- Chapter 9 sets out recommendations on the funding mechanisms that can be used to support implementation of the approach identified in the previous chapters. It also looks at what potential there is for the Council to use other mechanisms for the implementation and delivery of low carbon and renewable energy approaches, which could include establishing a Green Energy Fund or an Energy Service Company (ESCO).

Chapter 2: Policy context

Chapter purpose

- To set out the key policy and strategies related to carbon reduction and renewable energy
- To identify national and local CO_2 reduction targets
- To highlight key issues for Epping Forest District Council

Chapter summary

The Government has set binding National CO_2 reduction targets. Although local authorities have not been set individual targets, to assist in meeting the national target, local authorities are required to assess local opportunities for low and zero carbon technologies including renewables and play a role in enabling implementation through their various functions including planning. It will be important for EFDC to consider the evidence and recommendations in this study and consider establishing a challenging, but realistic, carbon reduction target for the District.

The Government has set out a plan to transition the UK to a low carbon economy by 2020. This will require CO_2 reductions in homes, workplaces and in transport. In particular the Low Carbon Transition Plan highlights the need to improve energy efficiency in homes and build new homes that are more energy efficient and are zero carbon from 2016.

The Government has introduced changes to the Building Regulations and has introduced the Code for Sustainable (CfSH) in order that new homes that are built can meet the highest standards in energy efficiency. EFDC will need to consider how it implements the CfSH. Chapter 5 explores the viability of implementing CfSH in the District.

The Energy Act 2011 includes provision for a Green Deal which has the potential to significantly increase the take up rates of energy efficiency measures in the District. EFDC will need to consider how it engages with Green Deal; Chapter 9 provides a commentary on what EFDC will need to do to engage with Green Deal.

The NPPF makes it clear that the planning system has a significant role to play in delivering sustainable development and meeting the challenges of climate change. Local authorities are advised to plan for development in locations and ways that reduce greenhouse gas emissions, support energy efficiency improvements to existing buildings, and set local sustainability requirements for buildings that are consistent with the Government's zero carbon buildings policy.

The NPPF also places an emphasis on local planning authorities increasing the use and supply of renewable and low carbon energy. When determining planning applications for renewable energy development, local planning authorities should not require the applicant to demonstrate the need for renewable or low carbon energy.

The Council's Local Plan includes various policies that will assist in: improving energy efficiency; reducing greenhouse gas emissions; supporting renewable energy; and supporting low carbon transport modes. However, the Council is in the process of reviewing the Local Plan, the emerging planning policies will need to take account of the requirements of the NPPF and the policies will need to be strengthened to ensure that the Council can help to achieve carbon reductions through positive planning.

2. Policy Context

Introduction

2.1. This section provides a review of the national, regional and local policy context and strategies that impact on carbon (CO_2) reduction and renewable energy. It includes reference to measures to secure CO_2 reduction including regulatory and voluntary mechanisms such as Code for Sustainable Home (CfSH) and BREEAM.

2.2. The purpose of the policy review will be to: identify national and local aspirations and targets for CO_2 reduction; to identify emerging policy documents that should inform the approach taken in the District; identify how the assessment links with the national policy context including likely future policy changes. The policy review highlights the role that policy can play in encouraging low carbon and renewable energy generation in the District which may include establishing relevant objectives, targets and standards. The Council will need to draw on baseline evidence and local circumstances to determine which options for intervention are most appropriate.

European Union policy

2.3. The European Union (EU) legislation sets out the legislative framework for climate change targets, which the UK Government has now implemented through national legislation and policy. The following are the key pieces of EU legislation on climate and greenhouse gas emissions.

Climate and energy package

2.4. The climate and energy package is a set of binding legislation which commits the EU member states to tackling climate change. The climate and energy package included setting targets for 2020 including:

- 20% reduction in EU greenhouse gas emissions from 1990 levels;
- Raising the share of EU energy consumption produced from renewable resources to 20%; and
- 20% improvement on EU energy efficiency.

2.5. The targets were introduced by the European Commission in 2007 and were adopted by the European parliament in December 2008. The climate and energy package includes four pieces of complementary legislation (described below).

Reform of the EU Emissions Trading System (EU ETS)

2.6. The EU ETS is a tool for reducing emissions from industrial installations such as power stations, refineries and large manufacturing plants. The system places a cap on how much greenhouse gas can be emitted from those installations covered by the system, Companies receive allowances that they can buy or sell as needed (EU Allowance). The climate and energy package included a revision of the EU ETS system to strengthen the legislation. The revisions will come into force in 2013. The revisions include replacing the existing national caps on emissions with an EU-wide cap. The cap will be cut each year.

National targets for non-EU ETS emissions

2.7. EU Member States have taken on binding annual targets for reducing their greenhouse gas emissions from the sectors not covered by EU ETS, such as housing, agriculture, waste and transport (excluding aviation). These account for 60% of EU emissions.

2.8. The targets cover the period 2013-2020. Targets vary according to wealth with the richest nations having a 20% target, while the least wealthy can increase emissions (although the targets still require them to make efforts to limit emissions).

National renewable energy targets

2.9. The Renewable Energy Directive sets binding targets for Member States to raise the share of renewable energy as a proportion of their final energy consumption by 2020. The targets take account of where Member States are starting from, and the potential for further renewable energy production. The UK's target is 15%. The national targets will help to achieve the EU's overall target of 20% by 2020.

National policy and legislation

2.10. The UK has implemented the above EU directives and translated these into legislation and supporting regulations which are summarised below. The UK is leading the way on carbon reduction by being the first country in the world to adopt a legally binding greenhouse gas emissions target beyond 2020.

Climate Change Act

2.11. The Climate Change Act 2008 created a new approach to managing climate change by: setting legally binding targets; establishing powers to meet the targets; strengthening institutional frameworks; enhancing the UK's ability to adapt to the impact of climate change; and setting a framework for clear and regular accountability to the UK parliament.

2.12. The aims of the Act are: to improve carbon management, helping with the transition towards a low carbon economy; and to demonstrate the UK's leadership in global emissions reductions.

2.13. The Climate Change Act sets legally binding targets, placing a duty on the Secretary of State to ensure that they are met and this includes greenhouse gas emissions reductions through actions in the UK and abroad of at least 80% by 2050, and reductions in the CO_2 emissions of at least 34% by 2020.[1]

2.14. The Act introduced a carbon budget system that caps emissions for five year periods. The first three budgets run from 2008-12, 2013-2017 and 2018-22. The 4th carbon budget covering 2023 – 2027 was set last year, and this made the UK the first country in the world to set binding targets beyond 2020, committing the Government to achieving a 50% reduction on 1990 levels. The Government must report to Parliament on the policies and proposals to meet these budgets. This requirement has been fulfilled by the UK Low Carbon Transition Plan (see National Strategy for Climate and Energy below).

2.15. Local authorities have not been set individual carbon reduction targets to assist in meeting the national target. However, Epping Forest District Council will need to consider setting a carbon reduction target for the District, based upon consideration of local opportunities.

Planning and Energy Act

2.16. The Planning and Energy Act 2008 enables local authorities to set requirements for energy use and energy efficiency in Local Plans. In particular the Act allows local planning authorities to include policies that require:

- A proportion of energy used in a development in their area to be from renewable sources in the locality.
- A proportion of energy used in a development in their area to be low carbon from sources in the locality.
- Development in their area to comply with energy efficiency standards that exceed the requirements of Building Regulations.

2.17. Policies within the development plan must be consistent with relevant national policies, including policies related to renewable energy sources, low carbon energy and furthering energy efficiency.

[1] Both targets are reductions against 1990 levels.

The Energy Act

2.18. The Energy Act 2011 enables a stronger integration of energy saving measures. Some of the key points include:

- Green Deal - The Act supports a new financing mechanism for enabling households and non-domestic properties to achieve fixed energy efficiency improvements. The upfront costs will be removed and paid back through energy bills.
- Private Rented Sector – The Act specifically focuses on plugging a gap in this sector. From April 2016 all private residential landlords will be obligated to meet a tenant's reasonable request for consent to energy efficiency improvements, where a finance package such as Green Deal and / or Energy Company Obligation (ECO) is available. In addition from April 2018, it would be unlawful to rent out residential or business premises that do not reach a minimum energy efficiency standard (minimum of Energy Performance Certificate rating 'E').
- Energy Company Obligation – The new Act has enabled the Secretary of State to create new Energy Company Obligations and has expanded existing powers to cover the Gas Act 1986, Electricity Act 1989 and the Utilities Act 2000. This ensures that the Green Deal finance measures shall directly target households and take over responsibility of the existing obligations placed on energy suppliers that expire in 2012 which include the Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP).

2.19. The Energy Act has enabled the Green Deal approach to financing retrofit that is discussed in further detail in subsequent chapters of this report (chapters 6 and 9).

National Strategy for Climate and Energy

2.20. The UK Low Carbon Transition Plan: National Strategy for Climate and Energy was published in July 2009. It sets out a route map for the UK's transition to a low carbon economy by 2020, cutting emissions, maximising economic opportunities and protecting the vulnerable. The key action points of the strategy are:

- Protecting the public from immediate risk – climate change is already happening (increased flooding risk and greater risks of heat waves).
- Preparing for the future – climate change is happening so there is a need to plan for a changing climate. Climate risk needs to be factored into decision making.
- Limiting the severity of future climate change through a new international climate agreement – challenging targets need to be set to limit global temperature rises to an acceptable level.
- Building a low carbon UK – the first country in the world to set legally binding "carbon budgets" to help achieve emissions reduction targets.
- Supporting individuals, communities and businesses to play their part – this includes providing information and financial help to achieve energy efficiency.

2.21. The strategy focuses on driving the transition and reducing emissions through five sectors: the power sector; homes and communities; workplaces and jobs; transport and farming, land and waste.

2.22. To drive the transition to a low carbon future the Government set emissions targets with carbon budgets to help achieve the targets. Those key policies set out in the Strategy that have particular relevance to policy development in Epping Forest District are related to energy efficiency in homes and communities including the need to build new homes to higher standards and from 2016 for Zero Carbon Homes.

2.23. In transforming existing homes and communities 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 Transition 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 renewable energy providing around 30% of the electricity supply (including 2% from small scale sources) and 12% of the heat supply.

2.24. The Transition Plan identifies ways of helping households to make energy savings of 20%, reaching the Carbon Emissions Reduction Target (CERT), between April 2008 and March 2011. This was extended to December 2012 with a higher target and refocused around supporting home insulation. CERT requires domestic energy suppliers to make savings in CO_2 emitted by householders. The refocusing of the CERT on home insulation will help to pave the way for the Government's Green Deal.

2.25. To deliver energy savings in the longer term, the Transition 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.

2.26. The Transition Plan also included an initiative called The Community Energy Saving Programme (CESP). This commenced in September 2009, and requires gas and electricity suppliers and electricity generators to deliver energy saving measures to households 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. The CESP obligation ran until 31st December 2012 and will now be replaced by Green Deal.

Heat and Energy Saving Strategy

2.27. The Heat and Energy Saving Strategy (2009) was prepared by the Department for Communities and Local Government (DCLG) and the Department for Energy and Climate Change (DECC). It sets out the Government's strategy for saving energy and decarbonising heating, now and in the future. The Government aims for emissions from existing buildings to be approaching zero by 2050. To achieve the emissions reductions the strategy recognises this will require a step change in energy saving measures as well as decarbonising of the generation and supply of heat.

2.28. Some of the key policy proposals in the strategy include:

- All lofts and cavity walls to be insulated by 2015 where practical.
- Providing new ways of financial support so people can make energy savings and renewable energy improvements by offsetting costs against energy bill savings.
- Widening of Building Regulations to ensure that alongside certain types of building works energy saving measures are carried out.
- A new focus on district heating in suitable communities.
- Encouraging combined heat and power.

2.29. It should be noted that the financial mechanisms for encouraging people to carry out energy savings and renewable energy improvements identified in the strategy are now being implemented through the Green Deal (see chapter 6 and 9 for further detail).

2.30. The strategy has four main objectives:

- To help to reduce people's energy bills.
- To reduce the UK's emissions and increase the use of renewable energy to meet carbon budgets and renewables targets.
- To help maintain secure diverse energy supplies.
- To take advantage of the economic opportunities that a low carbon economy present.

2.31. The strategy acknowledges that it will be easier to achieve carbon reductions from some sectors, meaning that other sectors such as buildings will need to make bigger contributions to carbon reduction. Once easier actions such as cavity wall and loft insulation are implemented, the task of achieving further reductions in carbon emissions will become more challenging, and more substantial changes to homes will be required, including small scale energy generation.

Building Regulations, standards and certificates

2.32. The Government's Building a Greener Future: policy statement (2007) identified the pressing need to cut carbon emissions. It also acknowledged the need for significant new housing and the importance of new housing in delivering carbon emissions reductions. Importantly this policy statement set out the Government's intention to progressively improve energy and carbon performance in Building Regulations to achieve Zero Carbon Homes by 2016.

2.33. The requirements to meet Building Regulations should not be addressed in planning conditions but policy can promote standards that exceed Building Regulations. Energy efficiency standards can exceed the energy requirements of Building Regulations and so lower emissions rates for buildings.

2.34. Part L of the Building Regulations deals with 'Conservation of Fuel and Power' and sets the mandatory minimum thresholds for CO_2 emissions for all types of buildings. Part L is periodically reviewed and each review requires the dwelling emission rate (DER)[2] for new residential developments to reduce. Building Regulations that cover energy set the Target Emission Rate (TER) which is the maximum amount of CO_2 emissions per square metre for a building resulting from energy used in heating (space and water) and lighting. Changes to the Building Regulations are setting a progressively more challenging TER, meaning that CO_2 emissions in new developments will be expected to reduce over time to meet Building Regulations.

2.35. Part L Regulations were updated in 2010 and will be again updated in 2013 and 2016. Changes to Part L in 2010 set the energy performance requirements equivalent to those of the Code for Sustainable Homes Level 3 (see below). Amendments to Part L in 2013 and 2016 will increase these requirements to those of CfSH Level 4 and Level 6 respectively.

Domestic buildings – Code for Sustainable Homes

2.36. The Code for Sustainable Homes (CfSH) is the national standard and assessment method for rating the performance for the sustainable design and construction of new homes. The CfSH is voluntary, and is intended to help promote higher standards of sustainable design above current Building Regulations. The CfSH measures the sustainability of new homes against nine categories of sustainable design, rating the 'whole home' as a complete package. It covers energy and CO_2 emissions, water, materials, surface water runoff, waste, pollution, health and well-being, management and ecology.

2.37. The link between the CfSH and the Building Regulations Part L has meant that some people have assumed that the CfSH itself is mandatory and over time there will be a need to meet the highest levels of the CfSH. The CfSH is not intended to be mandatory and although over time the energy and carbon emissions requirements will become mandatory through revisions to Part L of the Building Regulations, other parts of the CfSH will remain voluntary.

2.38. The following CfSH Levels will apply to the Building Regulations and the energy improvements over 2010 TER relative are:

- 2013 – CfSH Level 4 – 25% improvement
- 2016 - CfSH Level 5 – zero carbon.

2.39. The Government has been working on a definition of zero carbon for the purpose of meeting the 2016 target. The Housing Minister announced in May 2011 that the Government had 'decided that the regulatory threshold for zero carbon should be set to cover only those emissions which are within the scope of the Building Regulations, such as those from heating, ventilation, hot water, fixed lighting and building services'.

2.40. It is unlikely that many developers will want to voluntarily exceed current requirements in terms of targets given the demands, costs and technological challenges that satisfying the criteria raise.

[2] Dwelling Emissions Rate (DER) represents the estimated Carbon dioxide (CO2) emissions per sq.m of floor area for the purpose of Building Regulation compliance.

Guidance on how to comply with the CfSH can be found in these publications on the DCLG website:

- The Code for Sustainable Homes Good Practice Guidance (2009): Setting out detailed case studies on homes that have been built according to different levels of the CfSH.
- The Code for Sustainable Homes: Technical guide (November 2010): sets out the requirements for the CfSH, and the process by which a CfSH assessment is reached.
- Code for Sustainable Homes: A Cost Review (March 2010): presents the findings of research into the costs of building to the CfSH, based on recent real cost experience.
- Code for Sustainable Homes, Case Studies (December 2010): sets out a set of case studies on sustainable homes, covering a range of housing types and development sizes. One of the case studies showed how CfSH Level 3 could be achieved without the use of renewables.

Non-residential building standards - BREEAM

2.41. The Building Research Establishment Environmental Assessment Method (BREEAM) addresses similar topics to the CfSH, 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 but unlike the CfSH there is no requirement to gain a rating against the standard. 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.

2.42. BREEAM assesses a wide range of environmental and sustainability issues that includes:

- Management – sustainable procurement, life cycle costs
- Health and Well being – indoor air quality, thermal comfort, water quality
- Energy – reduction in CO_2 emissions, energy monitoring, energy efficiency
- Transport – public transport accessibility, proximity to amenities, cycling facilities
- Water – water consumption, water monitoring, and water efficient equipment
- Materials – life cycle impacts, responsible sourcing, designing for robustness
- Waste – construction waste management, operational waste
- Land use and ecology – site selection, ecological value and protection of ecological features
- Pollution – emissions, surface water runoff, night time light pollution.

2.43. 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.

Energy Performance Certificates

2.44. The Energy Performance of Buildings Directive introduced a requirement for all buildings including homes, commercial properties and public buildings when sold, built or rented to provide an Energy Performance Certificate (EPC). It is too early to say what the measurable achievements of EPCs or Display Energy Certificates (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.

National Planning Policy Framework

2.45. The National Planning Policy Framework (NPPF) was published in March 2012. The NPPF sets out the Government's requirements for the planning system. The NPPF states that applications for planning permission must be determined in accordance with the development plan, unless material considerations indicate otherwise. Additionally the NPPF must be taken into account in the preparation of local and neighbourhood plans, and is a material consideration in planning decisions (Paragraph 2).

Achieving sustainable development

2.46. The NPPF outlines that the purpose of the planning system is to contribute to the achievement of sustainable development and that the three dimensions to sustainable development are economic, social and environmental (Paragraph 6 and 7). At the heart of the NPPF is a presumption in favour of sustainable development. This is therefore at the heart of both plan making and decision taking (Paragraph 14).

Core planning principles

2.47. The NPPF sets out core planning principles that should underpin plan making and decision taking (Paragraph 17). Those of most relevance to this study include:

- The need to take account of different character of different areas, protecting the Green Belts, recognising the intrinsic character and beauty of the Countryside.
- Supporting the transition to a low carbon future in a changing climate, encouraging the use of renewable resources for example by the development of renewable energy.
- Actively manage patterns of growth to make the fullest possible use of public transport, walking and cycling, and focus significant development in locations which are or can be made sustainable.

Delivering sustainable development

Promoting sustainable transport

2.48. Transport policies have a role to play in facilitating sustainable development. Technology can help to reduce the need to travel. Transport systems need to provide sustainable transport choices, but the NPPF acknowledges the opportunities will vary from urban to rural areas (Paragraph 29). Solutions which support reductions in greenhouse gas emissions should be supported (Paragraph 30). Plans should ensure that developments that generate significant movements are located where the need to travel is minimised and the use of sustainable transport modes can be maximised (Paragraph 33). Planning policies should promote a mix of uses, particularly on large residential developments, in order to minimise journey lengths (Paragraph 38).

Requiring good design

2.49. The NPPF makes it clear that the Government places great importance on good design (Paragraph 56). The NPPF states that local planning authorities should not refuse planning permission for buildings or infrastructure which promote high levels of sustainability because of concerns about incompatibility with an existing townscape, if those concerns have been mitigated by good design (Paragraph 65).

Protecting Green Belt

2.50. The Government attaches great importance to Green Belts, and the NPPF acknowledges that when located in the Green Belt, elements of many renewable energy projects will comprise inappropriate development. However, there can be very special circumstances that if demonstrated could allow the development to proceed. These may include the wider environmental benefits associated with increased production of energy from renewable sources (Paragraph 91).

Meeting the challenge of climate change

2.51. Planning has a key role in shaping places to help reduce greenhouse gas emissions, minimising vulnerability and providing resilience to climate change and supporting the delivery of renewable and low carbon energy and associated infrastructure (Paragraph 93). To support the move to a low carbon future, local planning authorities should (Paragraph 95):

- plan for development in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.

2.52. In determining planning applications local planning authorities should expect developments to comply with any local plan policies on decentralised energy supply, unless it can be demonstrated that it is not feasible or viable (Paragraph 96).

2.53. The NPPF places an emphasis on local planning authorities to increase the use and supply of renewable and low carbon energy, by: having a positive strategy in place; designing policies to maximise renewable and low carbon energy development whilst ensuring that adverse impacts are addressed; identifying suitable areas for renewable and low carbon energy sources; supporting community-led initiatives for renewable and low carbon energy; and identifying where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems (Paragraph 97).

2.54. When determining planning applications, local planning authorities should not require applicants for energy development to demonstrate the overall need for renewable or low carbon energy; and should approve the application if its impacts are (or can be made) acceptable (Paragraph 98). The NPPF also advises that once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should also expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the same criteria used in identifying suitable areas.

Plan making

2.55. The NPPF provides guidance on plan making, and advises that Local Plans should be aspirational but realistic (Paragraph 154). To assist with this, plans should be based on adequate up-to-date and relevant evidence about the economic, social and environmental characteristics and projects of the area (Paragraph 158).

2.56. The Government recognise that pursuing sustainable development will require careful attention to viability and costs in plan-making and decision-taking. Plans should be deliverable. Therefore, the sites and the scale of development identified in the plan should not be subject to such a scale of obligations and policy burdens that their ability to be developed viably is threatened. This will mean the costs of any requirements allow development to be deliverable (Paragraph 173).

Essex County Council policy

2.57. The Essex & Southend Waste Local Plan 2001 provides the local planning policies governing waste development in Essex. The policies in the Waste Local Plan have been saved for an indefinite period, until they are replaced by the policies in the Waste Development Documents (WDD).

2.58. The Waste Plan identifies that landfill has a declining ability to manage substantial volumes of waste as well as being seen as environmentally unacceptable. The strategy for dealing with waste in the County requires, in the longer term, real alternatives to landfill and where possible energy recovery. To achieve alternative waste management techniques the Waste Local Plan identifies preferred locations for waste management facilities. One of the Sites is in Epping Forest District, at North Weald Airfield. For those sites identified as preferred locations Policy W8A applies:

W8A: Waste management facilities will be permitted at the locations shown in schedule 1 provided all of the following criteria, where relevant, are complied with:

- There is a need for the facility to manage waste arising in Essex and Southend (subject to policy W3C);
- The proposal represents the best practicable environmental option for the particular waste stream, having regard to any alternative options further up the waste hierarchy;
- The development complies with other relevant policies of this plan, including the policies in chapter 7 for the type(s) of facility proposed;
- Adequate road access is provided in accordance with Policy W4C. access by rail or water will be supported if practicable;
- Buildings and structures are of a high standard of design, with landscaping and screening provided as necessary; and
- Integrated schemes for recycling, composting, materials recovery and energy recovery from waste will be supported where this is shown to provide benefits in the management of waste which would not otherwise be obtained.

2.59. Energy from waste is the burning of waste as a renewable energy to produce energy for electricity and / or heat in the form of a district heating system. With regards energy from waste incineration the plan neither supports nor opposes incineration but recognises that it may play a part in the mix of waste management.

Council policy, initiatives and strategies

Local Plan

2.60. The adopted Local plan for Epping Forest District consists of the Local Plan (1998) and Alterations to the Local Plan (2006). Many of the Local Plan policies were saved in 2009 under Schedule 1 of the Planning and Compulsory Purchase Act (2004). The Saved Policies that are of relevance to this study include:

- **Policy CP1 - Achieving Sustainable Development Objectives** – this sets out that the Council will use planning powers and actions to: avoid, or at least minimise, impacts of development upon the environment, help achieve prudent use of natural resources; and minimise the use of non-renewable resources.
- **Policy CP4 – Energy Conservation** - All new built development should incorporate principles of energy conservation in relation to the design, massing, siting, orientation and layout of buildings. Appropriate measures to utilize renewable energy resources and new energy saving/generating technologies as may become available, should be provided within new buildings or developments where appropriate. These principles should also apply to the conversion or re-use of existing sites and buildings.
- **Policy CP5 – Sustainable Building** – proposals may be refused where they do not do enough to conserve energy. Where possible new developments or conversions should incorporate measures which: reduce fuel use and greenhouse gas emissions (e.g. heat recovery, passive solar gain; minimise overall energy use and input of raw materials (e.g. building form, orientation, thermal mass, fenestration, natural ventilation, landscaping to create shelterbelts, use/reuse of construction materials); and incorporate renewable energy facilities or schemes. The Council may require that proposals for new development, or for the conversion or re-use of sites or buildings, demonstrate in a 'Sustainability Report' how various aspects of sustainability have been taken into account.
- **Policy CP9 – Sustainable Transport** - Where appropriate, development schemes will be required to: provide for a sustainable and integrated transportation system; include investment in transport infrastructure to facilitate and support economic success; promote and provide for sustainable means of transport, especially to key community facilities, particularly by public transport, cycling and walking; improve and make the best use of existing infrastructure, including demand management and reducing the need to travel; ensure access by all sectors of the community, including the mobility impaired and the economically disadvantaged; improve passenger transport services; provide for a

safe and efficient transportation network that improves the accessibility of local communities.

- **Policy CP10 – Renewable Energy Schemes** - Proposals for renewable energy schemes will be permitted provided there is no significantly adverse effect upon : existing land uses from loss of visual amenity, noise, pollution or odour; the local highway network; telecommunications networks, radar installations and flight paths for aircraft; sites of importance for nature conservation, conservation areas, scheduled ancient monuments and other nationally important; remains and their settings, listed buildings and their settings, or landscape character. In granting permission for a scheme the Council use Section 106 Obligations and /or planning conditions, to ensure mitigation measures are provided.
- **Policy GB2a – Development in the Green Belt** - Planning permission will not be granted for the use of land or the construction of new buildings or the change of use or extension of existing buildings in the Green Belt unless it is appropriate in that it is: for the purposes of agriculture, horticulture, or forestry; or for the purposes of outdoor participatory sport and recreation or associated essential small scale buildings; or for the purposes of a cemetery; or for other uses which preserve the openness of the Green Belt and which do not conflict with the purposes of including land in the Green Belt; or a dwelling for an agricultural, horticultural or forestry worker; or a replacement for an existing dwelling; or a limited extension to an existing dwelling that is in accordance with policy; or in accordance with another Green Belt policy.

2.61. EFDC are currently in the process of drafting a new Local Plan that will need to meet the requirements set out in the NPPF. The existing policy approach needs to be strengthened if it will help the District make a significant contribution to carbon reduction and renewable energy generation, chapter 8 sets out some policy recommendations for the District that take account of the NPPF.

Emerging Local Plan

2.62. Epping Forest District Council has started the preparation of a new Local Plan. This will replace the existing 1998 Local Plan and 2006 Alterations documents. The new Local Plan will guide development in the District up to 2033, being used to deal with planning applications and to provide land allocations.

2.63. The Council has recently consulted on the Planning Our Future: Community Choices, which is the Issues and Options for the Local Plan. Public consultation took place from 30th July 2012 until the 15th October 2012.

2.64. The Community Choices document sets out various options for housing growth over the Local Plan period to 2033. These options are narrowed down to three potential housing growth options which would require a residual housing need for between 6,400 – 10,200 units. This level of housing growth poses both challenges and opportunities for the District in terms of reducing the District's impact on climate change, promoting energy efficiency and encouraging low carbon energy and renewable energy.

2.65. The Community Choices document provides options for responding to climate change. The options relate to: carbon reduction; water usage and flooding; new development; and other measures.

2.66. For carbon reduction the options that are identified include transport measures such as locating new development to reduce the need to travel, promoting walking and cycling, encouraging mixed use development to encourage shorter trips, and promoting development along bus routes. For buildings more effective use of the CfSH and BREEAM has been highlighted.

2.67. For new development the options identified include assessing the possibility of on-site targets for renewable energy generation at an appropriate scale, assessing the suitability of widespread small scale carbon reduction schemes on a property by property basis, ensuring that all new developments incorporate ways to reduce carbon emissions, and investigating the promotion of housing insulation upgrades linked to any permission for new extensions.

2.68. Other measures identified include assessing the locations for larger renewable and low carbon energy schemes.

Climate Change Strategy

2.69. The main objective of the Council's Climate Change Strategy (2009) is to reduce greenhouse gas emissions (principally CO_2) from the Council's own operations and from the District as a whole, and to prepare and adapt to predicted climate change impacts.

2.70. The Strategy identified CO_2 per capita in the District as 6.3t per year (2006 figures). The Strategy identifies that this needs to be reduced by 8% by 2011, meaning that average CO_2 per capita will reduce to 5.8t per year. The strategy acknowledges that this target will need to be increased after 2011 based on experience of reducing emissions during the period 2006-2011.

2.71. The Strategy includes a series of action plans that identify measures for reducing emissions from: the Council's own buildings; transport; social housing; and private housing.

2.72. The Council is currently in the process of reviewing and updating the Climate Change Strategy, although at the time of writing there was not a timescale for publication.

Chapter 3: Energy and carbon dioxide emissions baseline

Chapter purpose

- To identify the District's energy use and carbon emissions baseline
- To compare the District's energy use and carbon emissions to those of other authorities in the region
- To determine a baseline of carbon emissions for the District in order to assess the potential for carbon reductions in the District over the plan period.

Chapter summary

This chapter has assessed the District's current energy use and existing carbon emissions in order to set a baseline from which targets for renewables and carbon reduction can be set. The key findings of the section are as follows:

Electricity

Average domestic electricity use in the District is above the regional average, as one of the top 10 authorities in East England. However, consumption has been declining over the period 2005 -2010.

Domestic electricity is highest in Buckhurst Hill, the rural east of the District, Nazeing, Roydon, parts of Loughton and North Weald Bassett, although consumption per head is highest in Chigwell.

Non-domestic electricity consumption accounts for 90% of use in the District. Average non-domestic electricity use in the District is below the regional average. Consumption has fluctuated over the period 2005-2010, but levels have remained broadly similar in 2010 as they were in 2005.

Non-domestic electricity use is highest in Epping, Nazeing, Roydon, North Weald Bassett and Theydon Bois. It is not possible to define who the main users are as figures are not provided for individual users.

Gas

Average domestic gas consumption in the District is above the regional average, and the District has the 5th largest consumption in the East of England. However, consumption has been falling broadly in line with the regional trend.

Domestic gas use is highest in Chigwell, Loughton, Buckhurst Hill, Grange Hill and parts of Epping, these areas have larger detached and semi detached properties. There is a potential opportunity for meeting these high heat demands through combined heat and power (CHP) systems. The potential for this is explored further in chapter 5.

Average non-domestic gas consumption is below the regional average. However, average non-domestic gas consumption has risen in the period 2005-2010.

Non-domestic gas use is highest in areas around Nazeing, Waltham Abbey and Loughton. These areas of heat demand coincide with areas where the glasshouse industry is clustered and where the District's larger industrial areas are located. There is a potential opportunity for meeting these high heat demands through combined heat and power (CHP) systems. The potential for this is explored further in chapter 4.

Carbon emissions

The District's carbon emissions are made up of 26% from road transport (excluding motorway emissions), 31% from industry and commerce, and 43% from the domestic sector. The District's emissions from industry and commerce, and the domestic sector are above the Essex average, but are below the average for road transport.

In absolute terms emissions from industry, domestic properties and road transport are all above the County average, although the average emissions per capita by sector are all below the county average. Overall carbon emissions per capita have fallen by 10% over the period 2005 – 2010.

Subsequent chapters assess the potential carbon savings from: large scale renewable installations (chapter 4); new residential development being built to CfSH standards and from fitting small scale renewables (chapter 5); retrofitting energy efficiency measures in existing buildings (chapter 6); and transport (chapter 7)

The outcome of this assessment is a recommended carbon reduction target (see chapter 8) for the District over the local plan period (2013-2033), which the Council should seek to implement by setting challenging carbon reduction policies.

3. Energy and carbon dioxide emissions baseline

Introduction

3.1. The UK has set challenging targets for carbon emissions reductions which include an 80% reduction in greenhouse gas emissions by 2050 and CO_2 reductions of 34% by 2020 (both against 1990 levels). Local authorities have not been set targets by the Government, but it is recognised that without local action on carbon emissions it will be difficult to achieve the overall UK targets. Many local authorities are setting their own carbon reduction targets in their climate change strategies as a way of help to frame the policy approaches that they adopt towards both energy use and carbon reductions.

3.2. This chapter assesses the baseline energy demand for Epping Forest District, with regards to electricity and gas consumption, as well the District's carbon emissions. The datasets have been analysed to portray how the demand for energy in the District has changed since 2005, in absolute terms and on a per capita basis, and how energy use in Epping Forest District compares with its neighbouring authorities within the region.

3.3. By determining the baseline of the energy demand for Epping Forest District, it will be possible to establish the extent to which energy from alternative renewable sources can contribute towards energy use. In particular the heat demands (shown through gas consumption) can provide an indication of whether there is scope for combined heat and power (CHP) systems in the District (this is explored further in chapter 4).

3.4. The baseline carbon emissions in the District are identified in this chapter in order to provide a starting point from which to develop a carbon emissions reduction target for Epping Forest District. Subsequent chapters assess the potential carbon emissions savings that could be achieved in the District:

- Chapter 4 assesses the potential CO_2 savings from large scale renewable installations;
- Chapter 5 assesses the potential CO_2 savings from new residential development being built to CfSH standards and from fitting small scale renewable; technologies;
- Chapter 6 assesses the potential CO_2 savings from retrofitting energy efficiency measures in existing buildings; and
- Chapter 7 assesses the potential CO_2 savings from transport.

3.5. The outcome of this assessment is a recommended carbon reduction target (see chapter 8) for the District over the local plan period (2013-2033), which the Council should seek to implement by setting challenging carbon reduction policies.

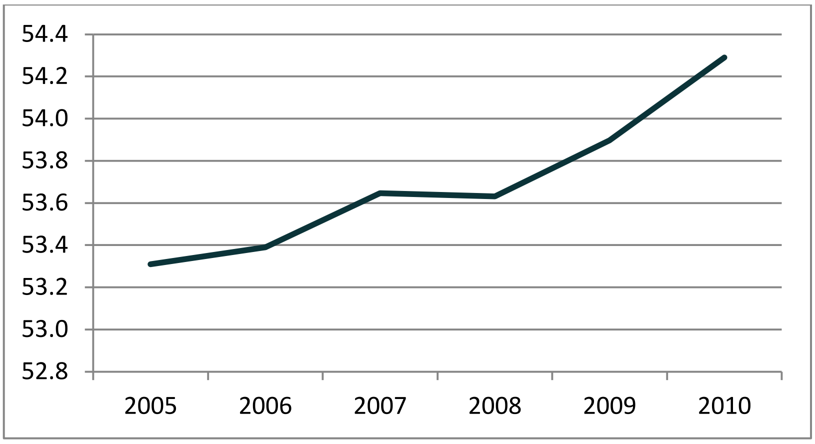
Epping Forest District's baseline electricity use

Domestic demand for electricity

Epping Forest District's domestic demand for electricity

3.6. Initially, the change in the amount of domestic Meter Point Administration Numbers (MPANs) in the District, between 2005 and 2010, was plotted. The MPANs are a reference used in the UK to uniquely identify electricity supply points, such as individual domestic residences. The amount of MPANs reveal the number of units (whether residential, commercial or industrial) that are connected to utility networks across the District and are an indicator of access to electricity. This is revealed in Figure 2.

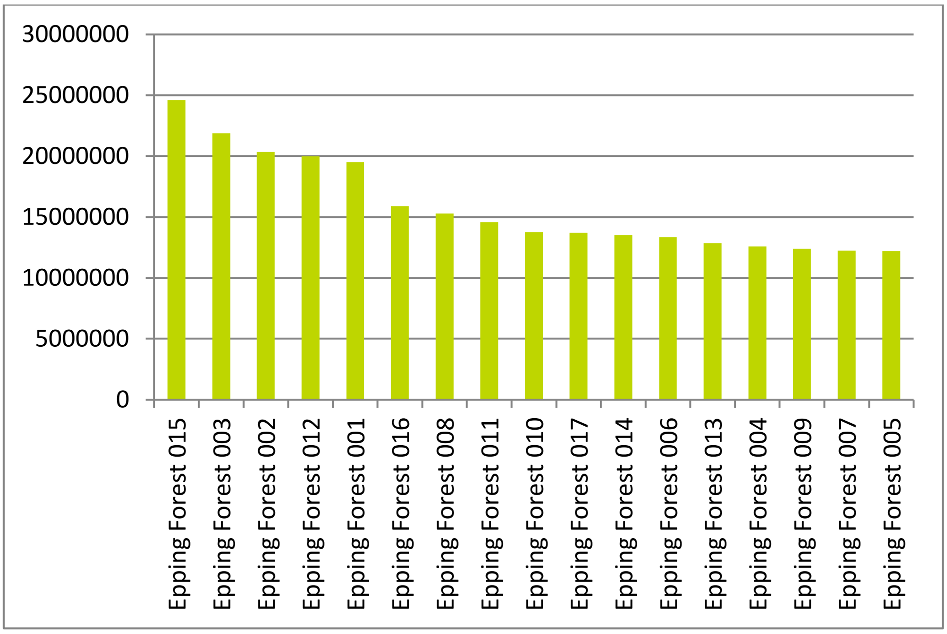
Figure 2. Number of domestic MPANs, 2005-2010 (thousands)



3.7. Figure 2 shows that, between 2005 and 2010, the number of domestic MPANs (households with access to electricity) rose by 1.8%, from 53,300 households to approximately 54,300. The data shows that the average household in Epping Forest District uses circa 4,947 kWh of electricity per annum.

3.8. Analysis of electricity consumption at output area level in the District, for domestic users has been undertaken in order to identify the areas with the greatest energy demands. Figure 3 below shows the total domestic electricity consumption for Middle Layer Super Output Areas (MSOAs)[3] (see Figure 38 at the end of this chapter for a map of MSOAs). The MSOAs with the highest level of consumption are in the areas around Buckhurst Hill (MSOA 015), the east of the District (MSOA 003 this is large MSOA which covers the east of the District (excluding Chipping Ongar) Nazeing/Lower Nazeing/Roydon (MSOA 002) parts of Loughton (MSOA 012) and North Weald Bassett (MSOA 001)

Figure 3. Total Domestic electricity consumption in kWh (MSOA)

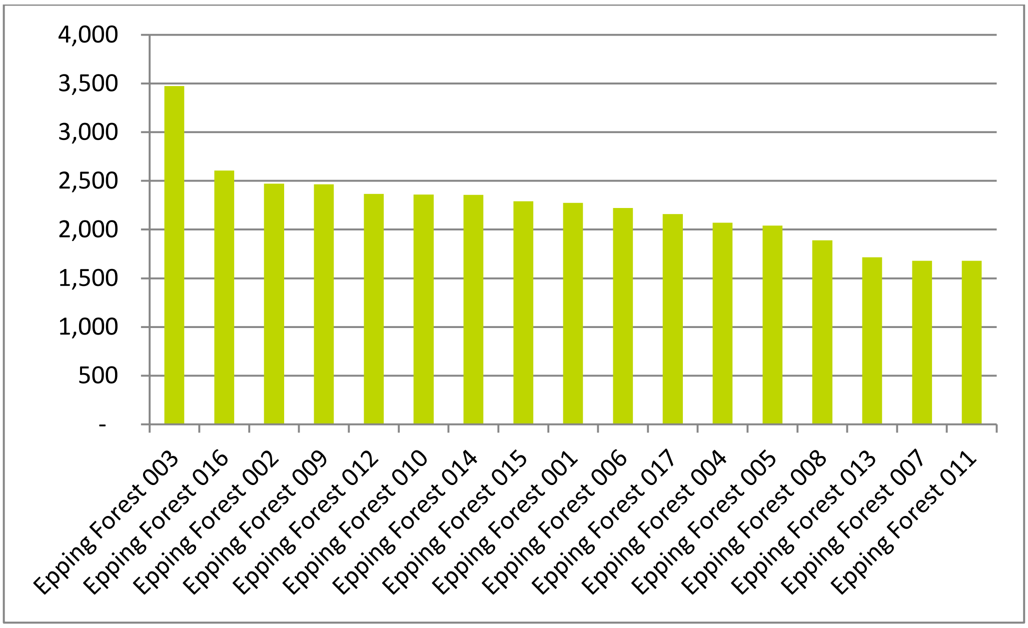


Source: Based on DECC Domestic Electricity MSOA, 2010

[3] Area of analysis below district and ward level for providing small area statistics from Census and other data sources. MSOAs have a minimum population of 5,000 and a maximum population of 15,000 and between 2,000 – 6,000 households.

3.9. Figure 4 shows the electricity consumption per head. When consumption per head is considered the east of the District (MSOA 003) has the highest rates of consumption followed by Chigwell (MSOA 016) Nazeing/Lower Nazeing/Roydon (MSOA 002) and the areas surrounding Waltham Abbey (MSOA 009).

Figure 4. Domestic electricity consumption per head in kWh (MSOA)



Source: Based on DECC Domestic Electricity MSOA, 2010

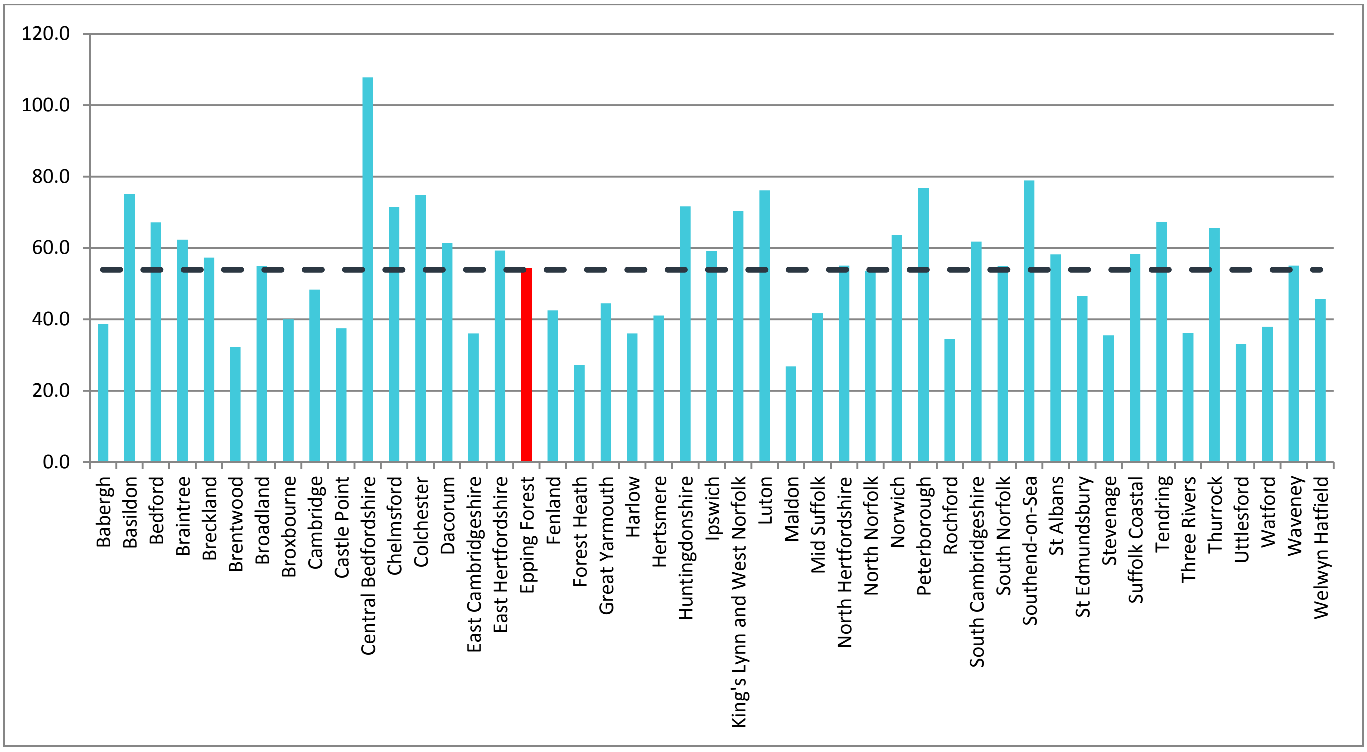
3.10. When data for domestic electricity use is analysed at Lower Layer Super Output Area (LSOA)[4], (see Figure 39 at the end of this chapter for a map of LSOAs) of the top ten LSOAs with the highest per head of population electricity use include: Chigwell (LSOA 016B); the rural east of the District (around Chipping Ongar) (LSOAs 003A, 003B and 003C); the rural area between Epping and Nazeing (LSOA 002A); Buckhurst Hill (LSOA 015E); Loughton (LSOA 012D and O14A); areas to the south and west of Waltham Abbey (LSOAs 009A) and the area to the east of Theydon Bois (LSOA 010c).

Comparison to the Region and other districts

In 2010, Epping Forest District - was only marginally above (less than 1%) the regional average for domestic MPANs, as is shown in the figure 5 below, which identifies the number of domestic MPANs in 2010 for each local authority in the region. The regional average is represented by the horizontal dotted line.

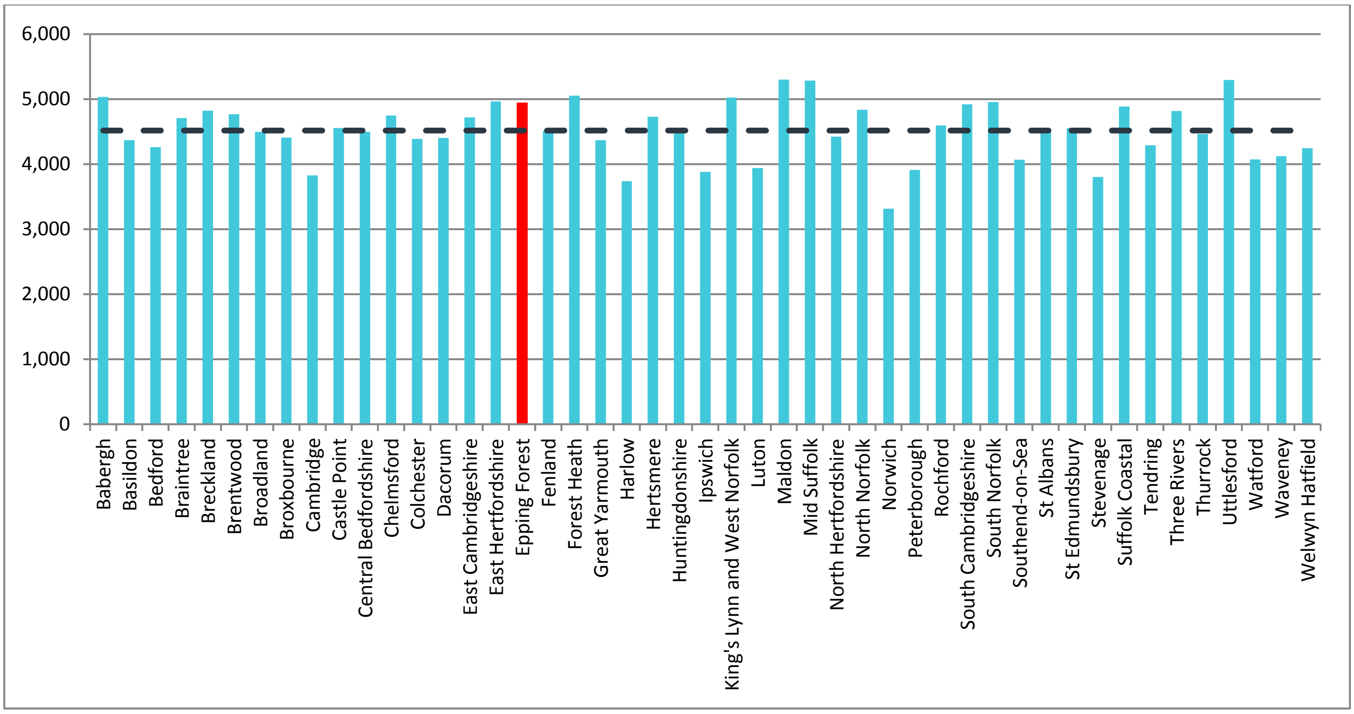
[4] Area of analysis below district and ward level and MSOA for providing small area statistics from Census and other data sources. LSOAs have a minimum population of 1,000 and a maximum population of 3,000 and between 400 – 1200 households.

Figure 5. Number of domestic MPANs across the East of England Region, 2010 (thousands)



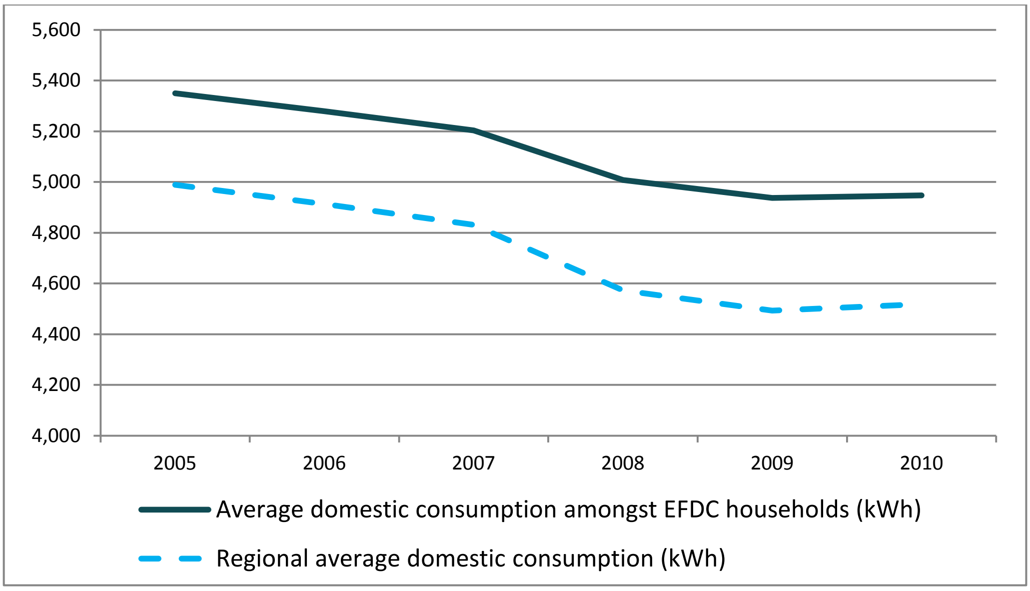
3.11. Despite having marginally more domestic MPANs in 2010 than the regional average, the data shows that the average household in Epping Forest District uses circa 4,947 kWh of electricity; 9.5% above the average electricity use at the regional level. This is shown in Figure 6, with the dotted line representing the regional average electricity use per household.

Figure 6. Average domestic electricity consumption across the East of England Region, 2010 (kWh)



3.12. As such, Epping Forest District is in the top ten local authorities in the East of England with the highest average household consumption of electricity. However, the data also shows that energy consumption per household in the District is declining, as electricity consumption per household in 2010 was 7.5% less per household than in 2005. The regional average consumption per household underwent a similar trend during this period, as it declined 9.5%.

Figure 7. Average electricity consumption per household, Epping Forest District & the East of England Region, 2005 - 2010 (kWh)

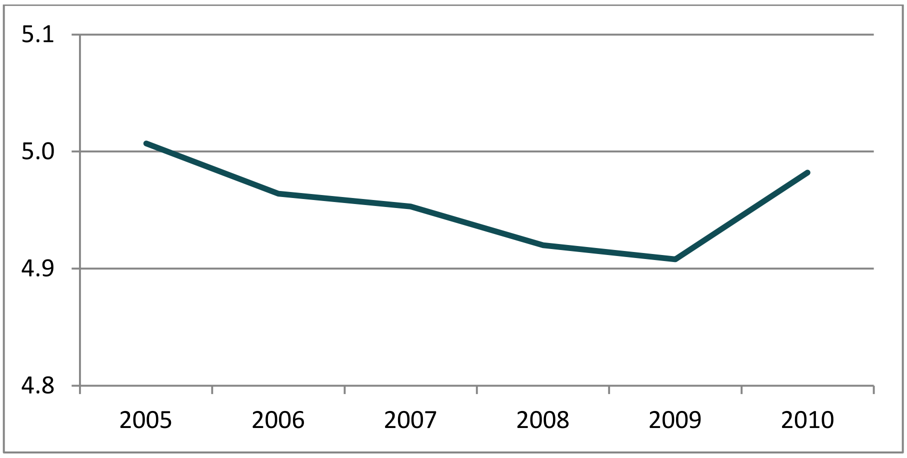


Commercial and industrial (non-domestic) demand for electricity

Epping Forest District's commercial and industrial demand for electricity

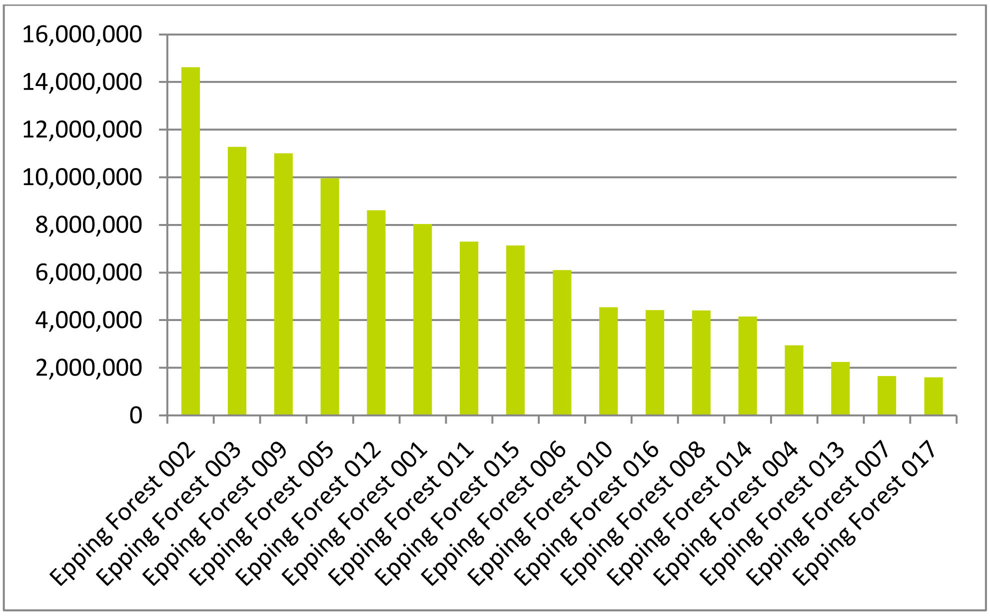
3.13. The demand for electricity amongst Epping Forest District's commercial and industrial building stock was examined by identifying the amount of commercial and industrial MPANs in the District, between 2005 and 2010 (Figure 8). This revealed that, by 2009, commercial and industrial units requiring electricity had declined by 2% but witnessed an increase in 2010 of an additional 74 units, producing an overall decrease of 0.5% in commercial and industrial MPANs between 2005 and 2010.

Figure 8. Number of commercial & industrial MPANs, 2005-2010 (thousands)



3.14. Analysis of electricity consumption at output area level in Epping, for non-domestic users has been undertaken in order to identify the areas with the greatest energy demands in the District. Figure 9 below shows the total non-domestic electricity consumption for MSOAs. The MSOAs with the highest level of consumption are in the areas around Nazeing/Lower Nazeing/Roydon (MSOA 002) the east of the District (MSOA 003) areas surrounding Waltham Abbey (MSOA 009) parts of Epping (MSOA 005) and Loughton (MSOA 012).

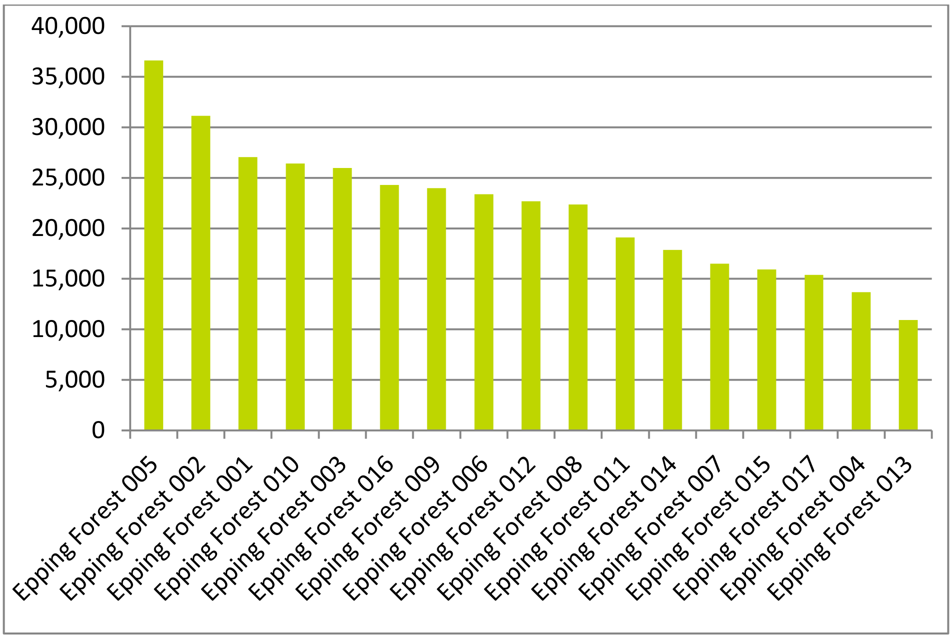
Figure 9. Non-domestic total electricity consumption Kwh (MSOA)



Source: Based on DECC Non-Domestic Electricity MSOA, 2010

3.15. Figure 10 shows the non-domestic average electricity consumption. When average electricity consumption is considered Epping (MSOA 005) has the highest rates of consumption followed by Nazeing/Lower Nazeing/Roydon (MSOA 002) and North Weald Bassett (MSOA 001) and Theydon Bois (MSOA 010).

Figure 10. Non-domestic electricity consumption, average consumption (by MSOA)



Source: Based on DECC Non-Domestic Electricity MSOA, 2010

3.16. It should be noted that data for non-domestic electricity use is not available at LSOA.

Comparison to the Region and other districts

3.17. Compared to East of England, in 2010 Epping Forest District had 10.4% more commercial and industrial MPANs than the regional average, as is shown in Figure 11 below. However, in terms of average electrical consumption per commercial and industrial unit, the demand in Epping Forest District amongst the average unit is 39% less than the regional average (Figure 12). This could imply that the consumption of electricity for these units is more efficient, than other similar units in the region, or that the operations in the Districts commercial and industrial units simply required less power. Additionally, this substantial gap in electricity demand could indicate that the commercial and industrial units in the District are provided with electricity through alternative sources that are not measured via the MPANs and are delivered by alternative infrastructure networks.

3.18. The degree to which the District's demands per commercial and industrial unit differ from the regional average is a contrast to how the District's average household performs relative to the average regional consumption per household (which is above the average).

Figure 11. Number of commercial & industrial MPANs across the East of England Region, 2010 (thousands)

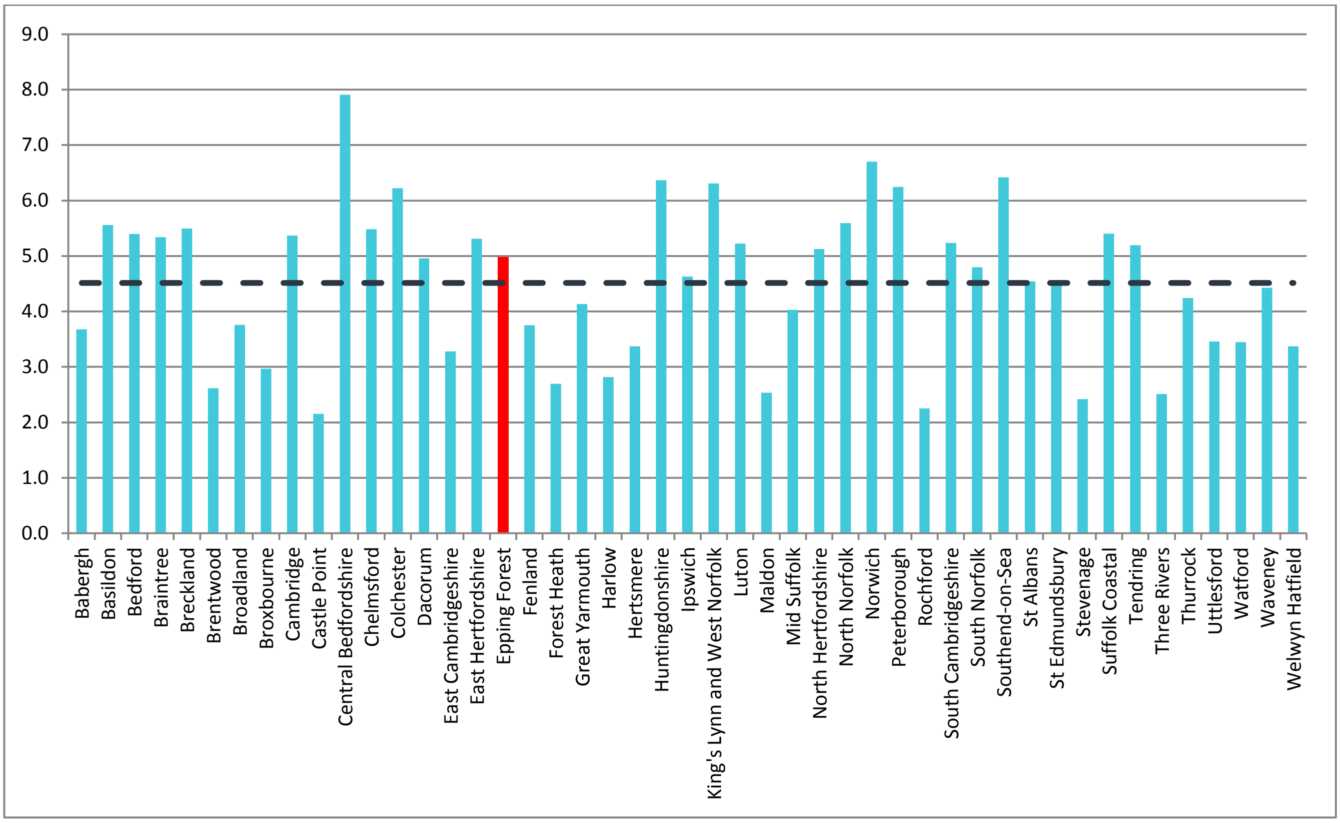
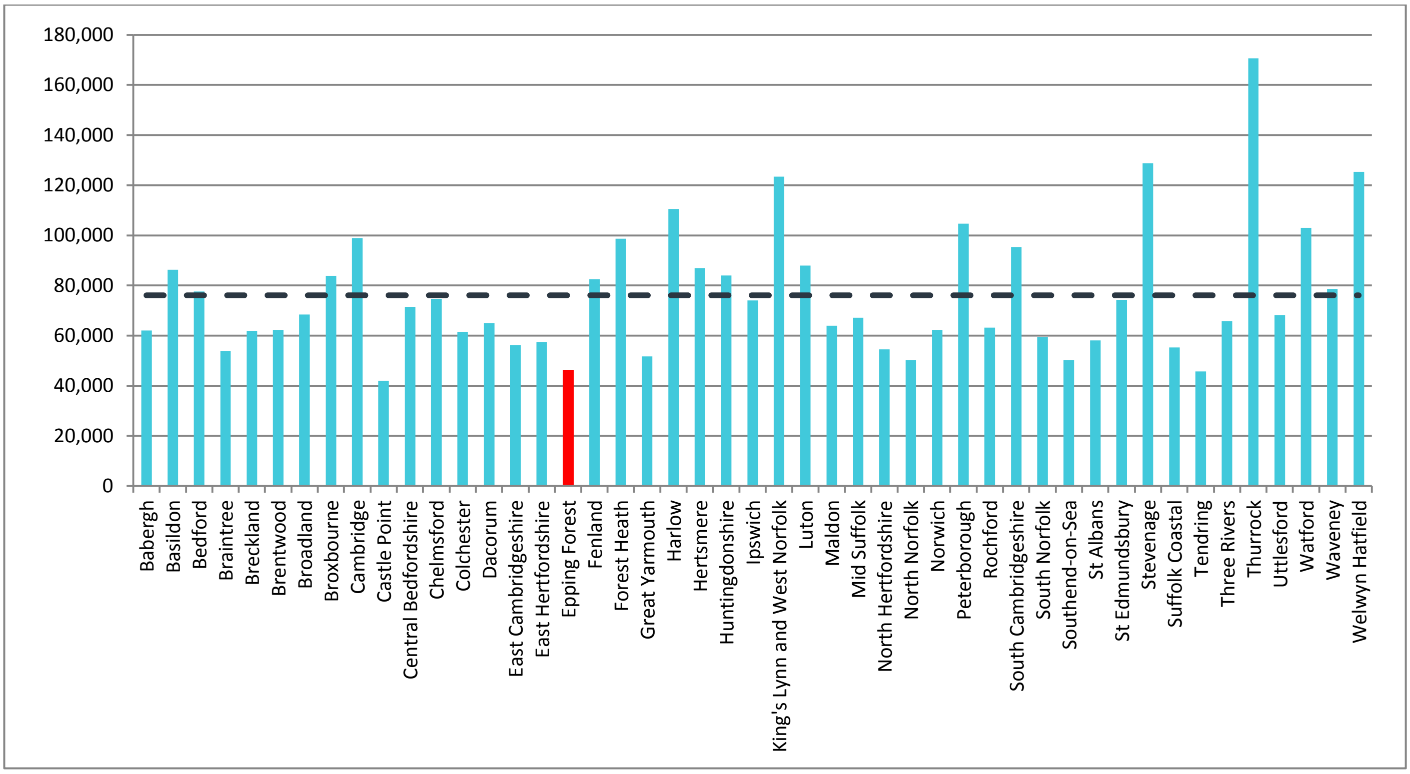


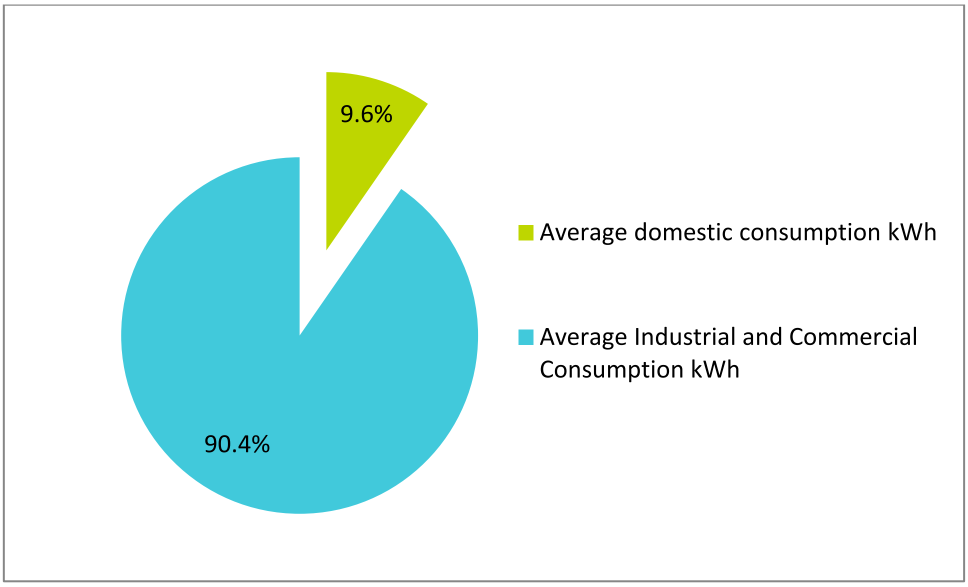
Figure 12. Average commercial & industrial electricity consumption across the East of England Region, 2010 (kWh)



3.19. Similarly to the number of commercial and industrial MPANs in Epping Forest District, the average electrical consumption per unit has largely remained unaltered between 2005 and 2010, with an increase of 273 kWh, or 0.6% (Figure 13). This could suggest that the growth of the commercial and industrial sectors in the District has remained relatively unchanged during this 5 year period, as demand levels for electricity can serve as indicators for production, especially in the industrial sector. Thus, a level demand for electricity can indicate a level demand for goods. Despite this, commercial and industrial demand for electricity far exceeds domestic demand in the District, as is to be expected, requiring over 90% of Epping Forest Districts' electricity outputs (Figure 14).

Figure 13. Average commercial & industrial electricity consumption in Epping Forest District, 2005 - 2010 (kWh)

Figure 14. Electricity consumption in Epping Forest District, domestic vs. commercial & industrial 2010 (kWh)



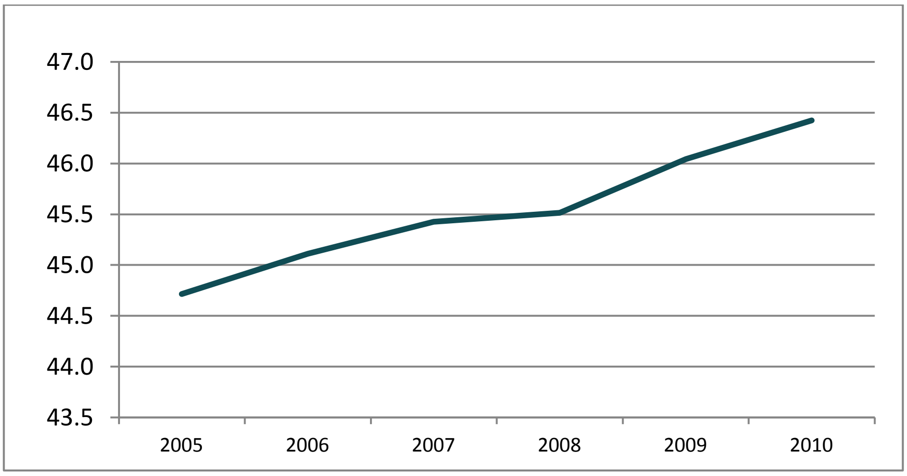
Epping Forest District's baseline gas use

Domestic demand for gas

Epping Forest District's domestic demand for gas

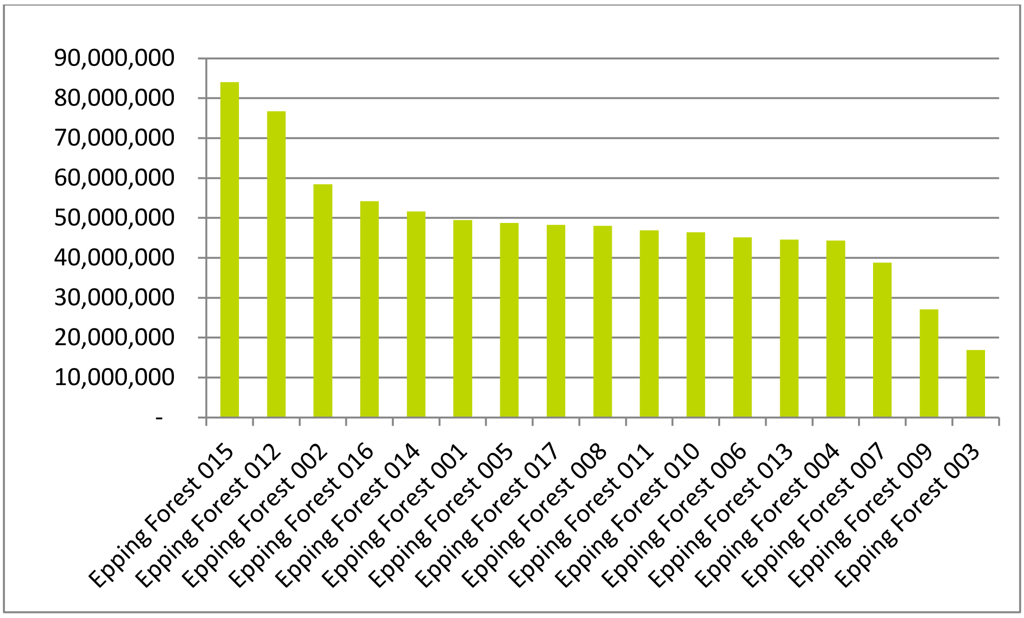
3.20. In order to establish the extent of the demand for gas amongst households in Epping Forest District, the number of domestic consumers (household units), between 2005 and 2010, was plotted to show how demand has changed over this period. The data shows that by 2010, the amount of household units that consumed gas increased by 3.8% above 2005 levels, to over 46,400 (see Figure 15).

Figure 15. Number of domestic gas consumers, 2005-2010 (thousands)



3.21. Analysis of gas consumption at output area level in Epping, for domestic users has been undertaken in order to identify the areas with the greatest heat demands in the District. This analysis is important as it can provide an indication of areas of the District that may need targeting for energy efficiency measures, and it can also provide an understanding of what potential there might be for combined heat and power (CHP) or district heating schemes.

Figure 16. Total domestic gas consumption (by MSOA)

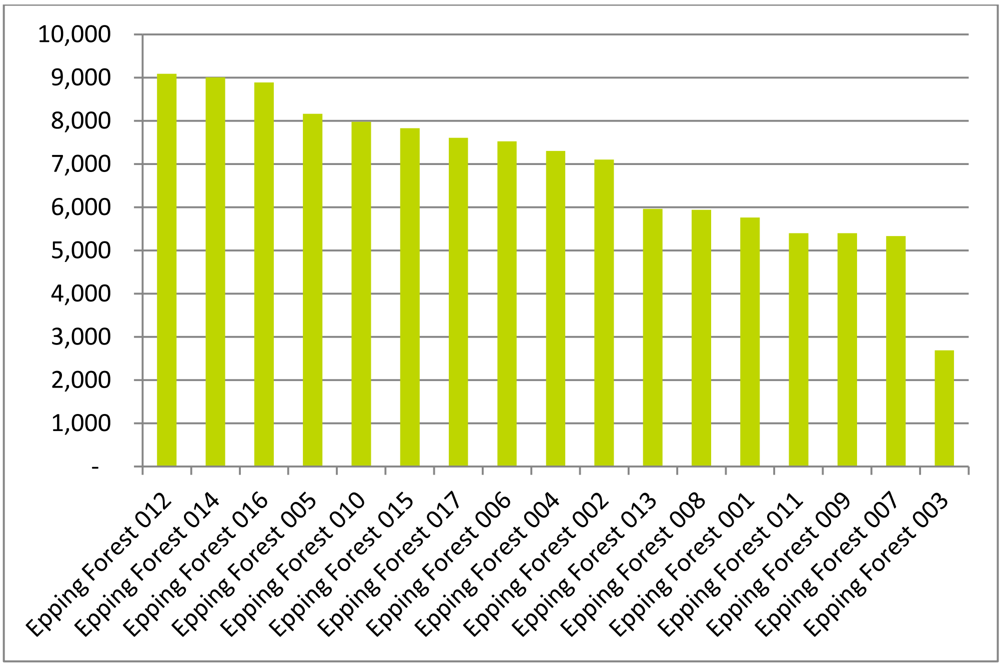


Source: Based on DECC Domestic Gas MSOA, 2010

3.22. Figure 16 above shows the total domestic gas consumption for MSOAs. The MSOAs with the highest level of consumption are in the areas around Buckhurst Hill (MSOA 015), parts of Loughton (MSOA 012 and MSOA014) Nazeing (MSOA 002) and Chigwell (MSOA 016).

3.23. Figure 17 shows the domestic gas consumption per head. When consumption per head is considered Loughton (MSOA 012 and MSOA014) and Chigwell (MSOA 016) still come out at the top in terms of consumption, and Epping (MSOA 005) moves up, whilst Nazeing (MSOA 002) is lower down the list of MSOAs.

Figure 17. Domestic gas consumption per head (by MSOA)



Source: Based on DECC Domestic Gas MSOA, 2010

3.24. When data for domestic gas use is analysed at the LSOA, of the top ten LSOAs with the highest per head of population gas use, all except one are in the south west of the District, the other is in Epping. The areas with the highest level of use are:

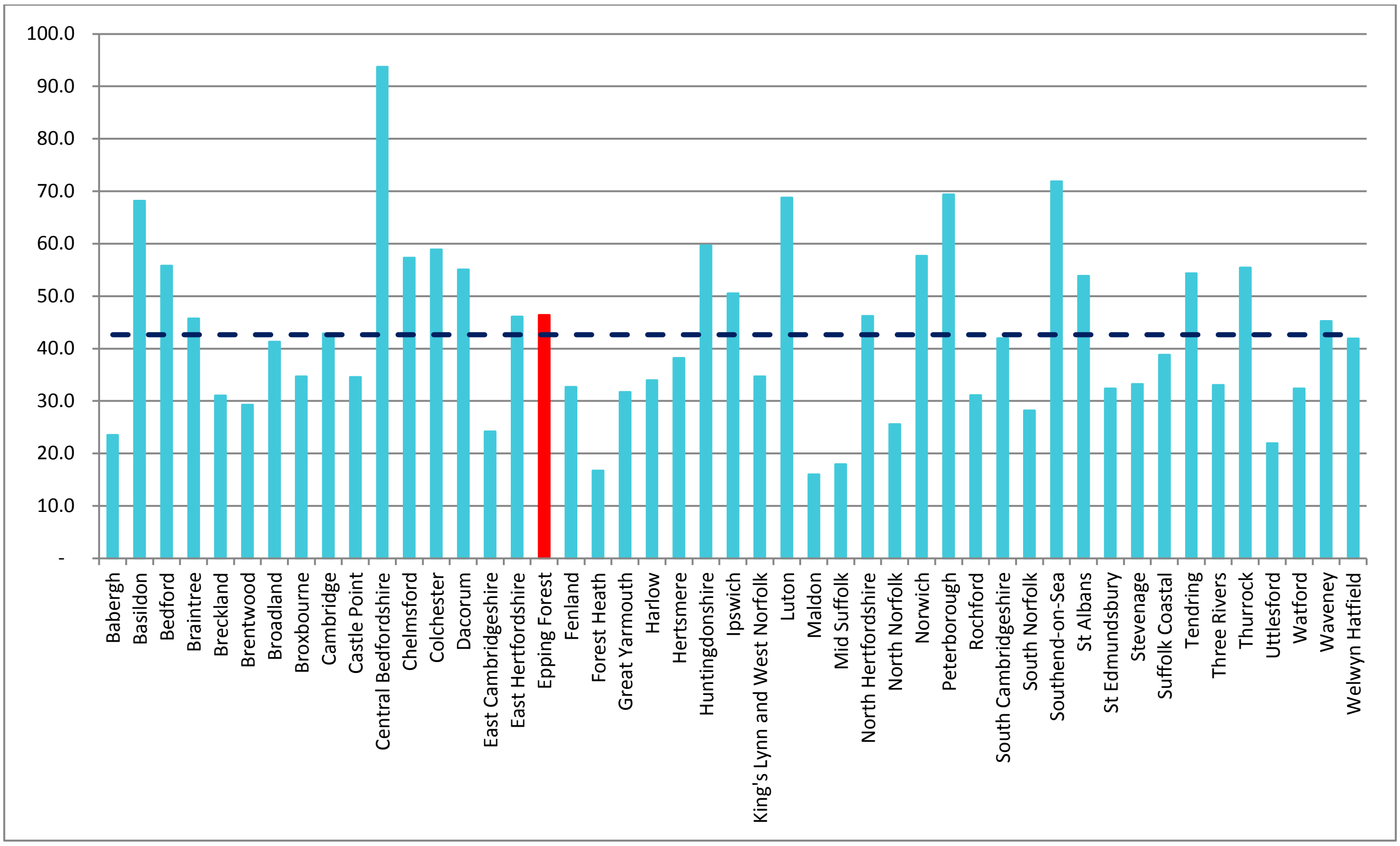
- Chigwell (LSOA 016B and 016C)
- Loughton (east / north east) (LSOAs 012B and 012D)
- Buckhurst Hill (LSOA 014A and 014B, 015F)
- Grange Hill (LSOA 017C)
- Epping (part of) (LSOA 006B)

3.25. The areas with high domestic per head use appear to be areas with large detached / semi detached properties, which is to be expected. To consider the potential for meeting these heat demands through CHP or district heating, there would need to be significant public housing estates in these areas that have the potential to introduce (retrofit) low carbon heating options. From discussions with the Council Housing Directorate, it appears that there is limited potential across the District for these types of scheme, and there are currently no plans to introduce them.

Comparison to the Region and other districts

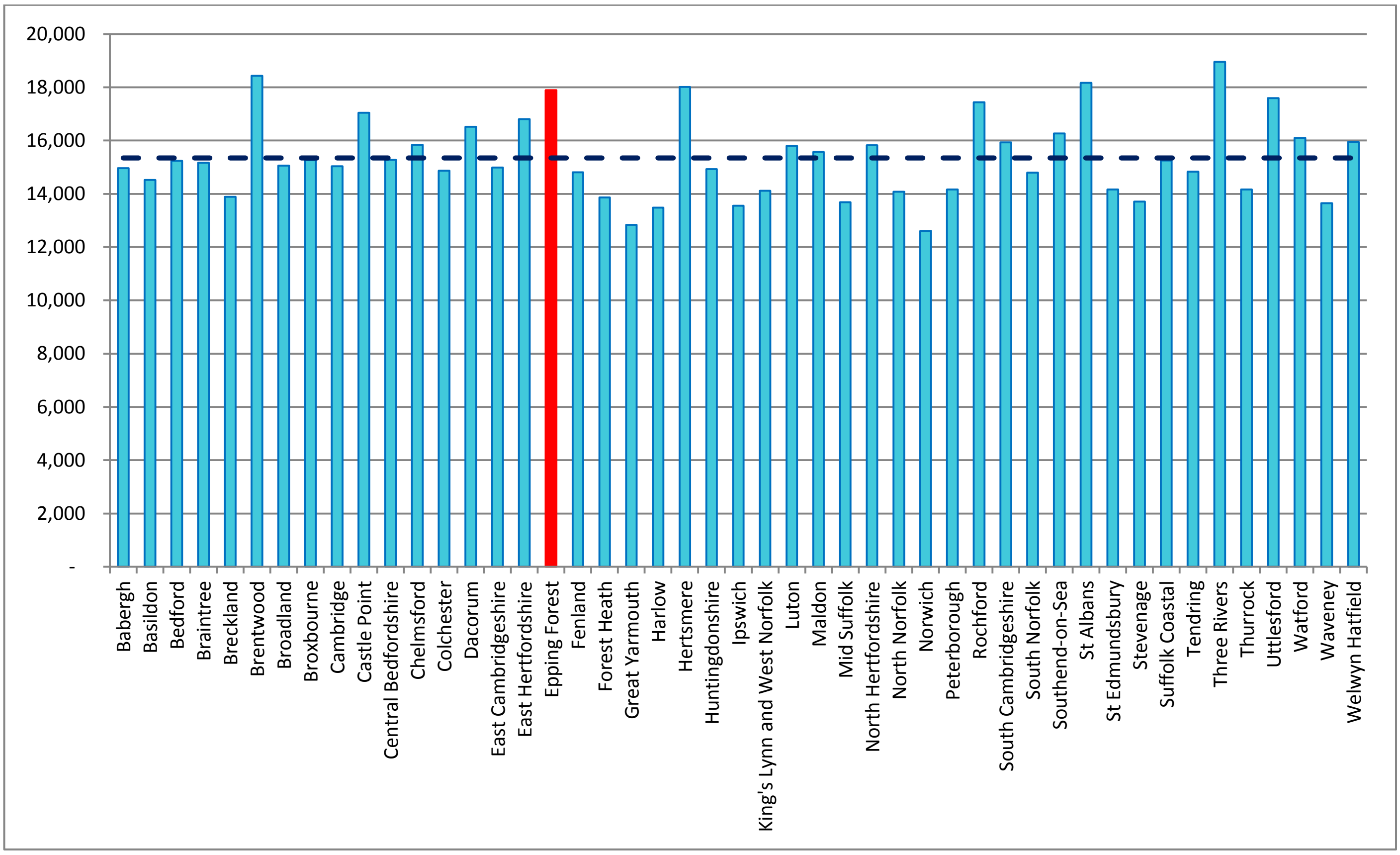
3.26. The amount of gas consumers in the District in 2010 was fairly aligned with the average amount within the region. Epping Forest District has 8.8% (or 3,774) more domestic gas consumers than the regional average, which, relative to the other authorities, is not a large disparity.

Figure 18. Number of domestic gas consumers across the East of England Region, 2010 (Thousands)



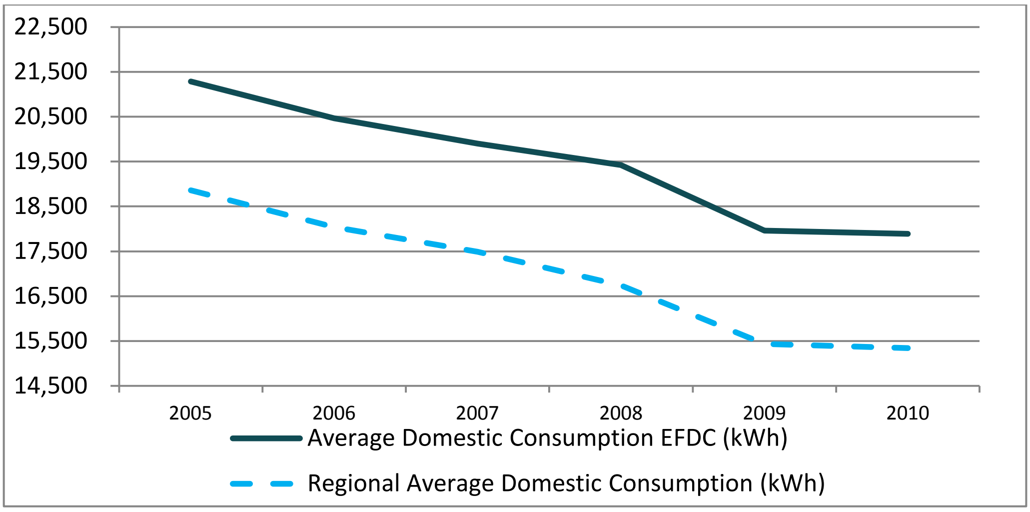
3.27. Similarly to Epping Forest District's average household consumption of electricity, the District's average gas consumption per household is amongst the highest in the region. Figure 19 shows that Epping Forest District households use 16.6% (2,545 kWh) more gas than their regional equivalents, making the District the fifth largest average household consumer of gas in the East of England, after Three Rivers, Brentwood, St. Albans and Hertsmere.

Figure 19. Average domestic gas consumption per household across the East of England Region, 2010 (kWh)



3.28. Despite this, the data on the period 2005-2010 reveals that the District's average gas consumption per household is declining. Over this five year period, gas consumption per household dropped by 16.0% to 17,888 kWh per household in 2010. The regional average consumption of gas per household underwent a similar trend during this period, as it declined 18.9%.

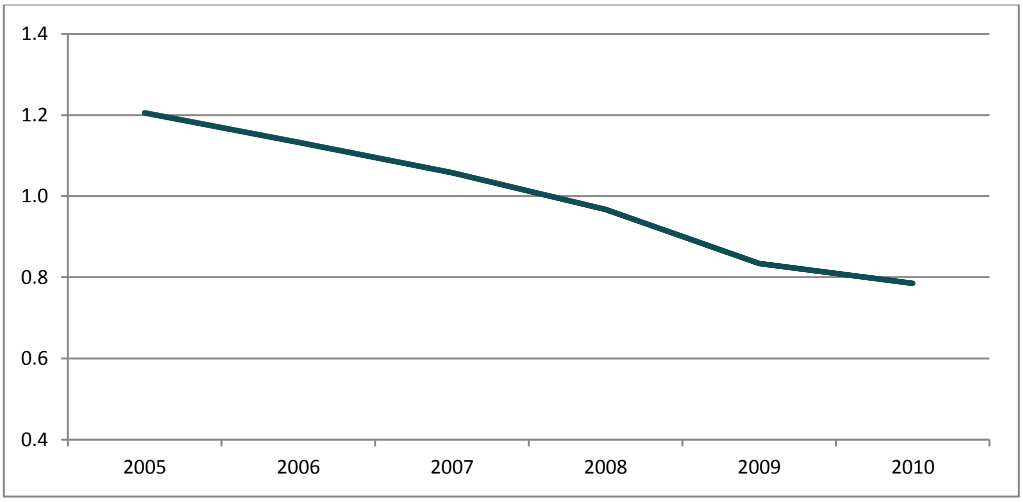
Figure 20. Average domestic gas consumption in Epping Forest District, 2005 - 2010 (kWh)



Commercial and industrial demand for gas

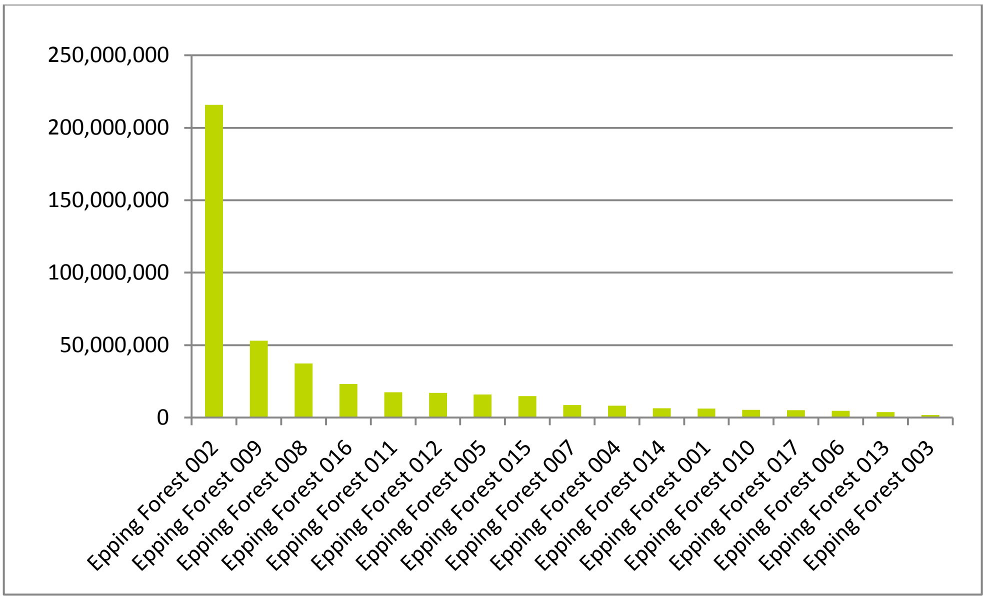
3.29. The number of registered gas consumers amongst Epping Forest District's commercial and industrial stock is portrayed in Figure 21. Between 2005 and 2010, Epping Forest District saw a significant decrease in its commercial and industrial gas consumers, from approximately 1,200 to 780; a 34.9% reduction.

Figure 21. Number of commercial & industrial gas consumers, 2005-2010 (thousands)



3.30. Analysis of gas consumption at output area level in the District, for non-domestic users has been undertaken in order to identify the areas with the greatest heat demands. This analysis is important as it can provide an indication of areas of the District that may need targeting for energy efficiency measures, and it can also provide an understanding of what potential there might be for combined heat and power (CHP) or district heating schemes.

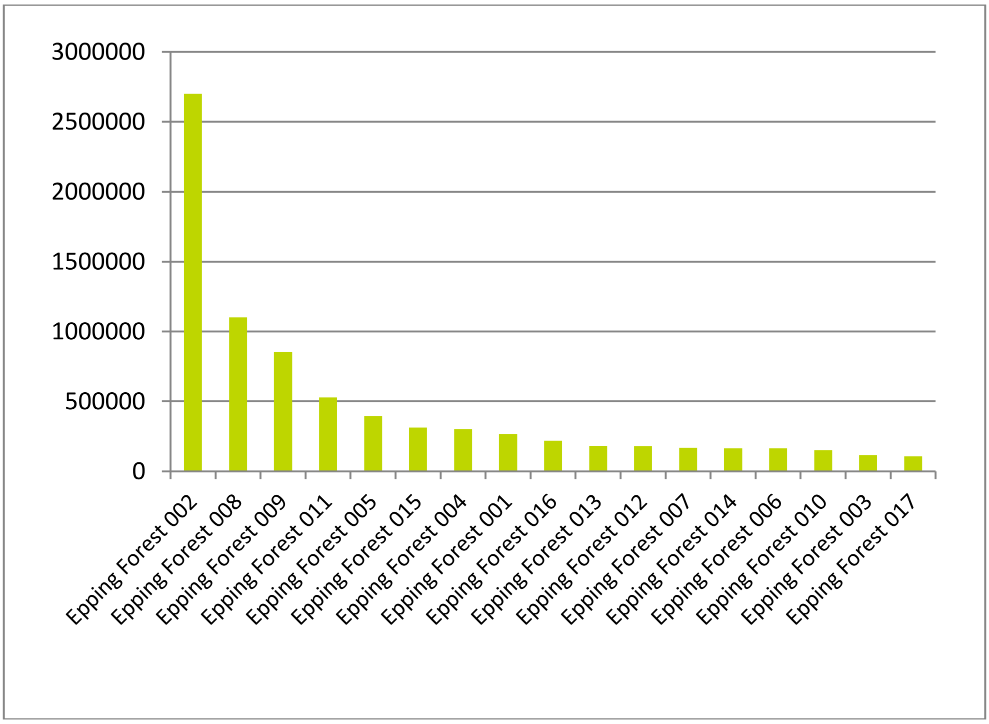
Figure 22. Total non-domestic gas consumption (by MSOA)



Source: Based on DECC Non-Domestic Gas MSOA, 2010

3.31. Figure 22 shows that the areas with the largest total consumption of gas are in the east of the District. The areas around Nazeing (MSOA 002) have significantly higher gas consumption than elsewhere. To the north of Waltham Abbey (MSOA 009) Waltham Abbey (MSOA 008), the area around Chigwell (MSOA 016) the MSOAs in Loughton (MSOA 011 and MSOA 012) also have a high level of use.

Figure 23. Non-domestic gas consumption, average consumption (by MSOA)



Source: Based on DECC Non-Domestic Gas MSOA, 2010

3.32. Figure 23 shows the average gas consumption, this shows a similar pattern in terms of the level of gas consumption as shown in Figure 22, with areas around Nazeing, Waltham Abbey and Loughton showing the highest level of gas consumption.

3.33. Non domestic data is only available at MSOA level, so it is not possible to identify in any greater detail where the heat demand is occurring. However the consultants have considered the type of commercial uses in these areas, and the concentration of non domestic heat demand appears to correspond with the Districts major industrial uses including:

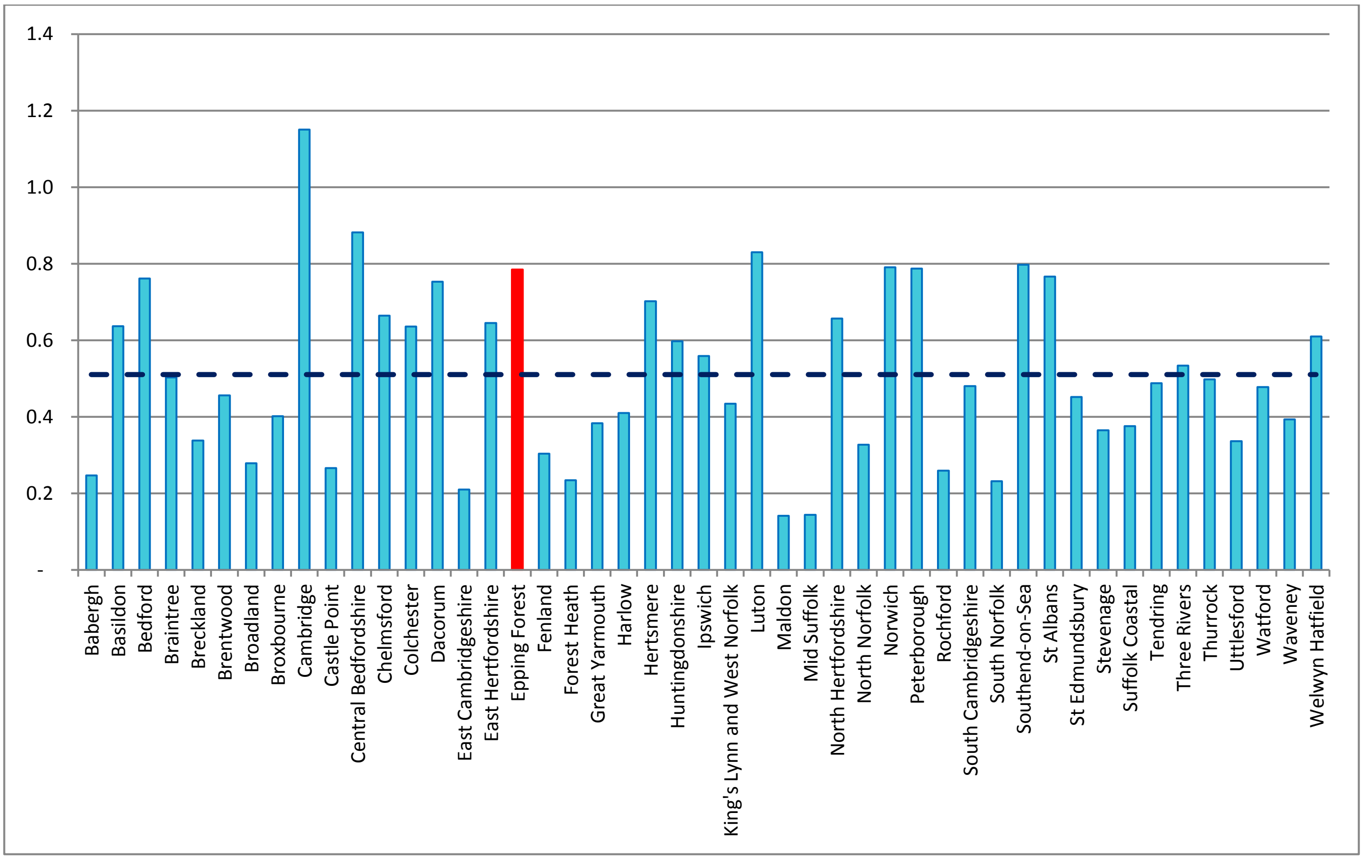
- the glass house businesses - in and around Nazeing
- the Sainsbury's distribution centre and the Abbey Mead Industrial Park – south of Waltham Abbey
- Oakwood Hill Industrial Estate / Langston Road Industrial Estate – south of Loughton

3.34. The above industrial and horticultural businesses may offer some potential for the introduction of CHP systems and other low carbon and renewables technologies, to help to reduce carbon emissions. As such, the consultants have developed three case studies related to these areas to test what the potential for CHP in the Districts key industrial areas (and horticultural industry) would be. This is discussed in more detail in chapter 4.

Comparison to the Region and other districts

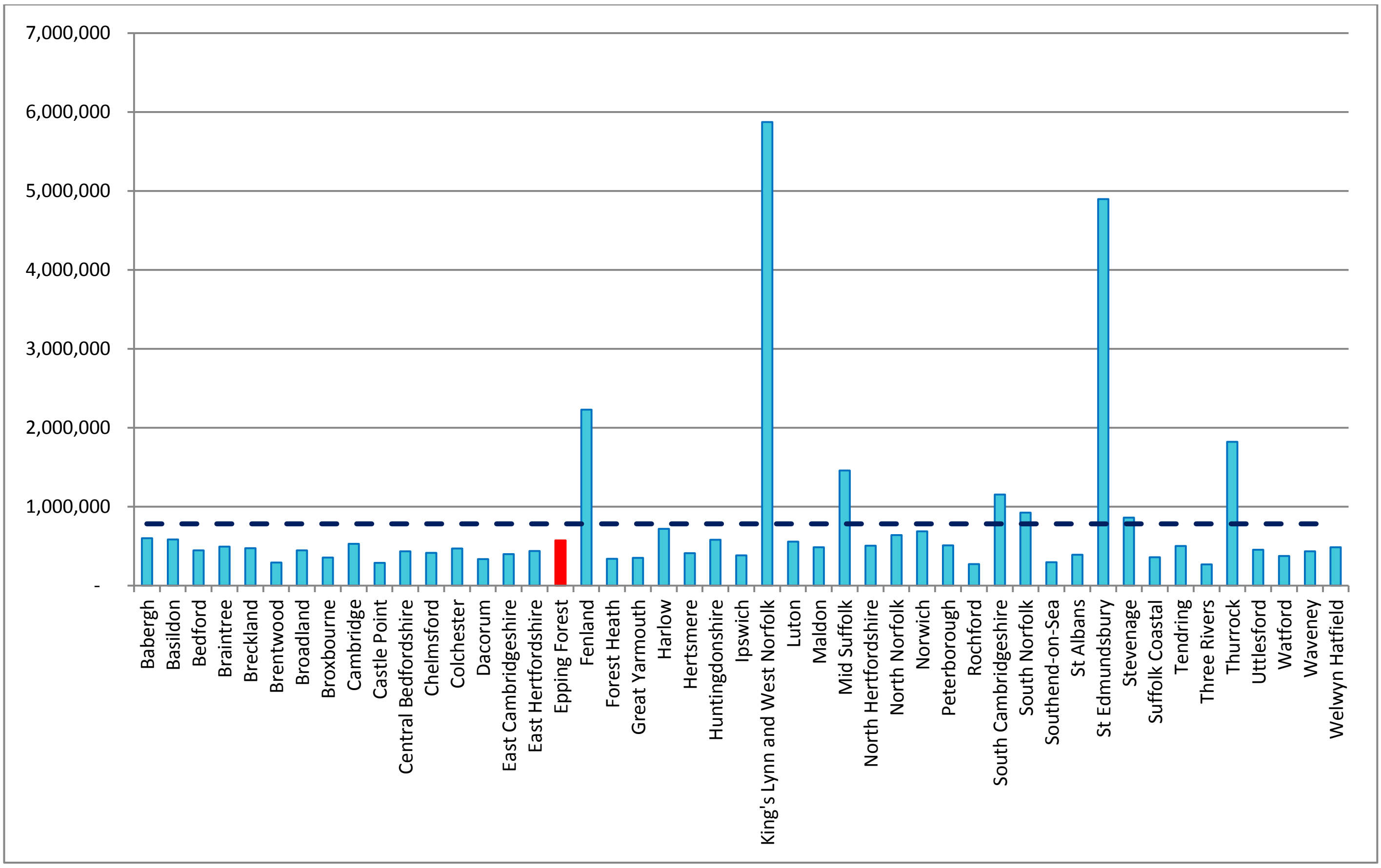
3.35. Epping Forest District has 53.9% more commercial and industrial gas consumers, than the regional average, placing it in the top seven of the 47 authorities in the region (Figure 24).

Figure 24. Number of commercial & industrial gas consumers across the East of England Region, 2010 (thousands)



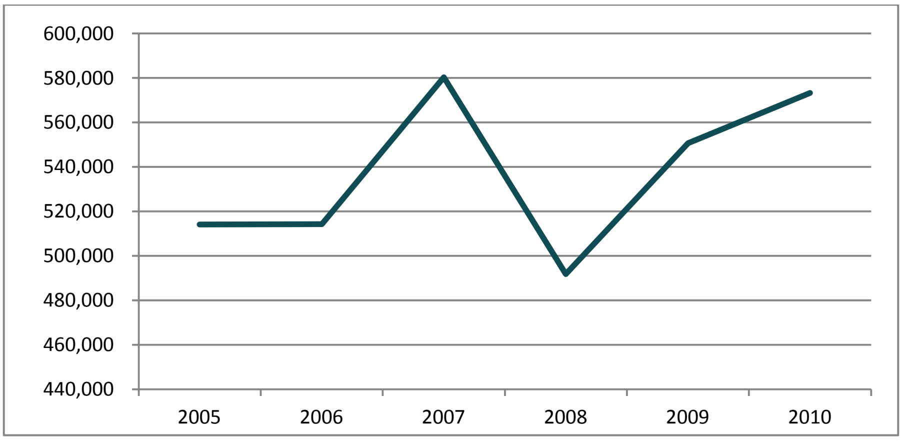
3.36. The commercial and industrial gas consumers in the District have lower consumptions of gas per unit than their regional counterparts. In 2010, the difference was rather significant, as the consumption rate for gas per unit in Epping Forest District is 26.9% lower than the regional average and less than 32 of the other authorities. This is shown in Figure 25.

Figure 25. Average commercial & industrial gas consumption across the East of England Region, 2010 (kWh)



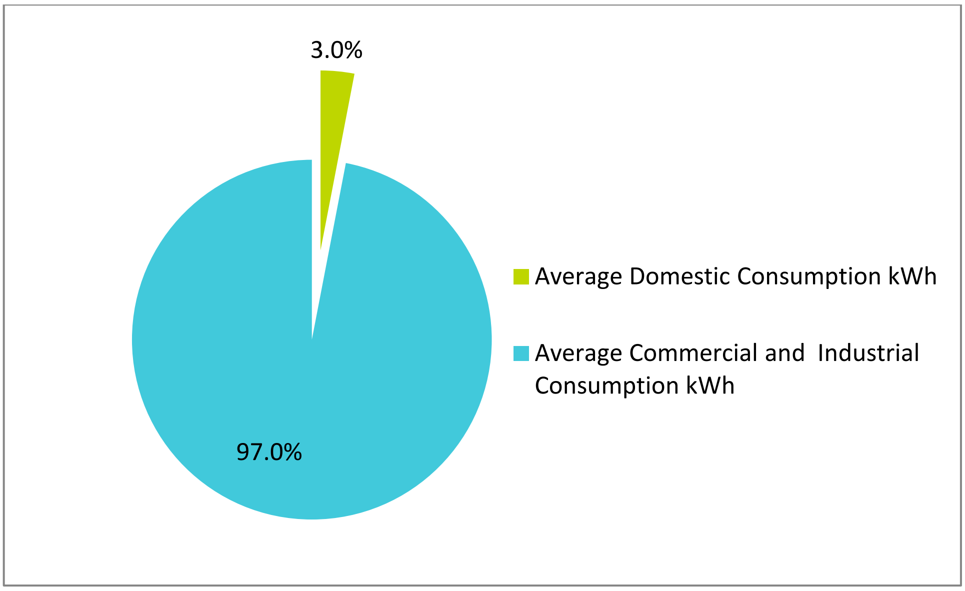
3.37. However, examining the trends of gas consumption for commercial and industrial units in Epping Forest District reveals that average gas consumption per unit has been on the rise since 2005. Between 2005 and 2010, average gas consumption per unit rose by 11.5%, to 573,200 kWh per unit. This is shown in Figure 26.

Figure 26. Average commercial & industrial gas consumption in Epping Forest District, 2005 - 2010 (kWh)



3.38. Although gas consumption amongst the commercial and industrial building stock in Epping Forest District is relatively low compared to that of the regional average, gas as a source of energy in the District is utilised largely by the commercial and industrial sectors, when compared to domestic consumption. Figure 27 below shows the split between commercial and domestic use.

Figure 27. Gas consumption in Epping Forest District, domestic vs. commercial & industrial 2010 (kWh)

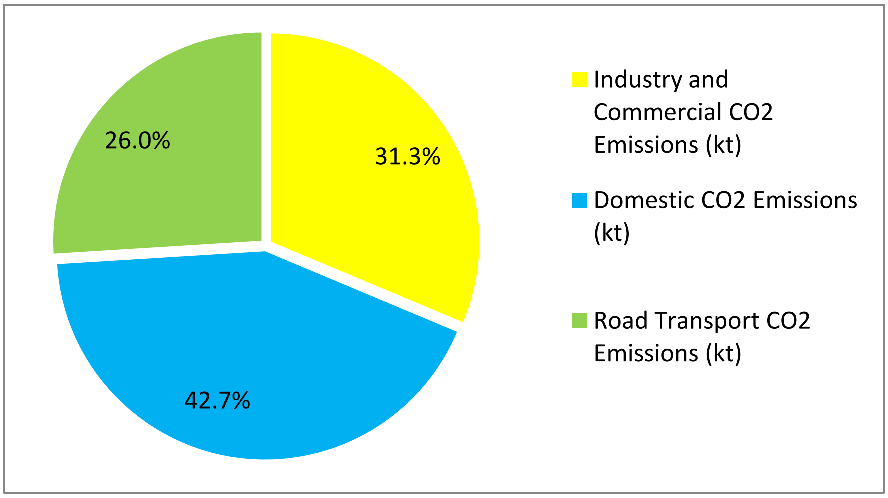


Carbon emissions in Epping Forest District

3.39. The latest DECC data on carbon emissions provides datasets at the national level, as well the local level, which allows for comparison of Epping Forest District relative to its immediate neighbours, and the wider Essex County.

3.40. In 2010 carbon emissions for the District were 754 kt. According to the latest data from DECC, the majority of carbon emissions, in Epping Forest District are emitted from its residential stock 322 kt (42.7%). This is followed by emissions from the commercial and industrial activity in the District 236 kt (31.3%) and the road transport 196 kt (26.0%).

Figure 28. Source of carbon emissions in Epping Forest District, 2010 (proportion of kt CO_2)

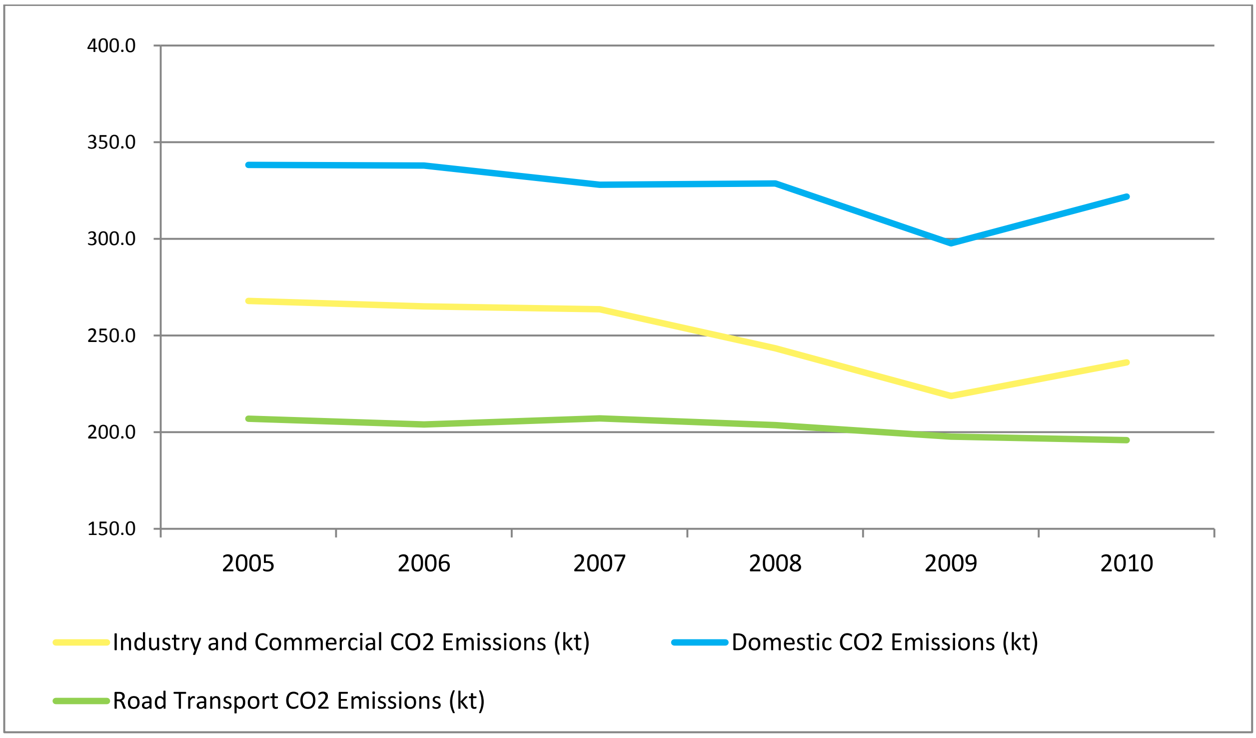


Note: Figure 28 excludes Road Transport emissions from motorway traffic.

3.41. Figure 29 shows the trend in carbon emissions from the aforementioned sources, between 2005 and 2010. The data reveals that emissions from all three main sources were gradually declining from 2005 to 2009. Emissions from industrial and commercial use declined the most during this period, with an 18.3% reduction. While domestic emissions declined by 12.0% by 2009, emissions from road transport reduced the least, by 4.5%.

3.42. Emissions from commercial and industrial use and the residential stock increased after 2009 in Epping Forest District; with increases of 8.0% and 8.1% on 2009 levels, respectively. This is likely to be related to the economic downturn, as there were sharper decreases in emissions in 2007 / 2008 (which is consistent with reduced economic activity), and the increase could represent a return to the longer term trend. However, total emissions from road transport continued to gradually decrease, by 1.0% of 2009 levels. This would imply a decrease in the frequency of private car use and perhaps a correlated increase in the population's use of public transport. Overall, total carbon emissions declined by 7.3% in the District, during the 2005-2010 period, with most of this reduction coming from commercial and industrial uses.

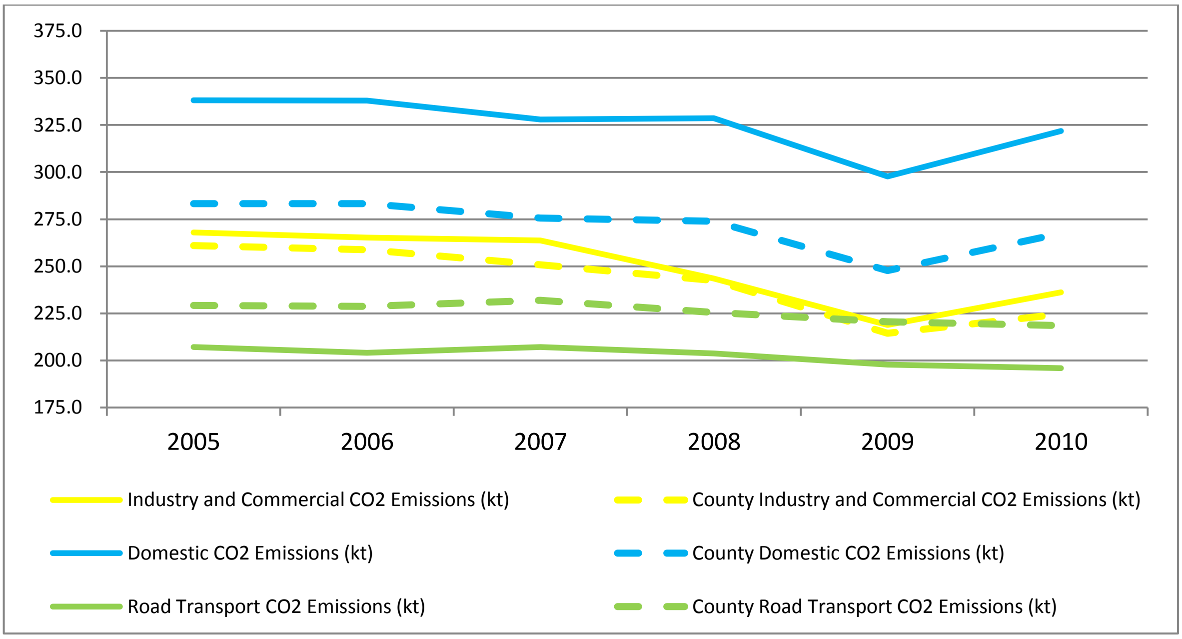
Figure 29. Carbon emissions by source, 2005-2010 (kt)



Comparison with the County

3.43. These trends are in line with County trends of carbon emissions, as is shown in Figure 30. It is worth noting that, although total emissions from the commercial, industrial and residential stock in Epping Forest District are higher than the Essex average, the DECC data reveals that the total amount of carbon emissions from road transport in Epping Forest District is less than that of the county average (this does not include emissions from motorway traffic passing through the District).

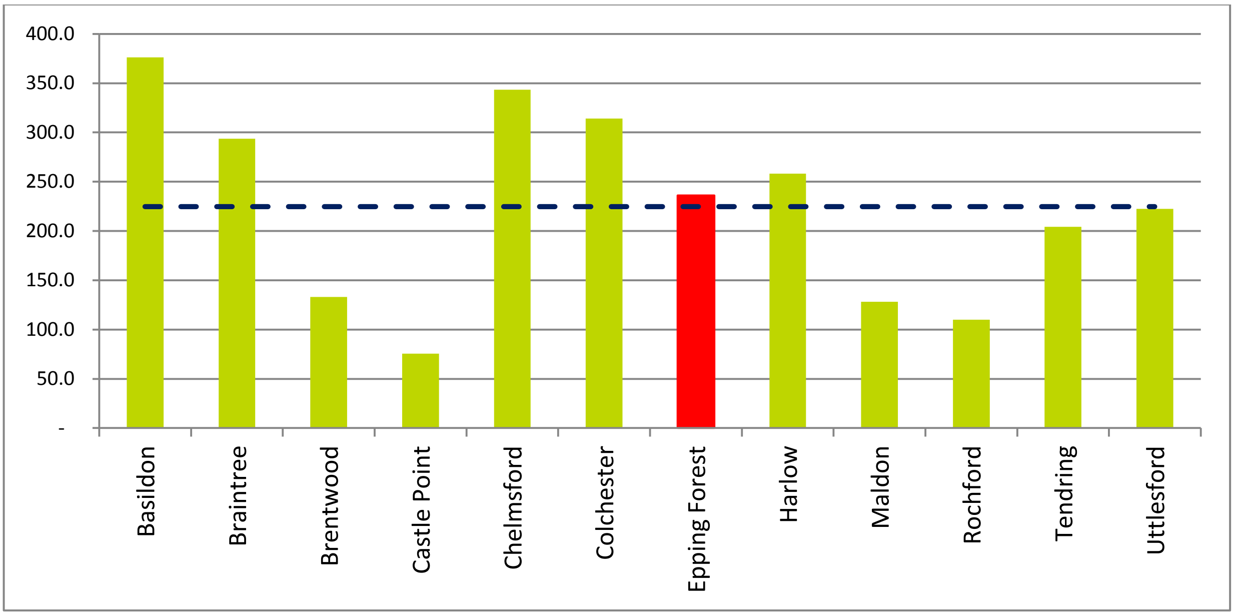
Figure 30. Carbon emissions per source in Epping Forest District vs. carbon emissions average per source at Essex level, 2005-2010, (kt)



Commercial and industrial emissions

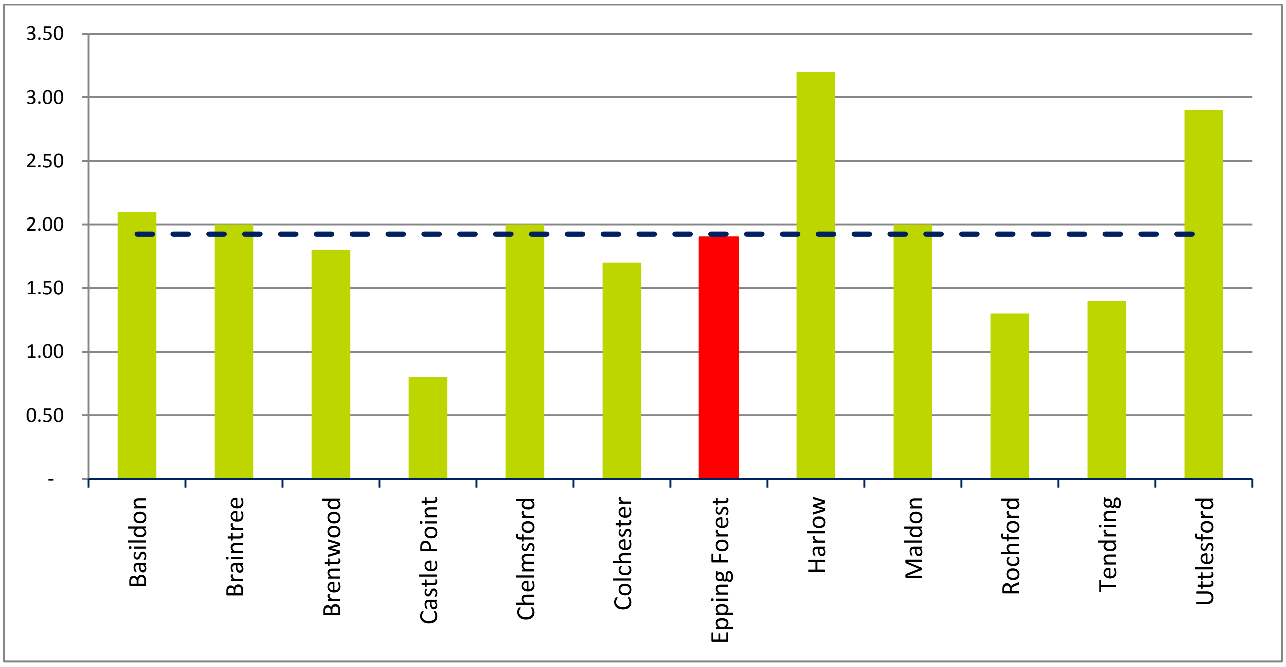
3.44. In terms of the absolute amount of carbon emissions produced by the commercial and industrial stock, the latest DECC data shows that Epping Forest District produced 11.6 kt more emissions than the county average in 2010, or 5.1% more (see Figure 31).

Figure 31. Absolute commercial & industrial carbon emissions, Essex level, 2010 (kt)



3.45. However, in terms of carbon emissions per capita (see Figure 32), emissions from commercial and industrial use in Epping Forest District are in line with the County average (a margin of 0.025 kt).

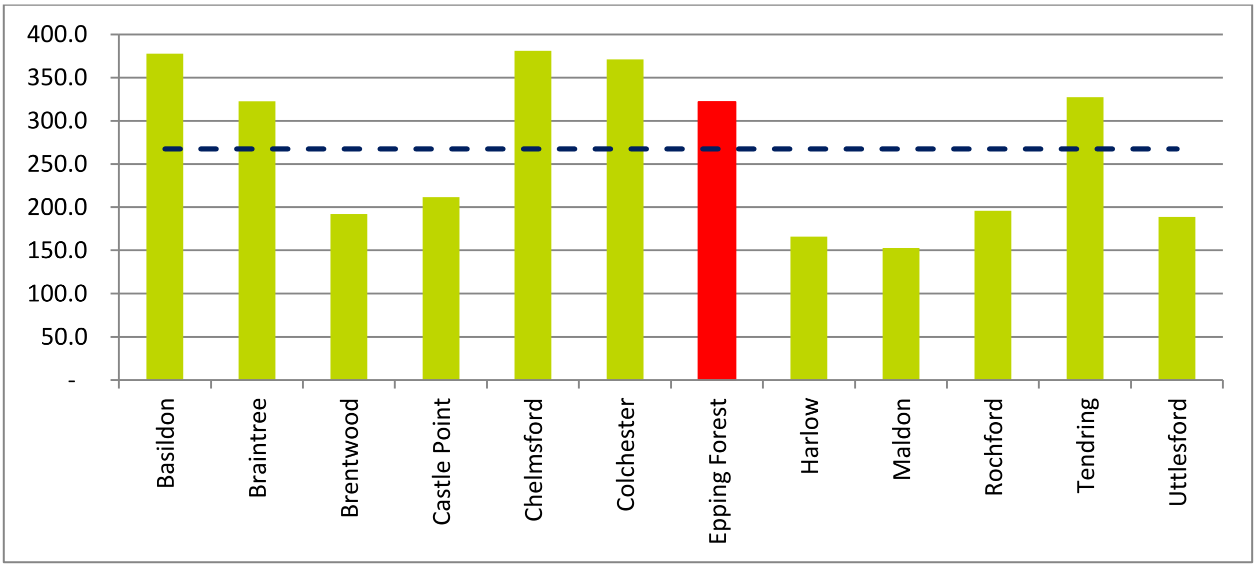
Figure 32. Commercial & industrial carbon emissions per capita, Essex level, 2010 (kt)



Domestic emissions

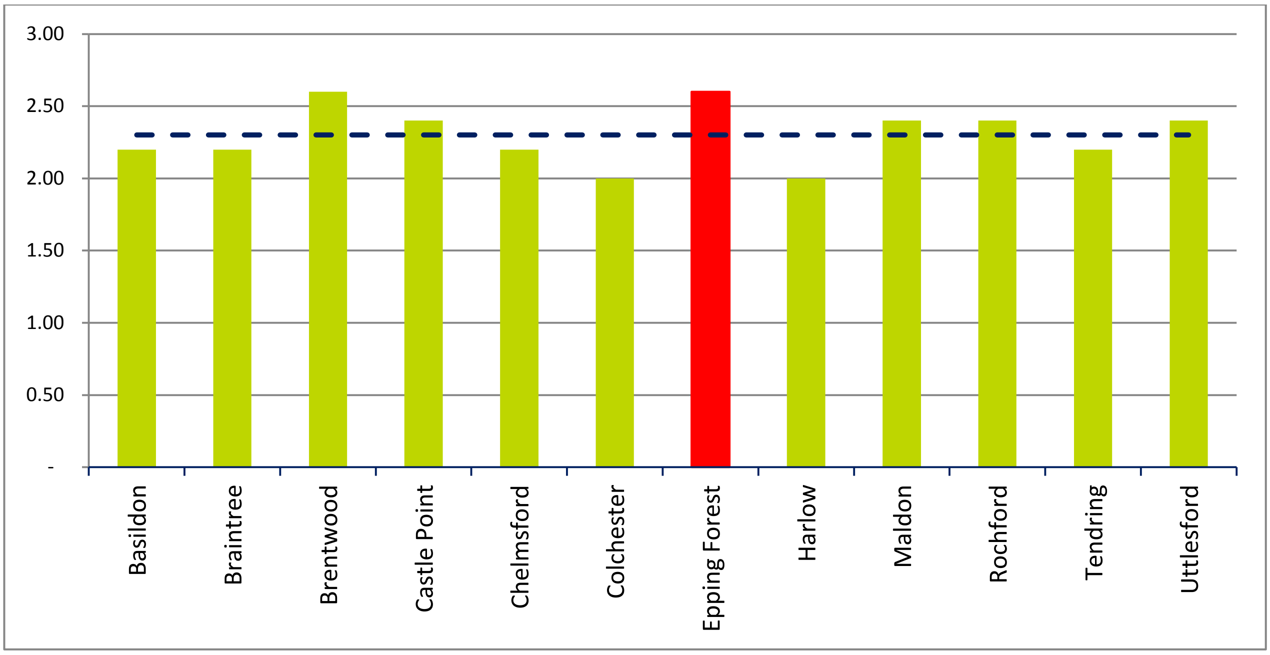
3.46. The total carbon emissions produced by the residential building stock in Epping Forest District in 2010 was 50.5 kt (or 20.4%) more emissions than the County average.

Figure 33. Absolute domestic carbon emissions, Essex county, 2010 (kt)



3.47. In examining the domestic carbon emissions per capita, the latest DECC data suggests that in 2010 the District produced the most per capita emissions in the County, along with Brentwood District, emissions from the residential stock are 13.0% higher than the County average (see Figure 34).

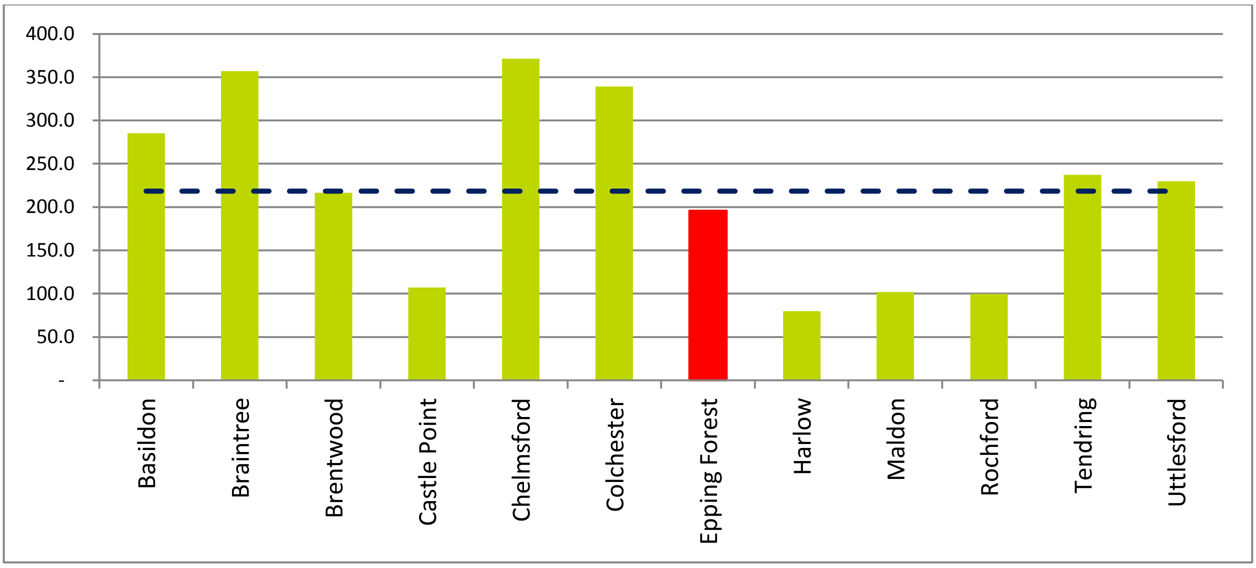
Figure 34. Domestic carbon emissions per capita, Essex level, 2010 (kt)



Road transport emissions

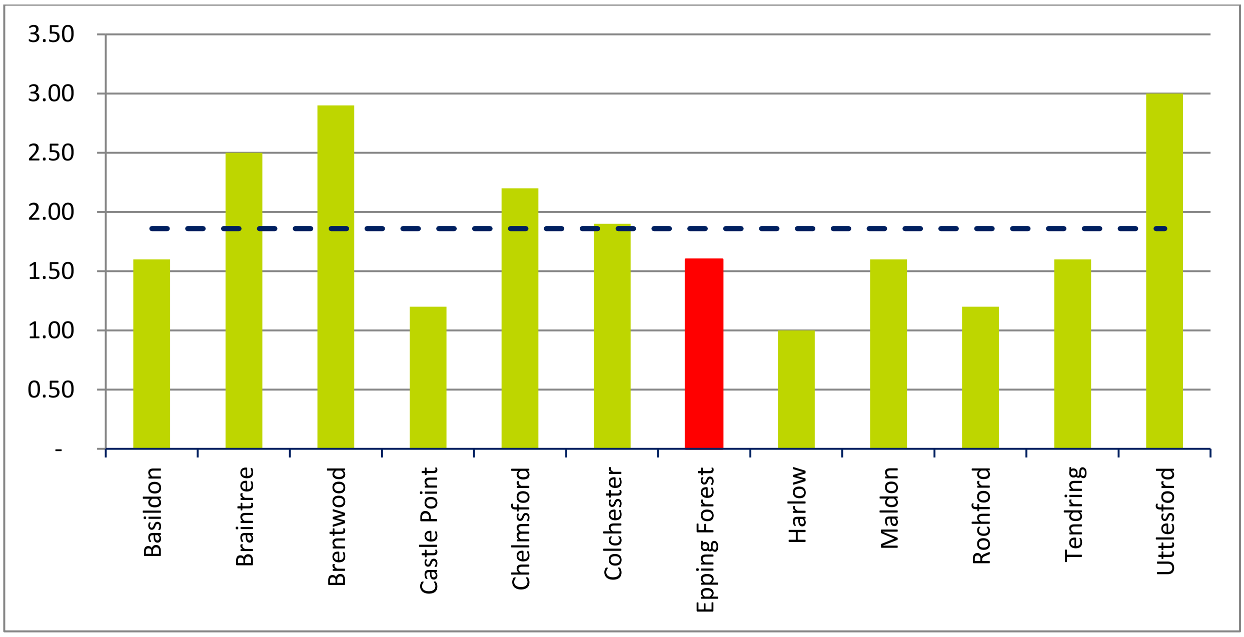
3.48. Epping Forest District's total carbon emissions from road transport have steadily declined since 2005. In 2010, the District emitted 11.5 kt of carbon, placing in the bottom five road transport emitters in the County; it is worth noting that when motorway emissions are included that Epping is above the average. However, there is little that can be done at a District level to reduce these emissions (Figure 35).

Figure 35. Absolute road transport carbon emissions, Essex level, 2010 (kt)



3.49. With regards to road transport emissions per capita, Epping Forest District also has lower than average emissions (16.1% less emissions) and is in the bottom six emitters in the County (see Figure 36).

Figure 36. Road transport carbon emissions per capita, Essex level, 2010 (kt)



Overall carbon emissions per capita

3.50. Overall, Epping Forest District's carbon emissions per capita have steadily decreased since 2005. The lowest level reached between 2005 and 2010 was 5.8 kt per capita in 2009, a 13.4% decline from 2005 levels. Emissions subsequently increased to approximately 6.0 kt per capita, bringing an overall decline of 10.4% per capita over the five-year period.

Figure 37. Overall carbon emissions per capita, Epping Forest District, 2005-2010 (kt)

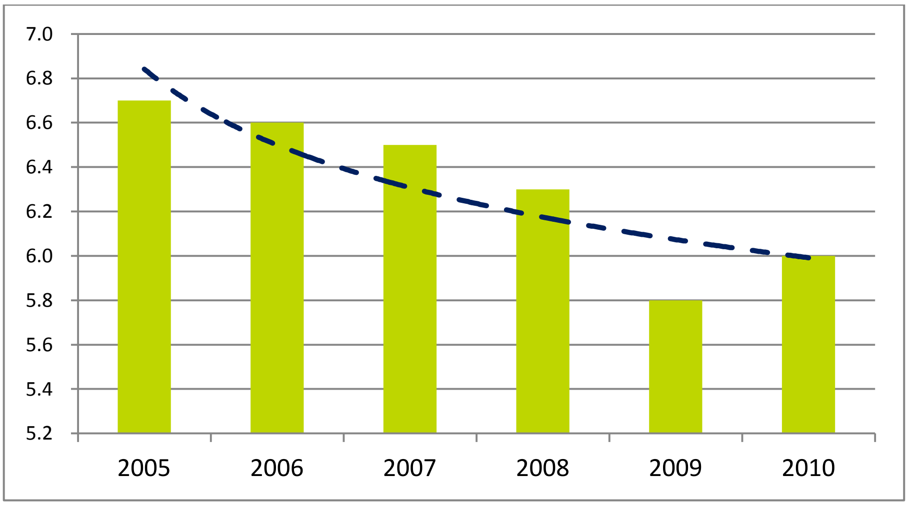


Figure 38. Epping Forest District Middle Layer Super Output Areas

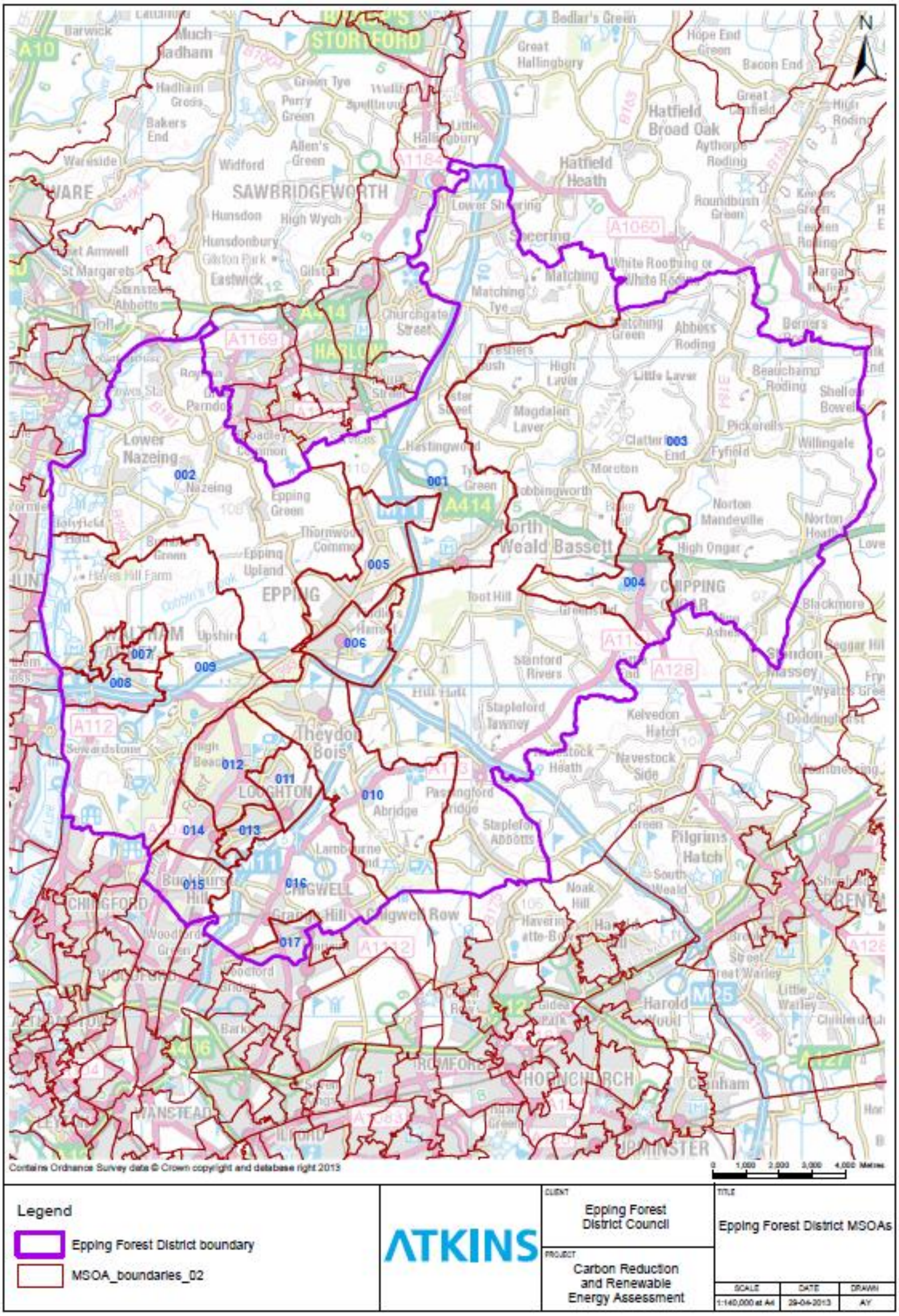
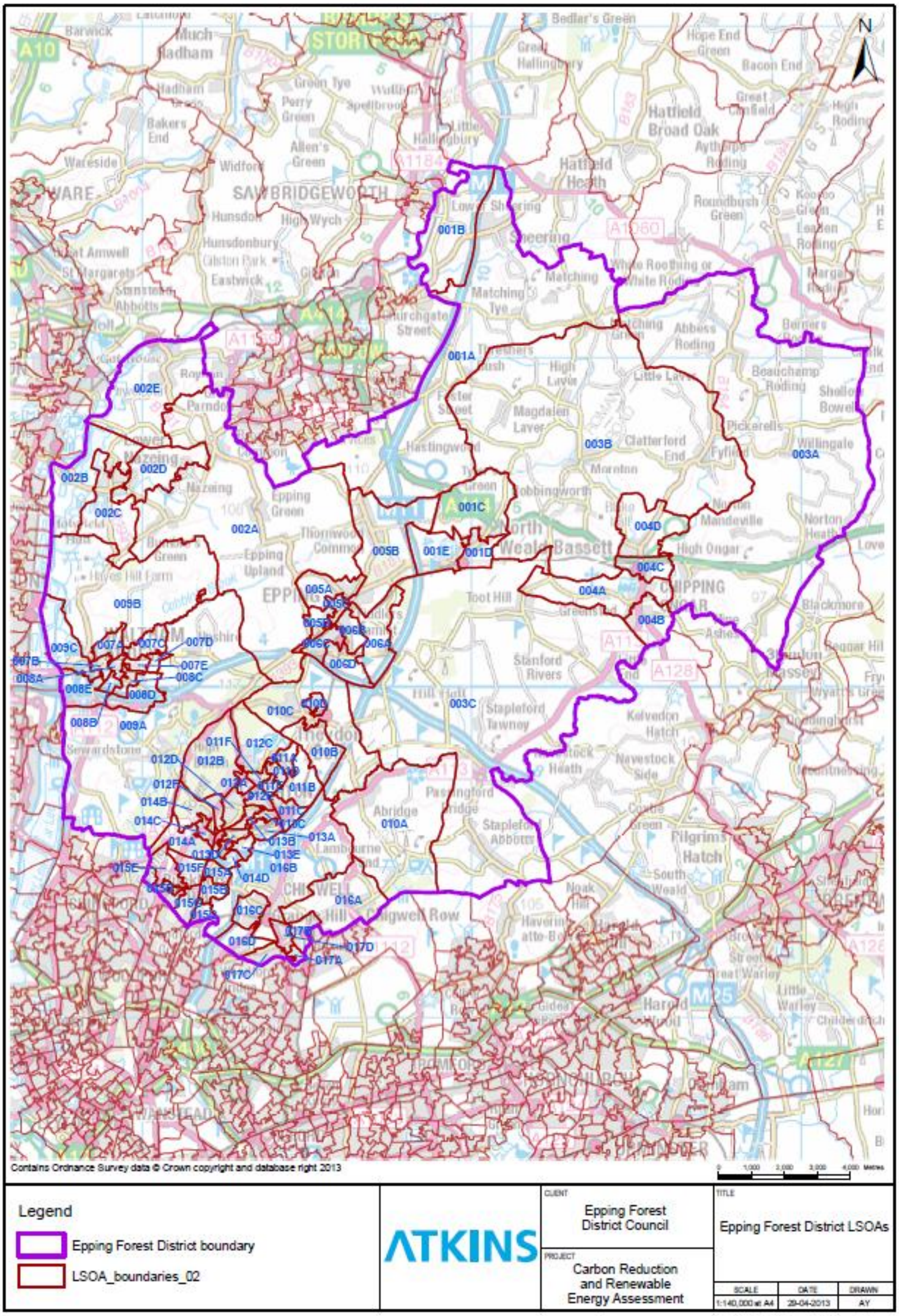


Figure 39. Epping Forest District Lower Layer Lay Super Output Areas



Chapter 4: Assessment of potential large scale technologies

Chapter purpose

- To identify the existing installed renewable energy and low carbon technology in the District
- To identify any potential issues with the existing electricity distribution network that could limit the potential introduction of renewable energy and low carbon technologies in the District
- To assess the potential opportunities for large scale development of renewable energy and low carbon technologies in the District
- To assess the potential opportunities for meeting energy needs for industrial and commercial areas (including the horticultural industry) through renewable energy and low carbon technologies
- To inform the development of carbon reduction and renewable energy targets based on the potential large scale development of renewable energy and low carbon technologies

Chapter summary

This chapter has considered the existing low carbon and renewable energy generation capacity in the District. It has shown that at present the current capacity is limited to four gas fired CHP plants which are located at glasshouse businesses. There are currently no planned large scale low carbon or renewable energy developments in the District.

This chapter has assessed the potential opportunities for large scale low carbon and renewable energy technologies in the District including wind power, solar PV, biomass, and CHP. There is no potential for large scale hydro power in the District.

Grid issues

UK Power Networks is the Distribution Network Operator (DNO) in the East of England, large scale renewable energy projects are likely to need to connect to UK Power Networks Distribution system.

There is a 132kv substation in Epping which connects to a 400kv / 275kv substation at Rye House. From the 132kv substation the power is converted to 33kv, a series of 33kv primary substations transform power to 11k, 11kv circuits then transfer the power to small sub stations in built up areas.

There are a growing number of local generators – known as embedded generators (renewable and non – renewable) who are connecting directly to the distribution network. Where new embedded generators want to connect to the network they will need to liaise with the DNO when a scheme has been worked up to a reasonable level of detail. On the whole it is likely that embedded generators can be accommodated by the network in the District, but the network may need upgrading or extending and the embedded generators would need to pay for the necessary work to accommodate their scheme.

Potential for large scale renewables

Evidence shows that there is sufficient resource for wind power in the District; although it is highly unlikely large scale wind farms would be suitable in the District (given the constraints). There may be potential for single wind turbines to power new or existing developments subject to landscape and aviation policy constraints. The potential for wind will be opportunity led and therefore carbon savings from wind power are not possible to define. There are no large scale wind turbines currently planned in District and the Council should not seek to limit the number of turbines coming forward on the basis of need, but should consider applications against policy criteria. Overall the potential carbon savings in the District from large scale wind generation are likely to be small.

There is sufficient resource for solar power in the District, although it is unlikely large scale solar PV farms would be suitable in the District given economics and potential landscape policy constraints, the opportunities for solar power are likely to be restricted to micro-generation, on new residential or commercial premises and through retrofit. Chapter 5 considers the viability and potential carbon savings from solar PV in new builds, whilst chapter 6 looks at the potential carbon savings from retrofit.

The potential for biomass boilers or biomass fuelled CHP will be heavily dependent on securing a reliable feedstock and improving the supply chain. At present there are no suppliers of feedstock for large scale biomass in the District. Farmers are currently not incentivised to supply biomass feedstock from agricultural arisings, and there is limited potential for the growth of energy crops. As such the opportunities to generate CO_2 savings from the agricultural sector are limited at present. There may be some potential to develop a supply chain for small scale biomass, by exploiting areas of under / unmanaged woodland in the District, but the District does not have a sufficiently large enough land area of unmanaged woodland to support large scale CHP. Any large scale biomass fuelled CHP in the District would need to make use of feedstock from outside the District.

The potential for CHP has been tested for the glasshouse industry, by looking at case studies. If CHP were introduced throughout the glasshouse industry there is potential for carbon savings of 146,000 CO_2 te per annum. However the assessment has shown that gas fired CHP is unlikely to be an option for glasshouses in the District until the relative price of gas and power makes it more economically attractive (this could happen within the next 5 – 10 years). There is potential for renewable fuelled CHP at glasshouse businesses but the business would need to be willing to invest and take some technical and business risk given the need to source sufficient feedstock to fuel the CHP. This feedstock would need to be imported from outside the District.

The potential for CHP in the District's industrial areas has been tested by looking at case studies of the Districts larger industrial areas. However, there are currently no "anchor" tenants with a sufficient heat demand to make investment in a retrofit CHP or district energy scheme a viable option for the District's industrial areas. There are no large scale industrial developments currently planned in the District that include a large "anchor" tenant with high heat demand that would make a CHP scheme viable. However, where large scale residential schemes are planned alongside new industrial or commercial premises there would be potential for both to be served by a district energy scheme.

The assessment of the potential for large scale renewable energy technologies shows that there is limited potential in the District at present. Therefore, the consultants do not identify a percentage target for carbon emissions savings for large scale renewables.

4. Assessment of potential large scale technologies

Introduction

4.1. 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.

4.2. 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[5]. Systems such as heat recovery ventilation, combined heat and power of fossil fuels and heat pump systems are all low carbon technologies. Appendix A provides further detail on renewable energy and low carbon technologies including: a brief description of the technology, technology considerations, indication of installation costs, indication of power generation capacity, retrofit and installation issues, key advantages and potential funding sources.

4.3. This chapter considers the potential for large scale renewable energy and low carbon technologies. It considers the existing installed capacity in the District and it scopes the main opportunities for different technologies and from different sectors (including agriculture and horticulture).

4.4. For the purposes of this study large scale renewable and low carbon technologies are defined as those that are developed at a commercial scale and could serve a large number of dwellings and or commercial properties, rather than small or micro-generation which are generally used for domestic purposes. Micro-generation technologies have an output of up to 45 kW / 50 kW. The outputs at the medium/larger scale vary as follows;

- Solar photovoltaics: over 1 MW (large scale)
- Wind: over 100 kW (medium scale), over 2 MW (large scale)
- Combined Heat and Power (CHP): 60 kW – 1.5 MW (medium scale), over 1 MW (large scale)

4.5. The East of England Renewable and Low Carbon Energy Capacity Study considered the potential for low carbon and renewable energy generation in the East of England. This study has considered the Regional study and other data sources to inform the assessment of the likely potential for large scale renewable energy and low carbon technologies in Epping Forest District.

4.6. This study has also considered case studies of glasshouses and industrial areas in the District to assess the potential opportunities for low carbon and renewable energy that these types of uses offer.

Summary of existing installed capacity

4.7. This section provides a brief summary of the existing installed capacity of low carbon and renewable energy in Epping Forest District. The current installed capacity has been derived by assessing the East of England Renewable and Low Carbon Energy Capacity Study, the East of England Renewable Energy Statistics (2009), the DECC renewables map[6] , the DECC CHP database[7] and RenewableUK, UK wind Energy Database[8].

[5] RETScreen International 'Clean Energy Project Analysis, RETScreen Engineering & Cases Textbook, 3rd Ed, 2005, Natural Resources Canada.
[6] http://restats.decc.gov.uk/app/pub/map/map
[7] http://chp.decc.gov.uk/app/

4.8. There are currently no built wind turbines, large scale solar, or large scale biomass facilities in Epping Forest District, there are none that are approved and awaiting construction and there are none that are awaiting planning consent.

4.9. There are four Combined Heat and Power (CHP) schemes in the District with a total generating capacity of approximately 10 MW these are:

- Coronation Nursery – Nazeing, EN9 2RN with 0.5 MW generating capacity
- Tower Nursery – Roydon, CM19 5JP – with 3.1 MW generating capacity
- Villa Nurseries – Roydon, CM19 5LE with 3.1 MW generating capacity
- Abbey View – Waltham Abbey, EN9 2AG with 3.1 MW generating capacity

4.10. There is some capacity from energy from waste in the District, with two sites in Ongar generating energy from landfill gas. These are operated by Infinis Ltd; the installed capacity at these plants is 1 MW and 1.77 MW.

4.11. This is a total installed capacity of 12.57 MW from renewable and energy from waste plants in the District.

Summary of grid Issues

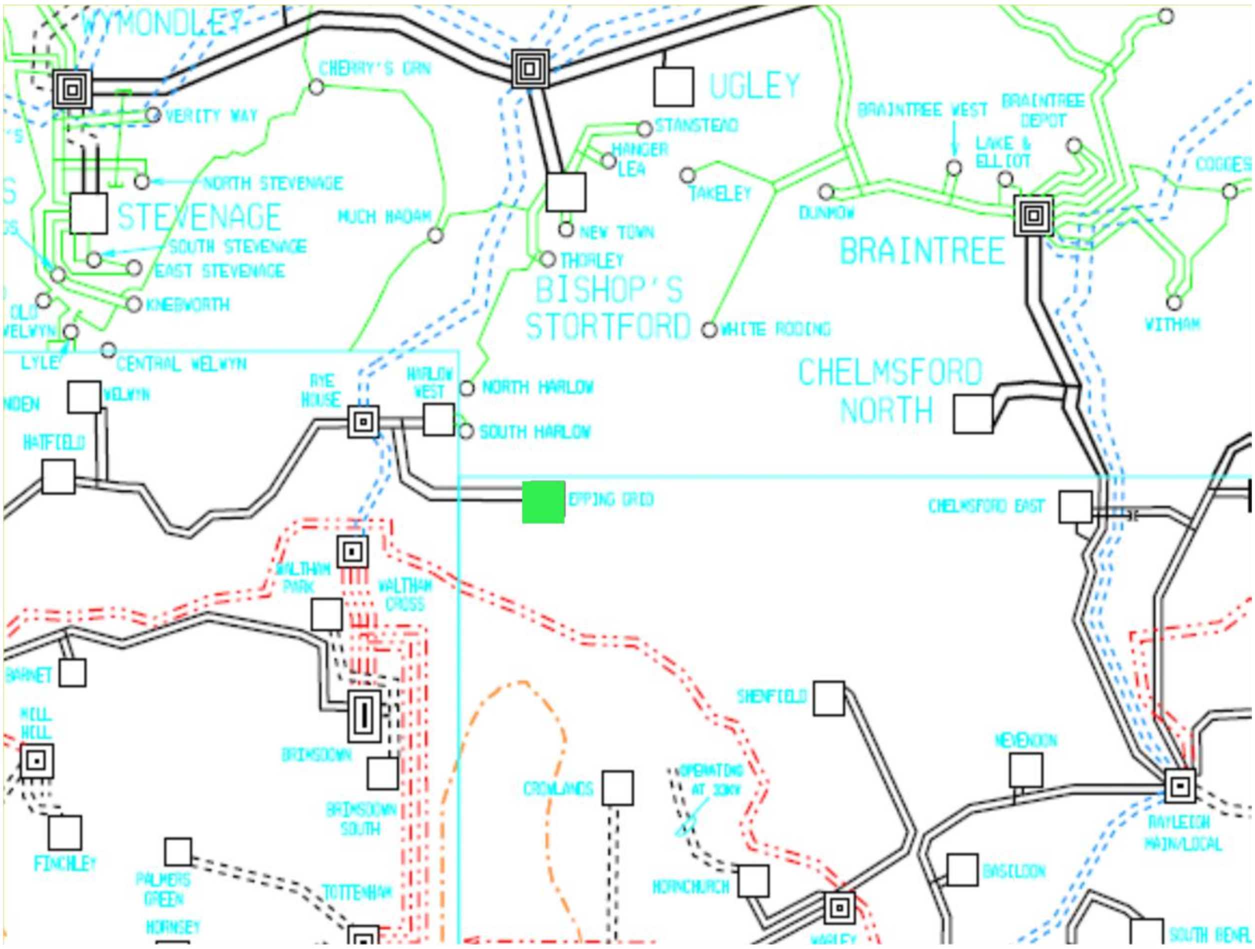
4.12. UK Power Networks is the Distribution Network Operator (DNO) in the East of England, large scale renewable energy projects are likely to need to connect to UK Power Networks Distribution system (the electricity network that delivers power throughout the region). This means that there needs to be sufficient capacity to connect to the network if the renewable energy provider wants to export power to the grid.

4.13. Figure 38 shows the electricity distribution network in Epping Forest District and the surrounding area. There is a 132 kV sub-station in Epping (shown as the green square in Figure 40) which connects to a 400 kV / 275 kV sub-station at Rye House. From the 132 kV sub-station the power is converted to 33 kV, a series of 33 kV primary sub-stations transform power to 11 kV, 11 kV circuits then transfer the power to small sub-stations in built up areas. For domestic properties the power is distributed at low voltage, but for some commercial premises where power demands are higher the supply will be directly at 11 kV, further stages of transformation then occur on-site rather than in the distribution network.

4.14. There are a growing number of local generators (renewable and non – renewable) who are connecting directly to the distribution network. These are termed dispersed, distributed or embedded generators. This is challenging to the DNOs as they not only have to deliver to consumers, but they have a new role in distributing energy from embedded generators. Where embedded generators are seeking to connect to the network, they will need to discuss the economic and technical factors on a site-by-site basis with the DNO. Given the heterogeneous nature of the network in terms of where capacity has been built (for good historical reasons) and where the capacity is being used, DNOs will prefer to engage with generators when a scheme has been worked up to a reasonable level of detail. On the whole it is likely that embedded generators can be accommodated by the network in the District, but the network may need upgrading or extending and the embedded generators would need to pay for the necessary work to accommodate their scheme.

Figure 40. Electricity Distribution network in Epping Forest District and surrounding areas

[8] http://www.renewableuk.com/en/renewable-energy/wind-energy/uk-wind-energy database/index.cfm/maplarge/1



Key renewable and low carbon opportunities

4.15. The scope for large scale renewable energy and low carbon technologies in the District will be reliant on two key components. These are the physical potential of the technology which is dependent on the availability of the resources required for each technology; and the capability to exploit the resource, which is largely related to environmental issues, policies and other constraints.

4.16. A high level, general, knowledge of all renewable energy technologies is required to understand their suitability to any particular location, the following section provides an overview of each renewable and low carbon technologies, a brief description of each is given, as well as their general applicability in urban areas. Furthermore, this chapter discusses the potential resource available to each technology in Epping Forest District. For each technology further detail is also provided in Appendix A. There is a range of technologies which are commercially available that can be exploited at a large scale which have been considered for whether they are appropriate for use within the Epping context, these include:

- Wind turbines;
- Solar PV;
- Combined heat and power (CHP) including Biomass CHP; and
- Hydro power.

4.17. It should be noted that hydro power is not considered practical in Epping Forest District. The District as a whole is low lying which means the rivers within the District including the River Lea and River Roding, the District's largest rivers, have very little head height, meaning that there is no potential for large scale hydro power in the District. As such Hydro power is not considered any further in this chapter or the study as a whole. Solar thermal systems and heat pumps (air source heat pumps and ground source heat pumps) are not usually developed at a large scale and therefore are not included in the assessment in this chapter. There are opportunities for these technologies to be used in retrofit schemes or new development at a micro-generation scale (chapters 5 and 6 and Appendix A provide more information on this).

4.18. Please note that this is not an exhaustive list of possible technologies but rather a list of the most readily available solutions.

Wind Power - overview/description

4.19. 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[9]. Large scale wind farms of 2 MW 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 (town, industrial park, etc.). There are also medium sized turbines of around 100 kW that can provide power for a number of homes and or businesses.

4.20. 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). Appendix A provides further detail on wind power.

Applicability in Epping Forest District

4.21. 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 used.

4.22. Electricity generated from a wind turbine can be integrated in similar ways to solar PV technology. For very large systems, 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. There can also be issues with locating wind turbines too close to airports, as the turbines can make it difficult for air traffic control to tell turbines apart from aircraft. However new radar technology is now available that can reduce or eliminate this issue and the National Air Traffic Services (NATS) can provide pre-planning advice on whether there will be any aviation objections to wind farm development. When considering the location of new wind turbines the applicant should consider the implications on aviation and should as necessary consult with the aviation authorities. The aviation authorities are in the process of developing a web based tool to assist the wind development industry in considering these issues[10]. Those seeking to develop wind turbines should also take account of the Stansted Safeguarding area.

4.23. 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 (base load demand is the amount of power required to meet minimum demands based on reasonable expectations of customer requirements). 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.

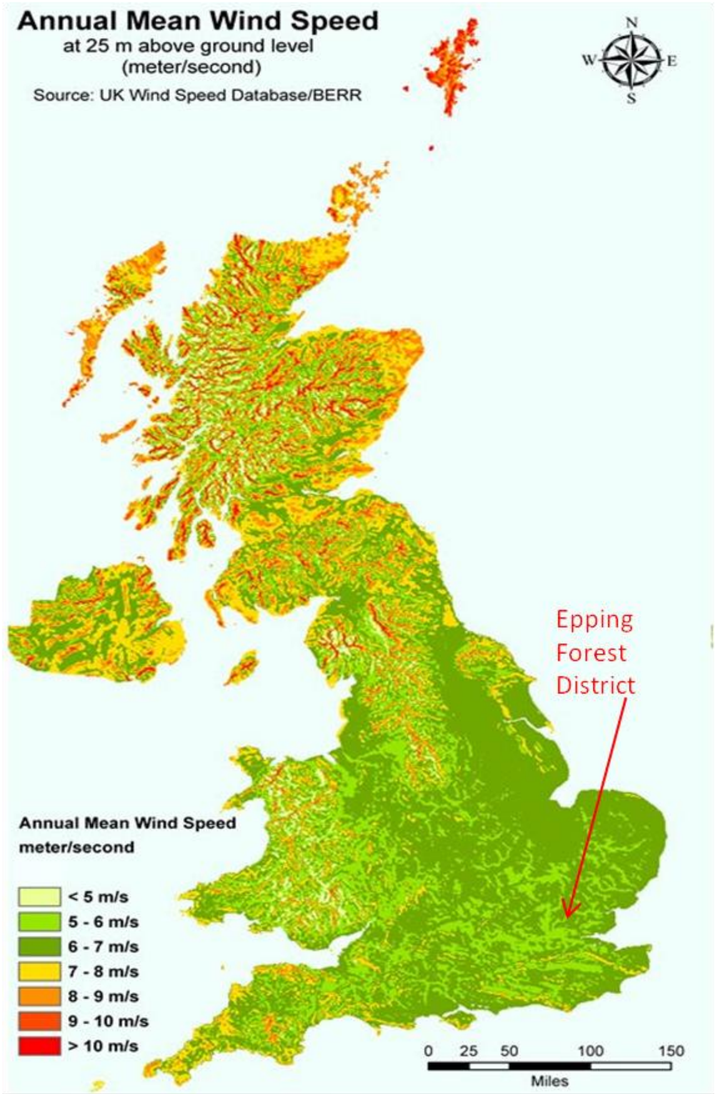
4.24. Taking these considerations into account wind power is applicable to Epping Forest District. The section below provides further detail on the level of potential for wind power in the District.

[9] Twidell, J, Weir, 'Renewable Energy Resources', 2nd Ed, 2006, Taylor Francis, London
[10] https://restats.decc.gov.uk/cms/aviation-safeguarding-maps/

Epping Forest District wind resource

4.25. Maps are available that give estimates of the mean wind speeds over the UK. The DECC wind speed database contains estimates of the annual mean wind speed throughout the UK[11]. This may give an indication of average wind speed in different parts of the country. However, the data is historic and no longer updated. On-site measurements would be required to gain an accurate idea of wind speed at a proposed site for a wind system, as site wind speed is very much dependent on local site conditions (location of buildings, trees, hills, valleys, etc.). Figure 41 gives an indication of the wind speed available in the District. This map was accessed from the British Wind Energy Association.

Figure 41. UK annual mean wind speed map[12]



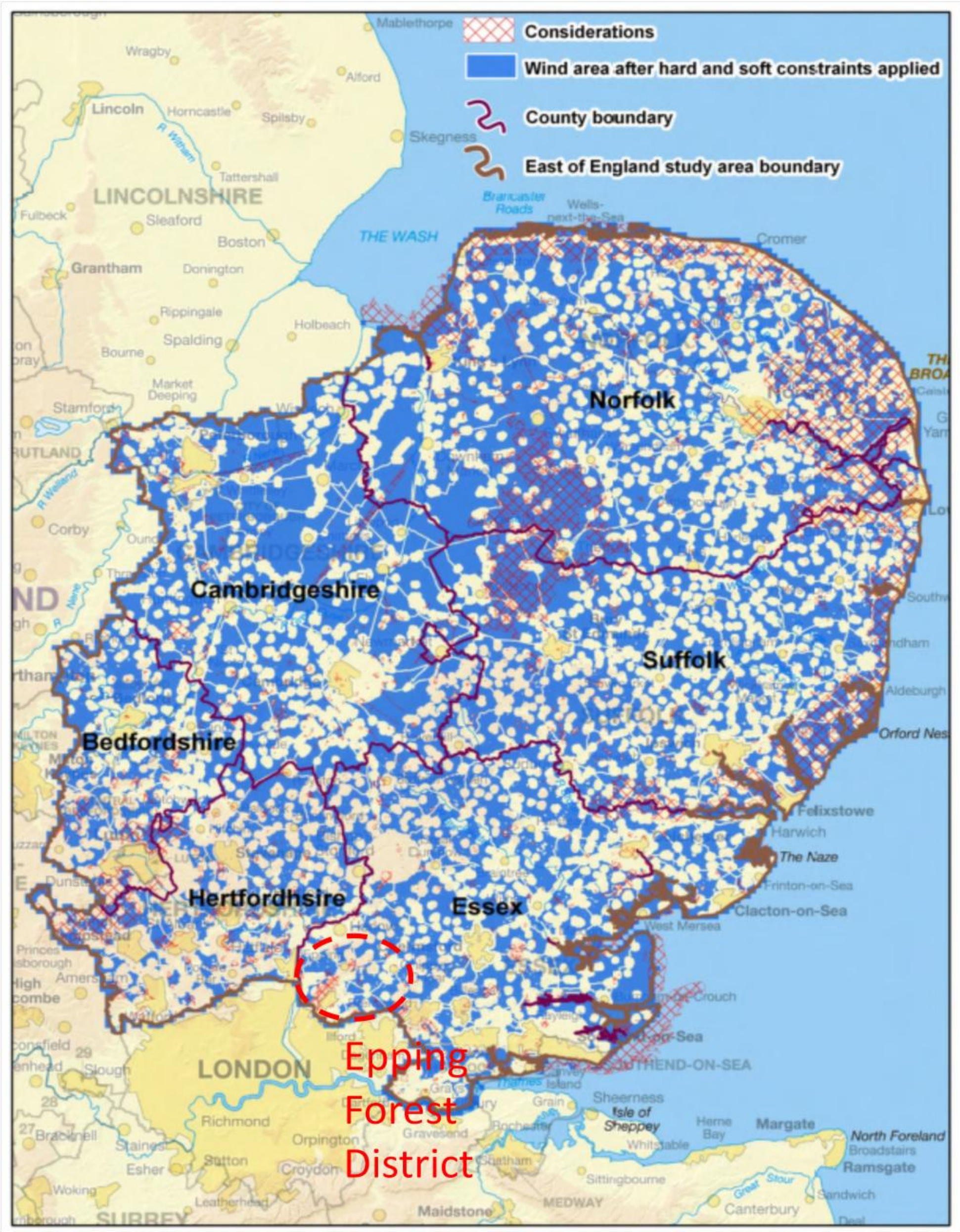
Source: DECC

4.26. From the Figure 41 it can be seen that the estimated annual mean wind speed in Epping Forest District at a level of 25 m above ground level, is approximately 5-6 metres per second. The East of England renewables capacity study carried out a constraints mapping exercise in order to identify areas where large scale wind energy generation may be feasible (based on wind turbine

[11] Department for Energy and Climate Change (DECC), "Wind speed Database", www.decc.gov.uk, Website cited October 2012
[12] Department for Energy and Climate Change (DECC), https://restats.decc.gov.uk/cms/annual-mean-wind-speed-mapWebsite cited October 2012

rotor diameter of 100 m and 135 m tip height). The exercise applied hard constraints such as roads, railways, waterways, airports and woodlands (with buffers) where turbines cannot be installed and soft constraints that take account of sensitive locations such as ancient woodlands, Areas of Outstanding Natural Beauty (AONB) etc. These are areas where turbines could be installed but these constraints would prevent installation. Green belt designation has not been applied as a constraint as planning decisions in these areas would need to be considered case by case to demonstrate exceptional circumstances. The map below (Figure 42) is an extract of the regional map. Areas that are shown as blue show the wind resource after taking account of hard and soft constraints

Figure 42. Areas suitable for wind turbines



Source: East of England renewable and low-carbon energy capacity study

4.27. Considering the constraints on the wind resource that have been identified in the Figure 40 above, the consultants have assessed in more detail four areas in parts of the District that once constraints have been applied offer the potential for wind turbines. This is an indicative exercise to assess the wind speeds in different parts of the District that have been shown the East of England Study to offer some potential for wind power, this helps to test the potential feasibility of developing wind power. Utilising the DECC wind speed database[13], estimates of wind speed for particular areas within Epping Forest District were determined. The figures are shown in Table 1 below.

Table 1 DECC wind speeds for Epping Forest District (test areas)

Location	Grid Ref	Location within District	Wind Speed m/s @ 10m	Wind Speed m/s @ 25m
Matching Green	TL 526 104	North	4.9	5.7
Willingale	TL 588 081	North East	4.9	5.7
Long Green	TL 413 047	West	5.2	5.9
Copthall Green	TL 422 020	West	4.5	5.4

Note: locations are approximate nearest village (shown on OS mapping)

4.28. From the Table 1 it could be deduced that in those test areas that were identified after applying constraints, there is a reasonable wind resource that could allow wind turbines to be developed. However, local microclimate issues are likely to affect local wind conditions significantly which will affect the efficiency of equipment, any energy developer wishing to develop a wind scheme in the District would test the wind speeds when assessing the feasibility of developing a wind energy scheme, whilst the Council should seek to guide wind developments to areas where no landscape or aviation constraints exist.

4.29. The availability of land in the District for freestanding wind turbines which is compatible with policy objectives relating to Green Belt is likely to be limited. To date the District does not include any installed wind capacity, and there are no schemes awaiting planning consent. Large scale opportunities are likely to be limited. Therefore it is unlikely that wind power will make a significant contribution towards meeting overall renewables targets in the District. However, this does not preclude wind from consideration as a potential resource where appropriate conditions exist, and there is potential for some single turbine developments.

4.30. Given the limited potential for large wind farms, the Council does not need to allocate land for wind farms. However, the Council will want to ensure that any schemes that do come forward take account of landscape and other constraints. A criteria based policy will help to deal with these issues.

Solar photovoltaic - overview/description

4.31. Solar photovoltaic (PV) systems convert solar radiation into direct current electricity in a semiconductor device or cell. The potential energy produced through the utilisation of solar PV modules is dependent on the amount of sunshine hours. Solar 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.

4.32. Solar PV at the small scale (less than 50 kW output) is now quite common in the UK for both domestic and commercial application, both through retrofit onto existing buildings and installations on new buildings. There are several agricultural barns / buildings in the District that have solar PV installed, providing power, but these are not considered large scale installations. Solar PV at the large scale (more than 2 MW output), is developed as commercial solar farms, where a large number of solar arrays are built in fields or open space, rather than attached to buildings. These are less common in the UK, but some have been developed in recent years.

4.33. 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

[13] Department for Energy and Climate Change (DECC), "Wind speed Database", www.decc.gov.uk, Website cited October 2012

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.

4.34. Appendix A provides further detail on solar PV.

Applicability in Epping Forest District

4.35. Large scale arrays or solar farms are not common in the UK. Many of the existing and planned commercial solar farms are in the south west of England. The relatively low output and the high cost of installation mean that operating large scale arrays in the UK has not made commercial sense.

4.36. The UK solar PV market is still relatively small, with long payback periods, due to both the high capital cost of the equipment, and the relatively low annual hours of direct sunlight. The uptake of solar PV in the UK and in particular large scale solar PV is heavily dependent on incentives. Site specific constraints provide further barriers to implementation of solar PV, although as long as there are sufficiently large areas that allow the correct orientation of panels which are not overshadowed, these can be overcome. 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 electricity demands of a building and effectively “slow down the meter” they are very beneficial.

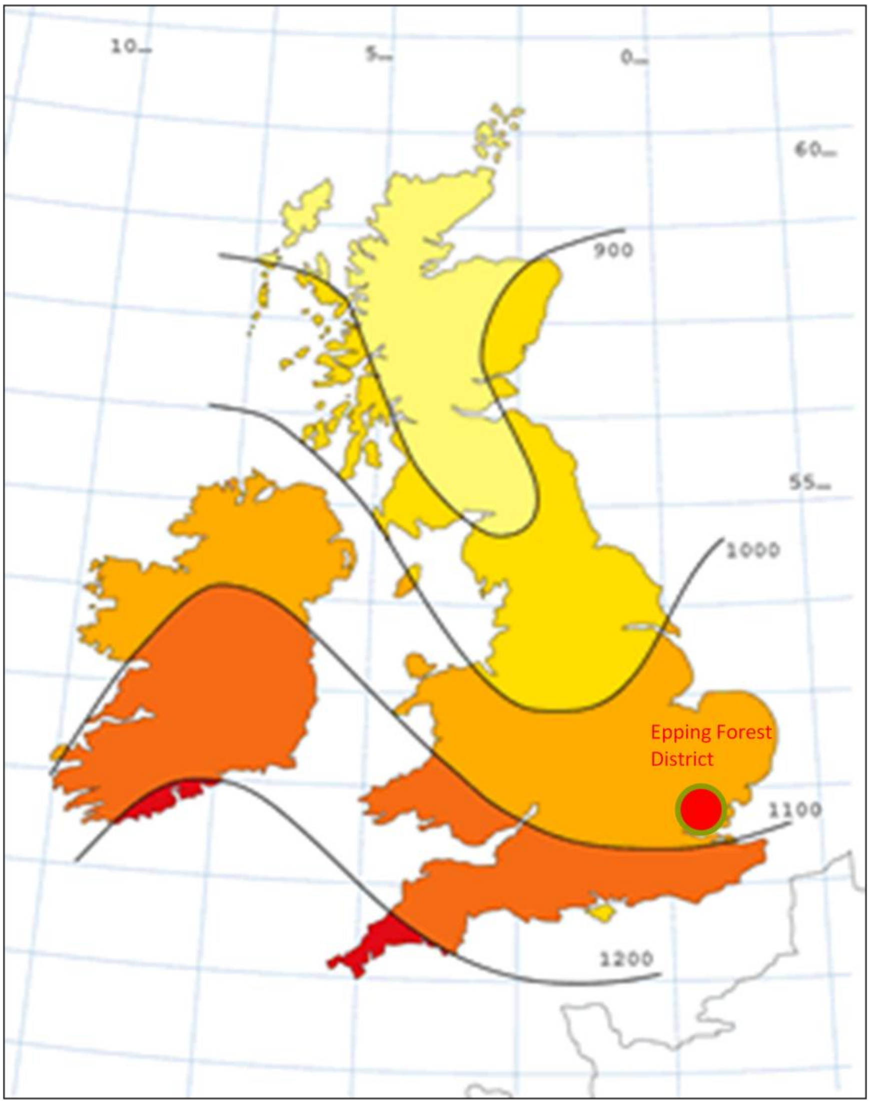
4.37. Taking these considerations into account solar PV is applicable to Epping Forest District. The section below provides further detail on the level of potential for solar power in the District.

Epping Forest District solar resource

4.38. There is a widely held opinion that the British Isles do not have “enough sun” to make solar PV systems worthwhile. In fact parts of Britain have annual solar radiation levels equal to 60% of those experienced at the equator. Figure 43 is a map of the UK average annual solar irradiation[14]. Figure 43 shows that the average annual solar irradiation for Epping Forest District is 1,100 kWh/sq.m, which is sufficient for solar PV to be technically viable.

Figure 43. UK solar irradiation, annual kWh/sq.m

14 Solar Trade, http://www.solar-trade.org.uk/solarHeating.cfm, Website cited October 2012



Source: www.solar-trade.org.uk

4.39. The East of England Renewable and Low Carbon Energy Capacity Study identifies that there is a large solar PV resource in the region, as there are large areas technically suitable for solar PV farms. However, the economics of schemes will be heavily dependent on incentive schemes such as the feed in tariff. The availability of land for solar PV farms, compatible with Green Belt policy objectives is likely to be limited. To date the District does not include any installed solar PV capacity, and there are no schemes awaiting planning consent. Large scale opportunities in the District are likely to be limited by these factors. Therefore it is unlikely that large scale solar PV will make a significant contribution towards meeting overall renewable and carbon reduction targets in the District. However, small scale solar PV on new or existing developments have the potential to contribute to the District carbon reduction, (chapters 5 and 6 consider this in more detail with regards new development and retrofit).

4.40. Given the limited potential for large scale solar PV farms, the Council does not need to allocate land for solar PV farms. However, the Council will want to ensure that any schemes that do come forward take account of landscape and other constraints. A criteria based policy will help to deal with these issues.

Biomass - overview/description

4.41. 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.

4.42. Biomass can either be used to generate heat in a heat only plant or in a combined heat and power (CHP) plant.

4.43. 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.

4.44. 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.

4.45. 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.

4.46. 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 of over 20 miles, and therefore wood chips are most cost effective if locally sourced.

4.47. 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 20mm 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.

4.48. 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 Epping Forest District

4.49. Biomass boilers can be integrated into developments in similar ways to conventional fossil fuel fired systems. Boilers can be installed into individual households which can be controlled by the occupier. Central building systems can be installed into flats, apartments and commercial or office 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. From discussions with EFDC Housing Department, it is clear that the Council has considered the potential for biomass boilers in its own housing stock. However, EFDC have not pursued this low carbon option due to issues with delivery, storage and loading of fuel.

4.50. Biomass systems are increasingly being used in whole district heating systems spread over a large area and interconnected with underground district heating pipes. Again, the boiler system is operated and maintained by a management company which sell, the heat to the individual users.

4.51. 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 (over 100 kW). Wood fuel storage can take many forms, but it must be located close to the boiler.

4.52. Taking these considerations into account biomass is applicable to Epping Forest District. Although issues of air quality would need to be considered and resolved. The section below provides further detail on the level of potential for biomass in the District.

Epping Forest District biomass resource

4.53. 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. When considering the larger scale energy demands in the District fuel availability and security are major concerns. Because biomass fuels can be imported or exported to an area, the resource in the District is not necessarily a constraint on the potential capacity for this type of technology. However, securing local supplies of energy crops, timber or agricultural arisings would reduce delivery times and create local employment, and would also ensure the cost of the fuel remained competitive against the fluctuating price of imported oil and gas.

4.54. The East of England Renewable and Low Carbon Energy Capacity Study acknowledges that currently, most of the agricultural arisings (such as straw) in the region are used by local farmers as fertilisers or bedding for animals, and therefore there is not a lot of un-used straw in the region, and it concludes that the resource potential in the region has almost been achieved when the existing straw power station at Ely is taken into account. As such the potential for biomass in Epping Forest to take advantage of this fuel source is likely to be very limited.

4.55. The East of England Renewable and Low Carbon Energy Capacity Study identifies that there is currently a very low level of land used for energy crops in the region at present, due to a perceived lack of interest in these crops. Energy crops tend to be water intensive and given existing issues of water stress in the region the Environment Agency is unlikely to be able to issue water licences. As such the potential for energy crops in Epping Forest District is considered to be limited. The Energy Crop Scheme (through the Rural Development Programme for England), offers grants to farmers for the establishing miscanthus and short rotation coppicing for their own energy use or to supply power stations, Natural England provide further guidance on applying for these grants[15].

4.56. Wood from managed woodland is another fuel source that could be used in biomass heating or biomass CHP. There are currently no suppliers of this fuel source in the District according to the National Biofuel Supply Database[16]. However, there are a number of under managed woodlands in the region (some 60,000 ha in total[17]) and these offer a significant potential fuel resource. The largest area of forest in the District is Epping Forest which is managed by the Corporation of London. Epping Forest does not feature on the national wood fuel directory and currently the Corporation of London only use woodchip to supply a boiler at the High Beech Visitor Centre in Epping Forest. The Corporation of London have confirmed that the potential supply of wood fuel for biomass is unlikely to be large over the plan period, although in theory the supply could be substantial. Epping Forest Countrycare is Epping Forest District Council's Countryside Management Service, it currently manages 36 hectares of woodland and will be felling a small amount of this in the next 5 years, and this is not sufficient land area to support a biomass CHP (see Appendix E).There are pockets of unmanaged woodland in the other parts of the District, but these are fragmented and not likely to be of the scale that can produce a commercial scale feedstock. There could be some potential at the individual building level for biomass boilers in rural areas at a micro-generation level assuming that individuals could source a feedstock. Given this evidence, Epping Forest District does not have the managed forest land area required to generate a sufficient amount of forest residues to support a large CHP plant (see Appendix E for typical land area required to support biomass schemes).

[15] http://www.naturalengland.org.uk/ourwork/farming/funding/ecs/default.aspx website cited October 2012
[16] http://www.woodfueldirectory.org/
[17] Woodland for Life "Reappraising the East of England's woodland"

4.57. In order to exploit the potential wood fuel resource there will be a need to identify and engage with woodland owners, and there would be a need to change negative perceptions about woodland management, so that owners can see the benefits in managing the woodland. To encourage woodland owners to manage their woodlands for wood fuel they need to be sure there is a market for the wood fuel, but often there will not be a market for the wood fuel unless a reliable source of feedstock for the end user is in place. Biomass systems often face a complex supply chain[18], so simplifying this can help to build confidence in the systems (both for supplier and end user) and encourage uptake. The Forestry Commission offers a Woodfuel Woodland Improvement Grant (WIG) for currently under managed or inaccessible woodlands, to support the sustainable production of woodfuel and other timber products[19].

4.58. The potential for large scale biomass CHP that is fuelled by a local feedstock is not feasible in the District. Biomass CHP could be fuelled from a feedstock outside the District (assuming the operator can source sufficient feedstock on a consistent basis). However, given the increased traffic and carbon emissions generated by transporting the resource into/around the District, this is not an option that should necessarily be encouraged. 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 low carbon 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.

Combined heat and power (CHP) - overview/description

4.59. Combined Heat and Power (CHP) systems can be either gas fired or biomass systems. This section provides information on both systems and further detail on the technology is set out in Appendix A. The above section on biomass sets out an assessment on the potential biomass resource in the District, but this section assesses the locations where there might be potential for CHP.

4.60. CHP will generally be opportunity driven, either through the development of a new residential area and or a commercial / industrial estate or other large scale user of heat and energy (such as a hospital).

Gas fired CHP

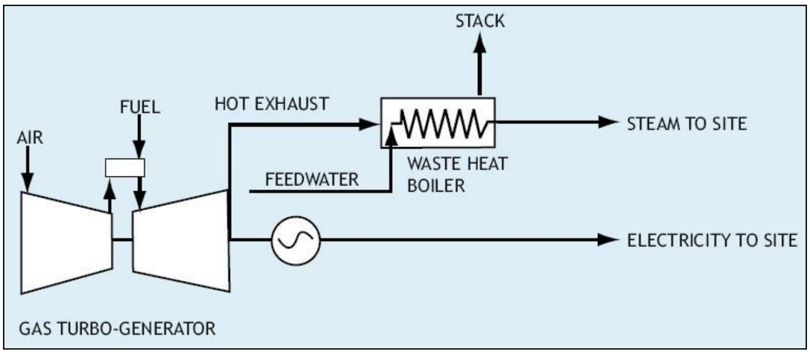
4.61. Combined heat and power (CHP), sometimes referred to as cogeneration, involves the simultaneous generation of electrical energy and heat energy in the form of low-pressure steam or hot water. By utilising the heat produced in an electricity generation system, CHP units can have typical efficiencies 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.

4.62. Small-scale gas CHP systems (less than 50 kW output) incorporate either a gas turbine or reciprocating engine. From the simple block diagram of a gas fired CHP system shown in Figure 44 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 district heating scheme. Reciprocating engines are commonly used for units with up to about 2 MW power output. It becomes more economical and efficient to use a gas turbine above 2 MW.

18 Forestry Commission England, “A woodfuel strategy for England”, 2007

19 http://www.forestry.gov.uk/forestry/infd-8nqegx

Figure 44. Simple block diagram of a gas fired CHP system



4.63. 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 (and therefore can be considered low carbon). The overall efficiency of small-scale CHP systems can exceed 80% compared with 35% for a typical coal fired power station in the UK.

Biomass CHP

4.64. Small scale biomass-fired CHP technology (less than 50 kW output) 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.

4.65. 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.

4.66. A downdraught gasifier with reciprocating engine tends to be the most common small scale biomass CHP technology. In the UK, this technology has only recently been in commercial operation, but it is well proven elsewhere in Europe. 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.

4.67. 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.

4.68. 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.” (See below for more detail on this). It is vital that the life cycle 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.

4.69. Both gas fired and biomass CHP systems could be used in new housing developments of a certain scale and chapter 5 assesses the viability of developing CHP in new housing areas of different scales. CHP can also be used by commercial and industrial users where there are sufficient heat and energy demands. The section below considers the potential for CHP in some of the Districts larger industrial areas and the glasshouse industry.

Applicability in Epping Forest District

4.70. 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.

4.71. 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.

4.72. CHP is applicable to Epping Forest District but will be opportunity led; the follow section considers some of the opportunities for CHP in the District.

Epping Forest District CHP resource

4.73. To assess the potential for CHP in Epping Forest District the consultants have considered the commercial and industrial areas with the greatest heat demands (these areas were identified in chapter 3). The areas with the greatest heat demand included those areas where the glasshouse industries are located and two areas with the District's largest industrial estates. As such the consultants have considered the potential opportunities for CHP at three case studies:

- Glasshouses.
- Waltham Abbey industrial areas – Sainsbury's distribution centre and Meridian Business Park, Abbey Mead Industrial Estate.
- Loughton industrial areas - Oakwood Industrial Estate / Langston Road.

4.74. For each of these case studies the consultants identified in more detail what each of these areas consisted of in terms of the type and scale of uses and floorspace where applicable, to help to establish the likely current energy demands (see Appendix B for further details).

4.75. It should be noted that there is likely to also be potential for large scale CHP in new housing areas (particular larger scale urban extensions). The potential for CHP in this type of development is considered in chapter 5.

Glasshouses

4.76. The glasshouse industry is located in the west of the District around Roydon and Nazeing. There are 77 glasshouse businesses in the District[20]. The average size of glasshouses in the District is 2.11ha, which is above the average for the Lea Valley, although 35% are 1ha or under. The Lea Valley Glasshouse Industry Report (2012) has identified that the economic climate for the industry has been challenging in recent years, and as a result the protected cropping area has been declining, with a reduced number of applications for replacement glasshouses coming forward.

4.77. The minimum unit size of viable glasshouses is anticipated to more than double, and many growers see that large scale glasshouse development will provide a more efficient form of production and will prove a more viable proposition in future.

4.78. Energy is a key concern for growers and renewable sources such as CHP are considered to be solutions that growers may pursue.

4.79. The Lea Valley Glasshouse Industry report (2012) recommends that the District supports large scale expansions of the sector, and support for small and medium sized growers. However, at this stage it is not clear whether the Council intends to implement these recommendations by increasing designations for glasshouses.

4.80. This study assumes that the glasshouse industry will continue to operate as business as usual over the lifetime of the plan.

[20] Lea Valley Glasshouse Industry Report, paragraph 4.2 identified that 27 responses to a survey were receive which represented 35% (by number) of the glasshouse sector.

Base Case

4.81. For the purposes of assessing the potential savings from CHP for glasshouses it is important to establish the base case that renewable technologies can be compared against. In the areas where there are glasshouses most of the smaller ones (without CHP already) use boilers to provide their heating. Some of these will be on the gas network and use gas boilers. Others will use kerosene or oil fired boilers.

4.82. Glasshouses producing edible crops typically[21] use 675 kWh/sq.m per annum of fossil fuel for heating and 15 kWh/sq.m of electricity. Allowing for some efficiency savings since 2004, with an assumed increase in efficiency of 15%, glasshouses could be expected to typically use 575 kWh/sq.m per annum of fossil fuel for heating and 12.75 kWh/sq.m of electricity.

4.83. Using the Carbon Reduction Commitment (CRC) carbon conversion factors this gives a CO_2 emission of 1,122 tonne equivalent (te) CO_2 /annum per hectare.

Description	Use	Area sq.m	Fossil Fuel Usage KWh/sq.m pa	Electricity Usage KWh/sq.m pa	Fossil Fuel KWh pa	Electricity KWh pa	CO_2 te per annum from Fossil Fuel use	CO_2 te per annum from Electricity
Glasshouse per ha		10,000	575	12.75	5,750,000	127,500	1,056	69

Energy efficiency

4.84. There are many steps that glasshouse operators can take to reduce their thermal energy consumption which should always be considered prior to considering renewable generation technologies. In the Consultants experience best practice for the amount of energy use in the industry is around 500 kWh/sq.m pa. Measures taken to achieve this best practice, such as improved controls, thermal screens, improved boilers, would therefore reduce CO_2 emissions by a further 13%.

Rainwater harvesting

4.85. In addition to carbon emission reduction methods on the site there are other climate change measures that can be employed. Rainwater harvesting is one which reduces the carbon emissions that the water companies make, by reducing the demand on the system by recovering run-off water. An example is Wisley RHS gardens in Surrey (see Appendix C for details). However it is not possible to define the carbon saving through this as these savings would be off-site at the water treatment plants, and are highly dependent on other factors, such as where the water companies source their energy from.

Natural gas CHP

4.86. Some of the greenhouses in the area already have CHP installed. Generally these are the larger ones which, in the late 1990s / early 2000s, found it economically attractive to pay for a gas connection and install CHP.

4.87. This is natural gas fired CHP using, in most cases, large reciprocating engines to produce heat, power and CO_2. Thermal storage is normally included to decouple the timing within the day of the demand for heat, the demand for CO_2 and the most favourably priced time for the export of electricity.

4.88. Greenhouses do not use much electricity in relation to their heat demand unless they include artificial lighting to increase the growing period to boost the crop yield.

4.89. CO_2 from the CHP is an important factor as this is used in the glasshouses again to promote crop growth.

4.90. CHP of this type therefore relies on selling much of the power generated to the grid. Due to the way that the relationship between natural gas and power prices has moved over the past few years this is not currently an economically attractive thing to do. The relationship between gas

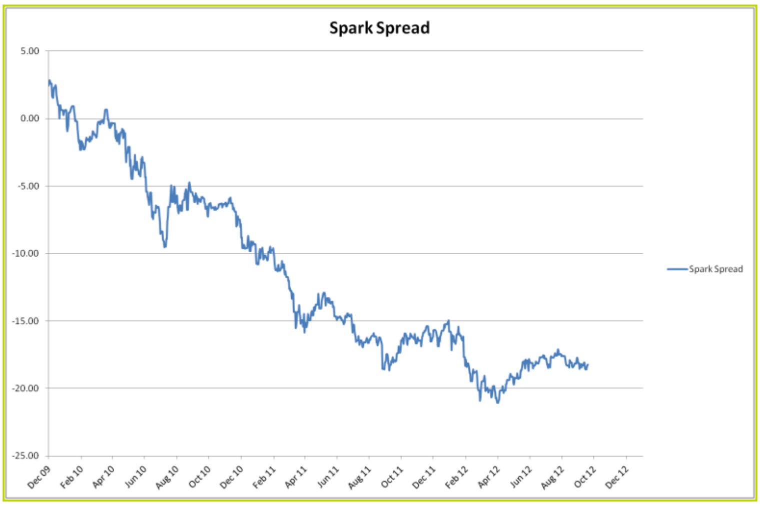
[21] Carbon Trust ECG091 dated 2004

and electricity prices is known as the "spark spread"[22] and the recent trend can be seen in Figure 45 below.

4.91. Additional measures are soon to be introduced with the intention of reducing the impact of UK businesses on climate change such as the Carbon Price Support, the removal of Climate Change Levy Exemption Certificates (LECs) and phase 3 of the EU Emissions Trading Scheme (ETS). Contrary to the intention of these measures to reduce carbon emissions, and the Government's stated aim to recognise the benefits of CHP, as currently proposed, these measures are likely to have an adverse impact on the existing use and further installation of gas fired CHP for the glasshouse industry. Unless prices change fairly rapidly we can expect to see existing CHP systems either reducing their running hours or (where they rely on exported power) closing down altogether.

4.92. Until the past trend of energy price movement reverses and the full impact of climate change measures are understood it should not be assumed that there will be further investment in natural gas fired CHP on glasshouse sites.

Figure 45. Movement of the spark spread since 2009



Renewable fuelled CHP

4.93. It is possible to use renewable fuel for CHP which could take the form of an anaerobic digester taking farm or food waste to make methane to be used in engines or micro gas turbines to generate electricity, heat and CO_2.

4.94. This is done in at least one glasshouse about 8 miles north of Nazeing at Much Hadham, Hertfordshire. This started life as a natural gas fired CHP plant using small gas turbines. It was later converted to include an anaerobic digester consuming waste fruit from Smithfield Market and some of the gas turbines were converted to run on digester gas.

4.95. There are incentives under the Renewable Obligation for producing renewable electricity and heat of this type. Alternatively the gas could be used in boilers to produce heat and get the Renewable Heat Incentive (RHI). It is likely that a plant of this type would need to import some or all of the waste as a fuel, and would therefore extend the concept of renewable energy towards

[22] The spark spread is the gap between the value of electricity on the grid compared to the value generated from gas. At a positive spark spread it is worth generating energy locally through CHP using gas. A reduction in spark spread will reduce the savings provided by a CHP plant. It is dependent on the efficiency used in converting gas to electricity. For the power station in Figure 45 it can be seen that the spark spread has fallen progressively over the last few years indicating that gas price has increased relative to electricity price. This does not take into account the value of heat, carbon or operation and maintenance costs but the trend will be true regardless of these factors indicating the value offered by CHP has reduced progressively over recent years.

requiring a project developer, willing to invest and take some technical and business risk. Theoretically this renewable energy could displace a large percentage of the CO_2 emission attributable to fuel used on the site. The limitations would include the space available, the size of the grid connection and the amount of waste available. A typical 200 kW CHP might displace around 1,000 CO_2 te per annum. This size plant could serve a 1ha – 1.5ha glasshouse. The investment return on a capital expenditure of around £500,000 is likely to be in the region of 6 – 10 years.

CHP potential at glasshouses - summary

4.96. In summary, glasshouses have a large heat load compared to their electricity load and have a requirement for CO_2 to promote crop growth. They account for an approximate carbon emission of around 1,100 te CO_2 per annum per hectare. In the past the energy demand on the larger sites has been met with natural gas fired CHP to provide heat and CO_2 with most of the power being exported to the grid. Currently the relative price of gas and power does not make this an economically attractive investment. Typically it would take an increase in export power price to around three to four times the gas price to make CHP at glasshouses economically attractive. Although not currently the case, within the next 5 to 10 years it is possible that the export power price might increase to a point where gas fired CHP is economically attractive again.

4.97. As identified above a typical 200 kW renewable fuelled CHP plant might displace around 1,000 CO_2 te per annum. This size plant could serve a 1ha – 1.5ha glasshouse. However, it should not be assumed that the CHP plant can be scaled to serve a larger glasshouse (with pro rata CO_2 savings). The capacity of the CHP can be scaled up if there is sufficient space available for the digester (approximately 1,000 sq.m for the typical plant referred to here). There is also the issue that the glasshouse would need to source a sufficient amount of waste to feed the CHP plant, which would increase as the size of the CHP plant increased.

4.98. As identified in the Lea Valley Glasshouse Report there are 77 glasshouse businesses, of these four already have gas fired CHP systems. To calculate the theoretical potential CO_2 savings from the remaining businesses that use fossil fuels, it could be assumed (by taking the average size of the glasshouses approximately 2 ha and applying this to the base case above) that approximately 2,000 CO_2 te per annum could potentially be displaced per business through the use of renewable fuelled CHP. This would give a total 146,000 CO_2 te per annum for the glasshouse industry as a whole. This is a theoretical exercise, given that some of the glasshouse businesses are larger than the average size and that a renewable fuelled CHP plant may not be viable for the larger businesses, given issues with supply of waste. Also some glasshouses will choose to use other technologies to meet their heat and energy needs.

Potential of other technologies at glasshouses - summary

4.99. Various other renewable energy generation technologies could be used and energy efficiency measures can be taken by glasshouse businesses to cut CO_2 emissions by a considerable amount (circa 500-1000 CO_2 te per annum per hectare could be achievable). There is not a perfect, indisputable, leading renewable or low carbon technology that can be used by the glasshouse industry and each grower will have specific circumstances determining which technology is most suitable for them (see Appendix C for more detail on how the other technologies could be applied to the glasshouse industry). The investment case should offer a simple payback period of 4 – 10 years. Of the main renewable technologies the key findings are:

- Solar PV – the nature of glasshouses means that installing solar PVs on glasshouses is counterproductive to the business (it would prevent daylight entering the glasshouse); the only potential would be where the grower has significant other land or buildings available to install panels.
- Solar thermal – the nature of glasshouses means that installing solar thermal on glasshouses is counterproductive to the business (it would prevent daylight entering the glasshouse); the only potential would be where the grower has significant other land or buildings available to install panels.
- Ground source heat pumps – unlikely to be a feasible option for growers due to technical issues that include the fact that growers need CO_2 for growing (so would need to burn fuel to produce this), and the lower water temperatures that come from heat pumps (60^oC whereas growers require 80^oC).

- Wind power – has some potential to provide for electricity needs of glasshouse businesses in those areas where there are no constraints (see Figure 42) and in areas where there is sufficient wind (this will be site specific). However, wind power only produces electricity and therefore growers would also need to source heat from an alternative technology.
- Hydro – not an option in the District due to lack of appropriate head height in rivers.

Industrial areas

4.100. The District has 42 employment land clusters[23] with an even split between rural and urban sites. The largest sites include Oakwood Hill Industrial Estate in Loughton and Abbey Mead Industrial Park in Waltham Abbey (see Appendix B for detail used to define energy demands in these areas).

4.101. Chapter 3 identified that carbon emissions from commercial and industrial areas represent 31% of all CO_2 emissions in the District. As such it is important to consider some of the potential carbon savings that could be achieved in the industrial case study areas.

Base case

4.102. From the perspective of renewable technologies the Sainsbury's depot plus industrial areas and Oakwood industrial estate can be grouped together in one category.

4.103. A very approximate estimate of the breakdown of consumption and carbon emissions from the various areas under consideration are shown below.

Description	Use	Area sq.m	Fossil Fuel Usage KWh/sq.m pa	Electricity Usage KWh/sq.m pa	Fossil Fuel KWh pa	Electricity KWh pa	CO_2 te per annum from Fossil Fuel use	CO_2 te per annum from Electricity
Sainsbury's Distribution Depot	Depot	70,000	80	20	4,480,000	1,120,000	823	606
Meridian Business Park	Light Industrial	15,000	90	31	1,080,000	372,000	198	201
Abbey Mead Industrial Park	Light Industrial / Office	46,000	79					
	Office	5,000	79	54	395,000	270,000	73	146
	Retail	5,000	122	246	610,000	1,230,000	112	665
	Factory	18,000	90	31	1,620,000	558,000	297	302
	Warehouse	12,000	103	53	1,236,000	636,000	227	344
Oakwood Hill Industrial Estate	Office	18,000	79	54	1,422,000	972,000	261	526
	Retail	14,000	122	246	1,708,000	3,444,000	314	1,863
	Factory	63,000	90	31	5,670,000	1,953,000	1,041	1,057
	Warehouse	37,000	103	53	3,811,000	1,961,000	700	1,061
	Total	303,000			22,032,000	12,516,000	4,045	6,771

Note: These are based on CIBSE Guide F 2012 based on average for buildings operating in accordance with "good practice"

CHP / district energy

4.104. Where there are industrial processes with high heat demands introducing CHP may be a cost effective solution for an industrial occupier. However, from the case study areas tested in this study (these are the largest industrial areas in the District with the highest heat demands – see chapter 3), it appears unlikely that CHP will be ideal for most of these building types as the heat demand will generally be for space heating and hot water with very little process demand (process demand is the heat required for industrial processes). The duration of a significant level of heat demand during the year is unlikely to be sufficient to make CHP viable.

[23] Epping Forest District and Brentwood Borough Employment Land Review (2010)

4.105. There are one or two possible exceptions to this which are the Sainsbury's distribution depot and the Bank of England / De la Rue facilities at the Langston Road site. Their suitability depends on the process in these buildings (detail that is unavailable to the consultants at the time of writing). If Sainsbury's has a centralised cold store, for example, that could provide the base load for some chilling which could be provided from a Combined Cooling Heat and Power (CCHP) scheme. There is a De La Rue money printing business at Portals in Basingstoke which does have a large 7 MW CHP and, if the process and size of this business is similar, then it may provide the "anchor" load demand for a CHP plant which could possibly feed into other businesses in the area. It is understood that the process in Basingstoke involves the production of the 'paper' for bank notes which is energy intensive. This may not be replicated at the Langston Road facility.

4.106. District heating in general is best suited to areas where the sum of the demands presents a larger and more diverse heat profile than any one user may have. Where all the loads types are similar, as is the case here, the advantage offered by district heating is diminished. A large thermal load during times whilst businesses are generally not operating, such as a dense residential area, hotel with leisure centre or a hospital, would greatly increase the effective hours of operation of CHP, and hence its economic attractiveness.

4.107. Another factor that improves the benefits offered by district heating is when a new development is being planned. This avoids the costs of retrofitting pipework and heat exchangers into existing infrastructure and also the cost of district heating can be offset by avoiding the cost of conventional heating plant within buildings. Where the buildings already exist this cost cannot be avoided.

CHP potential at industrial areas - summary

4.108. In summary, the industrial and commercial areas have a carbon emission due to electricity and fossil fuel use totalling in the order of 11,000 te CO_2 per annum. It is unlikely that the type of area with relatively similar heat profiles common to all users in the case studies would justify the installation of a retrofit district heating/cooling scheme.

4.109. There are no new large scale industrial developments currently planned in the District that include a large "anchor" tenant with high heat demands that would make a CHP scheme viable. However, where large scale residential schemes are planned alongside new industrial or commercial premises there would be potential for both to be served by a district heating scheme (chapter 5 explores the viability of CHP in residential schemes).

Potential of other technologies at industrial areas - summary

4.110. Various other renewable energy generation technologies could be installed at existing industrial sites. There is not a single leading technology and each business will have specific circumstances determining which technology is most suitable for their specific needs and site / building (see Appendix C for more detail on how the other technologies could be applied to the industrial areas). The investment case should offer a simple payback period of 4 – 10 years and could displace typically between 10 – 40% of the carbon emissions. Of the main renewable technologies the key findings are:

- Solar PV – can be easily integrated into existing industrial areas assuming that the correct orientation can be achieved. In some cases up to 75% of offices electricity needs have been achieved with solar PV. Ground source heat pumps – potentially more appropriate to new industrial areas rather than retrofitting to existing industrial areas, given the need for a sufficient ground area to accommodate the horizontal coil which would be disruptive to fit retrospectively.
- Biomass boilers – unlikely to be financially viable given the current economic advantage that gas heating would have over biomass.
- Wind power – there is scope for wind power to provide energy to existing industrial areas, either at the micro-generation scale, or more efficiently with a single turbine scheme that is serving a wider area (as developed at Green Park, Reading).

- Hydro – not an option in District due to lack of appropriate head height in rivers.

Chapter 5: Carbon reduction in new residential development

Chapter purpose

- To assess the ability of new housing development in the District to meet the CfSH.
- To assess the feasibility of introducing renewable and low carbon technologies (micro-generation) to meet CfSH for new development.
- To determine the total potential carbon emissions savings through active and passive design measures from new residential development in the District.
- To highlight key issues for Epping Forest District Council to address to ensure feasibility of implementing CfSH.
- This chapter has assessed the viability of residential development in the District complying with the CfSH standards and to adopt renewable and / or low carbon technologies to achieve these standards.

Chapter summary

Code for Sustainable Homes

The CfSH is a sustainable development standard that measures the sustainability of a new home against nine categories of sustainable design. There are six levels of the CfSH with Level 6 being the most sustainable. Code levels related to energy require a Dwelling Emission Rate (DER) a certain percentage lower than the Target Emission Rate (TER) as set in Part L1A of the Building Regulations. The Building Regulations Part L are changing over time to align with the CfSH and by 2016 will continue to improve until the 2016 target of “net zero CO_2 emissions” is met as Zero Carbon Homes.

The Government clarified the definition of Zero Carbon Homes with a clearer concept of what this would mean from 2016 onwards. The definition is based around a hierarchical approach to achieving zero carbon that includes: ensuring an energy efficient approach to building design; reducing CO_2 emissions on-site via low and zero carbon (LZC) technologies and connected heat networks; and mitigating the remaining carbon emissions with a selection of allowable solutions.

Allowable solutions aim to give developers an economical way of compensating for the CO_2 emissions reductions that are difficult to achieve through normal design and construction. Allowable solutions will therefore mean developers make a payment into a fund that invests in approved carbon-saving projects off-site.

Market viability assessment

There is a 45% price variation across the District’s housing market, which means that for the purpose of assessing viability the District has been classified into Hot, Moderate and Cold markets which were defined by their average price points in each post code. This differed by housing types and hence was incorporated within the case studies.

No case studies in Cold markets are currently viable, at any level of the CfSH. All case studies in Hot and Moderate markets were feasible for CfSH Level 4 standards in 2013 and Level 5 Zero Carbon Homes compliance in 2016 based on future projections pricing and costs. This aligns with the Government’s agenda of adopting zero carbon home standards by 2016 in a stepped manner.

In the current market scenario (i.e. 2012 market pricing) only Hot markets were able to achieve CfSH Level 5 Zero Carbon Homes with the 40% affordable housing provision, and should be encouraged to adopt this higher standard. The case studies in Moderate markets were feasible to achieve CfSH Level 4 standards only in 2013 with a 40% affordable housing provision and could be encouraged to adopt higher standards through support. In Cold markets feasibility is significantly impacted by the 40% affordable housing provision, which affects viability when seeking to achieve CfSH compliance (Details of Assessment are set out in Appendix F).

Technology adoption assessment

The choice of LZC technologies would depend on the types of housing in each project. This decision would be dependent on a range of factors that are site specific (cost, density, thermal or power demand, physical constraints, design). The case studies were tested for a selection of technologies (i.e. solar PV, solar thermal and CHP) Further micro-generation technology options are set out in Appendix A. While solar PV was the most expensive, it was also the most effective in terms of carbon emission reduction.

Density of development

The District typically has a higher concentration of housing (85%) than it does apartments (15%). Case studies have been used to explore contrasting development densities to evaluate whether higher developer returns and higher carbon standards could be achieved with higher densities. Developer returns and CfSH were similar for both higher and lower density case studies (see Appendix G) and hence the higher demand on energy created through the higher density scheme created no clear advantage. It is expected however, that higher density schemes may be more efficient in some areas in supporting public transport and will have resultant savings in carbon emissions.

There is no clearly definable advantage to encouraging or discouraging an increase in housing densities. Higher densities do not necessarily increase the range of LZC technologies that are viable, as although the increased density increases the Gross Development Value (GDV) for the developer it would also increase the energy demands of the scheme and would require additional renewable / low carbon technologies to compensate that may be constrained by physical space (i.e. insufficient roof area for solar PV).

Renewable technology hierarchy

Where the viability of a scheme can be proven to be relatively viable, and can therefore accommodate a combination of renewable technologies, it is recommended that the Council makes any requests for additional technologies based on the following hierarchy:

- Combined Heat and Power connections;
- PV and solar thermal technology (or other LZC technologies); and
- Allowable solutions.

This would enable the maximum amount of carbon emissions reductions to be achieved.

Carbon savings

The projection of CO_2 e from new build (in Figure 47) demonstrated a potential annual saving of almost 10 ktCO_2e from complying with CfSH Level 5 minimum compliance Building Regulations that are expected in 2016 and actively promoting micro-generation from renewable and low carbon technologies. This would contribute towards District carbon savings, and this estimate has been used to inform the carbon target discussed in chapter 8.

5. Carbon reductions in new residential development

Introduction

5.1. Epping Forest District's carbon emissions are above the national average (as set out in chapter 3), a key opportunity to reduce carbon emissions during the planning period is by addressing the emissions generated by new development, and in particular residential development. Carbon emissions reductions may be achieved by meeting the Government standard for new homes, the CfSH and by encouraging the use of small scale renewable and low carbon micro-generation to meet and exceed these standards. The CfSH is a sustainable building rating system that covers a broad range of categories including carbon reduction, water efficiency and other aspects of sustainable building (further detail is set out in the section below).

5.2. The NPPF supports the move to a low carbon future and encourages local planning authorities to plan in ways that reduce greenhouse gas emissions (as set out in chapter 2). The NPPF makes it clear that where local planning authorities set local requirements for building sustainability they should be consistent with the Government's zero carbon buildings policy and nationally described standards. NPPF supports the use and supply of renewable and low carbon energy, placing the emphasis on local planning authorities to increase the use and supply of renewable and low carbon energy, and designing policies to maximise renewable and low carbon energy development. In achieving the aims of the NPPF, Epping Forest District Council may chose to adopt a policy approach that sets local requirements for new buildings. However, there will be a need to show that the policies are based on evidence of local feasibility and that the opportunity for new development to adopt these technologies is viable.

5.3. This chapter assesses the potential for carbon savings from new residential development and the potential for local targets for new residential development set by the Council. This is assessed through an evidence based viability assessment, and considers the overall site development costs to meet the CfSH across housing markets in the District. The approach is sensitive to securing the supply of housing and without inhibiting the provision of affordable housing.

5.4. This chapter also tests the costs of different renewable and low carbon technologies which may be deployed within new development in the District, including on-site solutions (at the small micro-generation scale) and local energy networks. Where the CfSH standards cannot be achieved through passive design measures or there is an opportunity to achieve higher CfSH standards through on-site micro-generation.

5.5. To test the impact of different policy thresholds on viability there is a need to consider the cost of renewable and low carbon technology options in the context of other site development costs in the District. This has been carried out using a number of development appraisal case studies. This process is described in detail in this chapter and supporting appendices (Appendix F and G)

Code for Sustainable Homes

5.6. The Code for Sustainable Homes (CfSH) became operational in April 2007, replacing the EcoHomes scheme, developed by the Building Research Establishment (BRE). CfSH is the national standard for the sustainable design and construction of new homes with a view to encouraging continuous improvement in sustainable home building.

5.7. The CfSH measures the sustainability of a new home against nine categories of sustainable design, rating the whole home as a complete package. Each category includes a number of environmental issues that is broken down into:

- energy and CO_2 emissions
- water
- materials

- surface water run-off
- waste
- pollution
- health and well-being
- management
- ecology

5.8. Each issue is a source of environmental impact which can be assessed against a performance target and awarded one or more credits. Performance targets are more demanding than the minimum standard needed to satisfy Building Regulations or other legislation. Currently, compliance with higher levels of the CfSH is voluntary, with a long-term view for step-change increases.

5.9. The CfSH has 6 levels with CfSH Level 6 being the most sustainable home. Code levels pertaining to energy require a Dwelling Emission Rate (DER) a certain percentage lower than the Target Emission Rate (TER) as set in Part L1A of the Building Regulations. The October 2010 version of the CfSH saw Part L 2010 TER standards rise equivalent to CfSH Level 3. Since this change CfSH Level 4 requires 25% DER improvement over Part L1A 2010 TER standards and CfSH Level 5 requires 100% improvement i.e. the building should be thermally twice as efficient. It is also anticipated that the Building Regulations as well as the minimum mandatory CfSH level will continue to improve until the 2016 target of “net zero CO_2 emissions” is met as Zero Carbon Homes.

5.10. In December 2008 the Government clarified the definition of Zero Carbon Homes with a clearer concept of what this would mean from 2016 onwards. The definition is based around a hierarchical approach to achieving zero carbon:

1. **Ensuring an energy efficient approach to building design** – Achieved through passive energy efficiency measures set out in the building regulation standards, that is expected in 2013 to meet CfSH Level 4 and subsequent efficiency standards in 2016 to meet CfSH Level 5.
2. **Reducing** CO_2 **emissions on-site via LZC technologies and connected heat networks** – Encouraging active measures to reduce carbon emissions to match and exceed regulatory requirements.
3. **Mitigating the remaining carbon emissions with a selection of allowable solutions** – Monetary contribution against remaining un-mitigated emissions.

5.11. In 2011 the government revised the definition of Zero Carbon Homes to exclude “unregulated” emissions typically constituting electrical appliances that fell outside the building regulations. A new Fabric Energy Efficiency Standard (FEES) was defined based on the Zero Carbon Hub research proposals in 2009. The FEES is a performance standard, setting minimum levels for overall fabric performance that ensure house designs steer towards better heat and lighting efficiency. Achievement of the FEES is affected by heat loss[24] and features which affect lighting and solar gains. The FEES does not include typical building services, such as heating systems, fixed lighting, or ventilation strategies. The FEES sets a maximum limit on the amount of energy[25] (in kWh/sq.m per annum) that would normally be needed to maintain comfortable internal temperatures in a home. This was typically defined as 39 kWh/sq.m per annum for apartments and Mid-terraced housing and 46 kWh/sq.m per annum for End-terraced, Semi-detached and Detached housing types as they were less thermally efficient with more exposed walls. The above estimates were used to inform the case study assumption for energy requirements and are presented in Appendix F Table F1.

5.12. In order to ensure that mainstream Zero Carbon Homes are cost effective for delivery by 2016, the Government proposed the allowable solutions framework as a platform for wider engagement with businesses and communities. The aim of allowable solutions is to give developers an economical way of compensating for the CO_2 emissions reductions that are difficult to achieve through normal design and construction. In the Zero Carbon Hub framework proposals,

[24] Heat loss efficiency would be affected by U-values, thermal bridging and thermal mass
[25] Keeping in mind the practical application of Fabric energy performance in the field, the performance is measured in units of energy rather than units of Carbon.

developers who opt to use allowable solutions will make a payment into a fund that invests in approved carbon-saving projects. Mechanisms are being explored to help prioritise locally-relevant carbon-saving projects, and to ensure that all allowable solutions projects deliver verifiable carbon savings.

5.13. In subsequent sections the report sets out the assumptions and results of the viability assessment tested on case studies across markets in Epping Forest District to meet and exceed CfSH standards.

Development appraisal framework and assumptions

5.14. The development appraisal framework has been developed to be consistent with other EFDC studies. The primary appraisal tool used has been developed by the consultant, using standard provision of 40% affordable housing across all case studies and sales value assumptions from the Viability Assessment For London Commuter Belt (East)/M11 Sub Region (August 2010) (SHMA Viability 2010) and the London Commuter Belt (East)/M11 Sub Region Strategic Housing Market Assessment (2008). The planning obligation assumptions were updated to the Essex County Council Developers' Guide to Infrastructure Contributions (2010). The size and mix of housing types within the case studies were adapted from comparable case studies in the SHMA viability assessment. The case studies were tested in varying market conditions. These were identified as Hot, Moderate and Cold price points.

Market and supply

5.15. EFDC's Strategic Land Availability Assessment September 2012 (SLAA) database was used to analyse the quantum of potential supply of land for housing. The supply was split into sizes based on the capability to incorporate LZC technology within the project. In line with discussions with EFDC, the potential supply of housing projects has been categorized into 1-15 units, 15-50 units, 50-150 units, 150-500 units and over 500 units. This tested the proposed thresholds for affordable housing provision in rural and urban contexts as well as technology thresholds for on-site provision of renewable technologies.

5.16. This study has only considered the SLAA sites that were considered "Achievable, developable and deliverable". This market viability assessment does not taken account of the delivery timelines or the suitability within the existing policy context, as the focus is on testing the viability of achieving the CfSH and the impacts of building in renewable micro-generation across a broad spectrum of projects that could come forward in the District. At the time of writing the Council's preferred development option was not known, so it is not clear which of the SLAA sites would form part of the preferred option.

Segregation of sites

5.17. As seen in Table 2, a majority of the sites in the SLAA database are between15 -150 residential units, this constitutes over 50% of the sites, with sites up to 15 units and over 150 units constituting 19% and 27% respectively.

Table 2. SLAA by number of units supplied

Range	No. Sites	%	Units	%
1-15 Units	42	19%	374	1%
15-50 Units	63	28%	1,975	4%
50-150 Units	55	24%	5,104	11%
150-500 Units	37	16%	9,501	20%
>500 Units	24	11%	30,911	65%
Total	221/ 226	98%*	47,815	100%**

*Source: SLAA Data base analysis. *The remaining 2% sites are stand alone employment land that has not been included.*
**Total adds up to 101% due to rounding

5.18. Table 3 illustrates the distribution of sites by site area in hectares (ha) within the SLAA. Many of the potential development sites are less than 5 ha in size constituting 71% of future supply and 15% of the units. However, the concentration of smaller sites below 1 ha in size, may result in a reduced capability for some on-site LZC technologies as there might be limitations on physical site layout and economies of scale for technologies such as CHP. The Council has confirmed that many of the larger sites of over 25 ha have multiple owners and are unlikely to come forward as single land parcels. Sites of this size represent 9% of total sites.

Table 3. SLAA by plot sizes and number of units

Range (ha)	Units	%	No. of Sites	%
<1	1,180	2%	69	31%
>1<5	6,379	13%	87	40%
>5<10	4,093	9%	23	10%
>10<25	7,159	15%	21	10%
>25<200	20,504	43%	17	8%
>200	8,500	18%	3	1%
Total	47,815	100%	221	100%

Source: SLAA Data base analysis.

5.19. In addition to size, project density is important in determining the type of renewable technologies adopted within a project due to economies of scale. Unless otherwise promoted in the call for sites, a density of 30 dwelling per hectare (dph) was assumed in the SLAA study. As a result of this a majority of the sites (75%) had a potential density on or below 30 dph. Projects with a density of over 40 dph represented between 10% and 15% of potential supply. The viability assessment uses 30 dph as the typical density for three of the case studies, but has tested higher and lower densities on larger sites.

Viability assessment

5.20. The SHMA Viability Assessment (2010) has been used to provide assumptions relating to housing revenues in the District and other development appraisal assumptions such as type of housing units (detached, flats etc.), number of bedrooms, sizes (sq.m) and general development fees (professional fees etc).

5.21. The SHMA viability assessment is the most appropriate benchmark of market related data for policy development in the District. To ensure consistency across the evidence base the housing types and sizes used in this study are derived averages from the housing types in the SHMA[26]. The case studies within the SHMA are assumed to be representative of the expected potential market supply within the region. Table 4 introduces the types of housing adopted for the viability assessment and average unit sizes considered. The Consultants have adopted a combination of unit sizes for each of the house types to capture the likely mix of house sizes.

Table 4. Assumed housing types and average floorspace

Type	Type	Average Unit Floorspace Assumptions (Sq.m)
Apartment	Apartment 1 bed	40
	Apartment 2 bed	64
House	Terraced House 2&3 bed	79
	Semi-detached House 3&4 bed	101
	Detached House 4 & 4+ bed	116

Source: Atkins Estimates & SHMA Viability Assessment (2010).

Market pricing

5.22. The housing market in Epping Forest District has been categorised into seven postcode locations with price per square metre used to estimate average price distributed by typologies i.e. Flat, Terraced House, Semi-detached and Detached House. For the purpose of this study, the market has been further clustered into Hot, Moderate and Cold market areas based on their estimated

[26] The SHMA has broken down each of the housing unit types by size (number of bedrooms). However there are a large number of housing types and sizes. This study has clustered these SHMA type and size of housing and derived an average, which is used in the generic case studies.

price points with the Hot representing the highest price points, Moderate the average and Cold the lowest price points as seen in Table 5.

Table 5. Market benchmarks and price points (average price £)[27]

	Post Code						Market Price Points		
Type	CM16	CM17	CM5/EN9	IG 10	IG7	RM4	Hot (Highest)	Moderate (Average)	Cold (Low)
Apartment 1 bed	£140,160	£106,440	£110,480	£134,400	£147,400	£119,040	£147,400	£126,320	£106,440
Apartment 2 bed	£222,504	£168,974	£175,387	£213,360	£233,998	£188,976	£233,998	£200,533	£168,974
Terraced House 2&3 bed	£272,474	£197,428	£230,241	£266,665	£222,391	£284,720	£284,720	£245,653	£197,428
Semi-detached House 3&4 bed	£418,818	£268,297	£339,326	£330,158	£316,960	£363,607	£418,818	£339,528	£268,297
Detached House 4 & 4+ bed	£554,443	£416,700	£489,507	£657,344	£628,638	£461,148	£657,344	£534,630	£416,700

Source: Atkins Estimates & SHMA Viability Assessment (2010).

5.23. Based on Table 5 Postcodes and further analysis on market pricing and location analysis (presented in Appendix G), Hot markets were identified as CM16, IG10 and IG7 broadly located along the M11 commuter corridor to London and Epping. Moderate market typically included RM4 located along the M25 commuter corridor. Cold markets were determined by a consistent negative variation from the average which can be seen in CM17, CM5 and EN9 that are located in north and east of the District.

Construction costs

5.24. The construction costs used in the viability model were taken from the Building Cost Information Service (BCIS) at 3rd Quarter 2012. The BCIS provides a range of costs per square metre (sq.m) for the different housing types portrayed in the case studies, e.g. flats and housing (detached, semi-detached & terraced). Therefore the type of housing constructed would also have an effect on the viability of a case study. The construction cost rates are identified in Table 6.

5.25. The costs used in the viability model were adjusted to reflect the costs in the East of England region, during the third quarter of 2012. The BCIS database allows the user to pick regional cost variations as a variable in order give a finer grain of detail to costs. Furthermore, floorspace figures for the case studies were provided as gross internal areas (GIA), which are directly applied to sales revenues. However, costs must be applied to the gross external area (GEA) in order to portray the cost of the entire development. As such, the consultant has assumed the residential GIA floorspace to be 90% of the GEA.

5.26. Land prices were assumed to be an average price of £2 million / ha in line with the SHMA study (2010) assumptions across all the viability case studies except for the large urban extensions (i.e. more than 150 units). For these the consultants have assumed an average price for occupied agriculture land at approximately £19,000 / ha[28] and the above land price (£2 million / ha) to give a price of approximately £1 million / ha. This was assumed as a large greenfield extension would typically involve purchase of greenfield agriculture land where there would be an expected uplift value.

[27] Price assumption does not consider the price variation caused by the recession 2010 to 2012. The price dip and recovery was marginal and could have distorted future viability if included in the projections to 2033. This was verified against the house price index and hence future price projections were only considered after 2012.
[28] VOA Property Market Report 2011: East of England, Value for equipped Arable land.

Table 6. Residential construction cost rates

Residential Construction		
BCIS rate flats:	£944 /sq.m	BCIS: East Anglia Region - Median Construction Cost; General Flats, 3rd Quarter 2012
BCIS rate Housing (Terraced)	£825 /sq.m	BCIS: East Anglia Region - Median Construction Cost; General terraced Houses, 3th Quarter 2012
BCIS rate Housing (Semi-detached)	£815 /sq.m	BCIS: East Anglia Region - Median Construction Cost; General Estate Semi Detached Houses, 3th Quarter 2012
BCIS rate Housing (Detached)	£755 /sq.m	BCIS: East Anglia Region - Median Construction Cost; General Estate Detached Houses, 3th Quarter 2012
Commercial Construction		
BCIS rate Commercial (B1)	£873 /sq.m	BCIS: East Anglia Region - Median Construction Cost; Advance factories/offices - mixed facilities (class B1), 3th Quarter 2012
BCIS rate Commercial (A1)	£700 /sq.m	BCIS: East Anglia Region - Median Construction Cost; Shops General, 3th Quarter 2012

Source: BCIS Construction Averages based on GIA.

Relationship with Code for Sustainable Homes

5.27. The construction costs in the case studies were adjusted to also reflect the costs associated with the CfSH. The case studies were tested for compliance to Level 3, Level 4, Level 5 minimum compliance and Level 5 Zero Carbon Homes (equivalent: as per the new definition). In addition, the viability model tests compliance for zero carbon compliance of CfSH Level 6 which is the original definition of Zero Carbon Homes.

5.28. Information on the costs associated with CfSH has been drawn from the DCLG report[29]. This document provided cost estimates associated with different dwelling types for each level of the CfSH. Table 7 provides a summary of the overall costs of CfSH as per the updated cost review, but the energy costs have been excluded so that the impact of including renewable energy generation along with the CfSH can be considered in the viability model.

5.29. Table 7 show the non-energy costs for compliance including efficiency measures for water, materials, surface water run-off, waste, pollution, health, management and ecology. For the purpose of the viability assessment, the consultants have assumed the costs for implementation of the CfSH for “small brownfield” site costs would be primarily applicable to projects below 15 units and “edge of town” site costs for 15-50 units. For projects larger than 50 units the consultants have assumed an average of “strategic greenfield and urban regeneration” site costs based on the distribution of sites in the SLAA database. The costs per square metre were used as additional to the residential construction costs of each case study in order to derive a realistic assessment of viability.

[29] Cost of building to the Code for Sustainable Homes: Updated cost review' (August, 2011)

Table 7. Costs of implementing Code for Sustainable Homes (excluding energy costs)

Small Brownfield

	2 Bed Flat £/ Unit	Flat Average Size 52 sq.m	Terrace House £/ Unit	House Average Size 79 sq.m	Semi Detached-House £/ Unit	House Average Size 101 sq.m	Detached-House £/ Unit	House Average Size 116 sq.m
Code 1	£203 /unit	£4 /sq.m	£290 /unit	£4 /sq.m	£290 /unit	£3 /sq.m	£290 /unit	£3 /sq.m
Code 2	£403 /unit	£8 /sq.m	£440 /unit	£6 /sq.m	£440 /unit	£4 /sq.m	£440 /unit	£4 /sq.m
Code 3	£678 /unit	£13 /sq.m	£652 /unit	£8 /sq.m	£1,040 /unit	£10 /sq.m	£1,040 /unit	£9 /sq.m
Code 4	£678 /unit	£13 /sq.m	£1,040 /unit	£13 /sq.m	£1,190 /unit	£12 /sq.m	£1,190 /unit	£10 /sq.m
Code 5	£8,188 /unit	£158 /sq.m	£7,245 /unit	£92 /sq.m	£7,325 /unit	£73 /sq.m	£7,325 /unit	£63 /sq.m
Code 6	£8,188 /unit	£158 /sq.m	£7,245 /unit	£92 /sq.m	£7,325 /unit	£73 /sq.m	£7,325 /unit	£63 /sq.m

Edge of Town

	2 Bed Flat £/ Unit	Flat Average Size 52 sq.m	Terrace House £/ Unit	House Average Size 79 sq.m	Semi Detached-House £/ Unit	House Average Size 101 sq.m	Detached-House £/ Unit	House Average Size 116 sq.m
Code 1	£203 /unit	£4 /sq.m	£290 /unit	£4 /sq.m	£290 /unit	£3 /sq.m	£290 /unit	£3 /sq.m
Code 2	£403 /unit	£8 /sq.m	£440 /unit	£6 /sq.m	£440 /unit	£4 /sq.m	£440 /unit	£4 /sq.m
Code 3	£1,222 /unit	£24 /sq.m	£1,318 /unit	£17 /sq.m	£1,468 /unit	£15 /sq.m	£1,468 /unit	£13 /sq.m
Code 4	£1,772 /unit	£34 /sq.m	£1,818 /unit	£23 /sq.m	£1,968 /unit	£20 /sq.m	£1,968 /unit	£17 /sq.m
Code 5	£8,732 /unit	£169 /sq.m	£7,723 /unit	£98 /sq.m	£7,803 /unit	£77 /sq.m	£7,803 /unit	£67 /sq.m
Code 6	£13,712 /unit	£265 /sq.m	£7,723 /unit	£98 /sq.m	£7,803 /unit	£77 /sq.m	£7,803 /unit	£67 /sq.m

Average of Strategic Greenfield and Urban Regeneration

	2 Bed Flat £/ Unit	Flat Average Size 61 sq.m	Terrace £/ Unit	House Average Size 85.0 sq.m	Semi-House £/ Unit	House Average Size 85.0 sq.m	Detached-House £/ Unit	House Average Size 116 sq.m
Code 1	£203 /unit	£4 /sq.m	£290 /unit	£4 /sq.m	£290 /unit	£3 /sq.m	£290 /unit	£3 /sq.m
Code 2	£403 /unit	£8 /sq.m	£440 /unit	£6 /sq.m	£440 /unit	£4 /sq.m	£440 /unit	£4 /sq.m
Code 3	£956 /unit	£18 /sq.m	£977 /unit	£12 /sq.m	£1,152 /unit	£11 /sq.m	£1,152 /unit	£10 /sq.m
Code 4	£1,456 /unit	£28 /sq.m	£1,277 /unit	£16 /sq.m	£1,427 /unit	£14 /sq.m	£1,427 /unit	£12 /sq.m
Code 5	£8,086 /unit	£156 /sq.m	£7,344 /unit	£94 /sq.m	£7,432 /unit	£74 /sq.m	£7,432 /unit	£64 /sq.m
Code 6	£10,866 /unit	£210 /sq.m	£7,344 /unit	£94 /sq.m	£7,432 /unit	£74 /sq.m	£7,432 /unit	£64 /sq.m

Source: Cost of building to the Code for Sustainable Homes: Updated cost review' (August, 2011), Communities and Local Government

5.30. The energy costs were further divided between fabric energy costs and the cost for renewable energy technologies and have been described further in Appendix F sections F2 to F4. The renewable technologies were tested for solar thermal, solar PV and CHP to assess the viability of adopting these technologies within a range of case studies. Solar PV has been selected as it is usually the most expensive renewable energy technology and therefore serves as the upper band in terms of on-site costs and affordability. Solar thermal is usually the cheapest on-site renewable micro-generation technology and therefore is useful for testing what can be achieved in colder market areas. Other potential micro-generation technologies will fall between these technologies. Therefore, for testing viability these generally represent the highest and lowest cost alternatives for on-site LZC technologies and so embrace the range of costs for any given technology mix.

5.31. CHP has different parameters affecting its viability and is not as straight forward as the other technologies (costs change as the size of plant / equipment changes). It serves both heat and power requirements and plays a more efficient role for larger projects. Therefore, it is considered important to test CHP.

Planning obligations assumptions

5.32. The planning obligation assumptions made in the consultant's model are drawn from the Viability Assessment for London Commuter Belt (East)/M11 Sub Region (August, 2010). The costs associated with the planning obligation requirements vary by location and, where applicable, they are calculated on a per unit basis as per Table 8.

Table 8. Planning contribution assumptions

Contribution	Cost (£ per unit)*
Education 1 bed exempt + only projects over 10 units	flat £3,852 house £8,085
Transport	£2,714
Libraries	£235
Waste management	£288
Public art	1% (1% of cost including fees)
Adult learning & social care	£127
Lifetime Homes Standards	£600 (for 10% of total units over 10 units)

*Source: Essex County Council Developers' Guide to Infrastructure Contributions 2010 Edition & SHMA Viability Assessment (2010). *unless stated*

5.33. For affordable housing, a fixed assumption of 40% was assumed across all markets for initial viability assessment as agreed with EFDC.

Other costs

5.34. Other costs relating to land purchase and fees have been incorporated into the model. These are identified in the appraisal outputs in Appendix F Sections F5 to F10.

Case studies

5.35. To consider the effect of the increased development costs associated with meeting the CfSH Level 3, Level 4 Level 5 and Zero Carbon Homes, six case studies representative of the range of different residential developments within the Districts housing supply trajectory were identified. They were tested to consider the marginal and overall effect of the potential costs associated with different policy and renewable and low carbon technology thresholds and their effect on the viability of development and housing delivery. The case study results are indicative of other similar sized developments which may come forward in the District. The costs considered include CfSH requirements and the suggested technologies described above.

5.36. The case studies vary in terms of the type and scale of development to illustrate the effects of policy targets in different contexts in the District. Based on the supply analysis as described above. In Table 9, the case studies are summarised below:

- **Case Study 1 (CS1):** Consists of 2-15 units. This constitutes 19% of the number of sites in the District. The selected case study considered 2 Semi-detached houses with an average of 3 and 4 bedrooms. CS1 was assumed to be “small brownfield” projects for the purpose of CfSH costs.

- **Case Study 2 (CS2):** Consists of 15-50 units typically with a mix of Terraced, Semi-detached and Detached houses. This case study category constitutes a major supply of sites for the District (28%), but constitutes only 4% of the total number of units. CS2 was assumed to be “small brownfield” projects for the purpose of CfSH.
- **Case Study 3 (CS3):** Consists of sizes of 15-50 housing units with a mix of Terraced, Semi-detached and Detached housing typically for a medium density infill site. Although this case study category constitutes a smaller supply of residential units for the District (11%), it is 24% of the total number of sites and serves as the most challenging in carbon viability. CS3 was assumed to be “edge of town” projects for the purpose of CfSH costs.
- **Case Study 4 (CS4):** CS4 is higher density mixed housing scheme between 150-500 units with a density of 60 dph which includes Apartments, Terraced, Semi-detached and Detached houses.
- **Case Study 5 (CS5):** CS5 is a low density housing scheme between 150-500 units consisting of Terraced, Semi-detached and Detached houses at just under 30dph.
- CS4 & CS5 were used to assess renewable technology viability across two different densities. Both constitute 16% of sites and 20% of potential supply. In addition, the higher density assessments are likely to inform decisions on smaller sites that do not fall into this category. For the purpose of determining CfSH costs for CS4 & CS5, it was assumed that there are a combination of “strategic greenfield and urban regeneration” projects.
- **Case Study 6 (CS6):** Consists of a typical larger mixed use development of 500 units and above. Although this case study typically reflects only 11% of the sites in the SLAA, it represents 65% of potential units. EFDC have confirmed that these sites are likely to be fragmented and hence larger sites are not likely to come forward as single contiguous parcels. Hence, the consultants have assessed the development for potential 500+ units as an opportunity to test larger scale single projects. The case study also considers a key employment area of 10,000 sq.m to further test viability of commercial development with renewable technologies. CS6 was assumed to be a combination of “strategic greenfield and urban regeneration” projects.

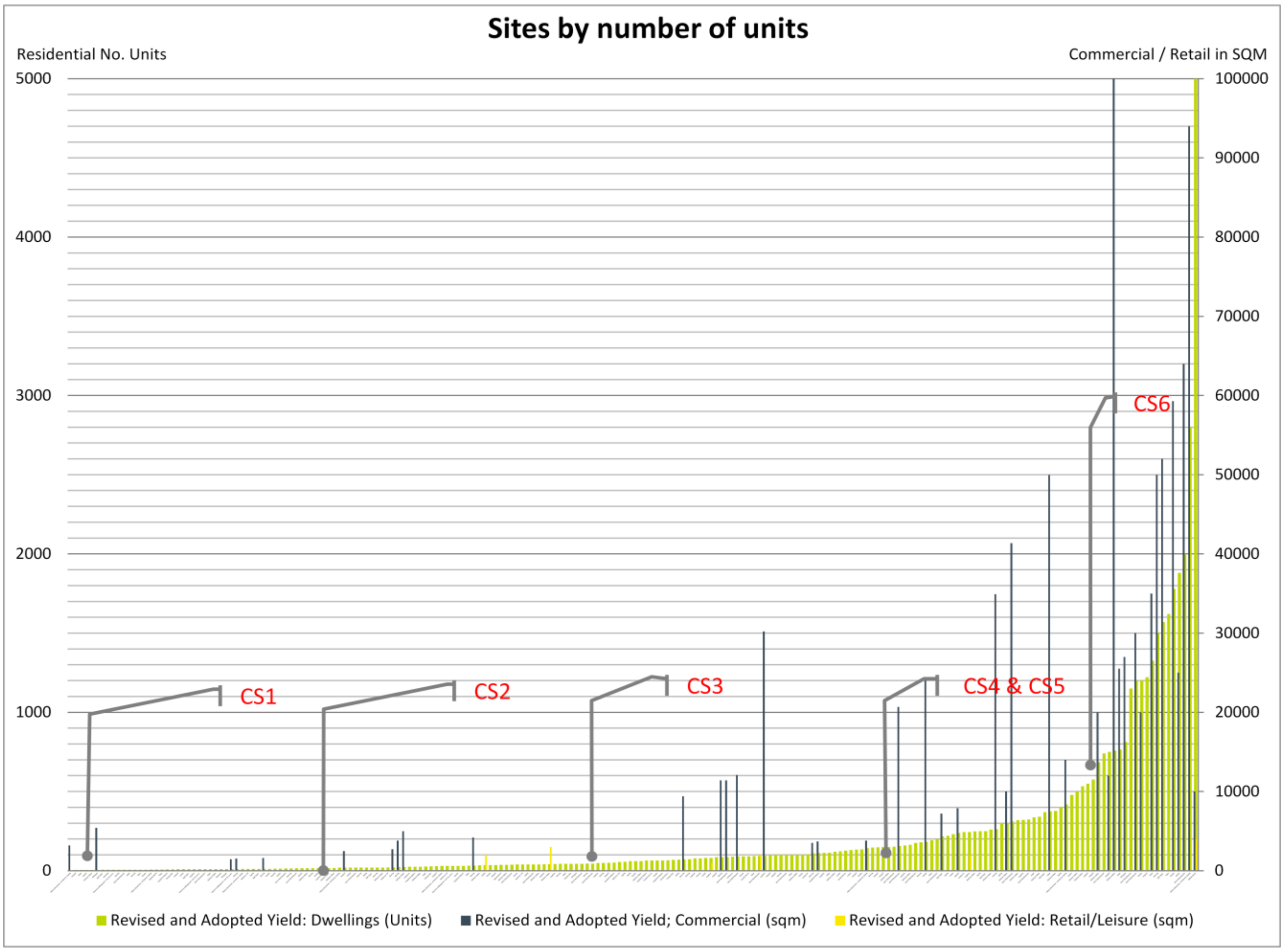
5.37. Furthermore, the details of individual case studies are as set out in Table 9 below:

Table 9. Generic case studies

	APARTMENT		HOUSE			COMMERCIAL	
Viability Case Study	Apartment 1 bed	Apartment 2 bed	Terraced House 2&3 bed	Semi-detached House 3&4 bed	Detached House 4 & 4+ bed	B1	Total Units Total Area (residential)
CS 1 – Small rural scheme				2			2
				202 sq.m		-	202 sq.m
CS 2 – Small urban scheme			5	6	4		15
			393 sq.m	605 sq.m	463 sq.m	-	1,460 sq.m
CS 3 – Small urban infill			18	16	16		50
			1,413 sq.m	1,612 sq.m	1,852 sq.m	-	4,877 sq.m
CS 4 – Medium Density urban infill	24	48	36	36	6		150
	960 sq.m	3,048 sq.m	2,826 sq.m	3,627 sq.m	695 sq.m	-	11,156 sq.m
CS 5 – Low density urban fringe development			54	48	48		150
			4,239 sq.m	4,836 sq.m	5,556 sq.m	-	14,631 sq.m
CS 6 – Large scale mixed urban expansion	45	65	228	129	33		500
	1,800 sq.m	4,128 sq.m	17,898 sq.m	12,997 sq.m	3,820 sq.m	10,000 sq.m	40,642 sq.m

5.38. Figure 46 below identifies the distribution of SLAA sites by number of units and identifies where within the distribution of sites that the selected case studies are. It should be noted the case studies are generic and do not represent a particular site. However, the case studies are derived to be broadly representative of sites across all of the SLAA sites.

Figure 46. Distribution curve of SLAA sites by number of units



Source: EFDC SLAA Database.

5.39. The appraisal showed that scheme returns varied significantly between the case studies. In some cases in current market conditions schemes were identified as not being viable or being marginally viable without considering the additional development costs associated with renewable technologies. In these situations the future improvement in market circumstances was modelled to identify where targets may be achievable later in the plan period. Further detailed illustrations of each case study appraisal and the assumptions used are included in Appendix F sections F5 to F10.

Low and zero carbon (LZC) technology costs

5.40. The choice of technology was based on testing key stages of LZC technology options and does not represent a comprehensive technology viability assessment. However, as set out above the technologies tested represent the technologies with the highest and lowest alternative costs for on-site LZC technologies and so embrace the range of costs for any given technology mix and therefore provide a robust basis to test on-site LZC viability.

5.41. For the purpose of sensitivity testing, the consultant has modelled the range of potential technology costs, based on the more expensive LZC technologies (i.e. solar PV) and CHP (on-site / scheme-wide) in line with proposed technologies and the targets of CfSH. Should technologies be combined then costs will lie within the limits of the renewable costs identified. The study specifically looks at solar PV, CHP and solar thermal technology. In most cases solar PV appears as the most expensive renewable technology to implement and hence served as the best opportunity to test the maximum spectrum of technology costs on the viability of a project. Solar PV also represents the highest carbon savings, but this is for single energy source (i.e. only electricity), and hence a household will need to consider an alternative source for heat which might negate this advantage. The CHP systems overall carbon savings are lower than solar PV but provide a household with heat and power. The cost advantage of solar thermal is substantially cheaper and would appear cost attractive to implement. CHP was considered viable only in case study schemes which were over 50 units. This refers to a single on-site system serving multiple properties, this form of CHP is not viable on projects under 50 units as the installation costs, heat demand and economies of scale do not exist below this scale. The costs for each low carbon technology which were applied and drawn from the tables are included within Appendix F (Sections F5 to F10), which relate to industry benchmarks.

5.42. The above renewable and low carbon technologies were considered in the case studies to evaluate energy savings over the Fabric Energy Standard specified in CfSH. This is particularly relevant to meet CfSH Level 5 Zero Carbon Homes and to explore the implementation viability of accelerating the implementation of these technologies at an earlier stage of the CfSH (i.e. CfSH Level 3 and Level 4). Solar PV was the most effective in Carbon reduction and was able to achieve CfSH Level 5 Zero Carbon Homes across lower density house only case studies (i.e. CS1, CS2, CS3, and CS5) for case studies CS4 and CS6 the greater number of apartments in these case studies offer a lower potential for solar PV whilst the higher density of the scheme mean that energy demands are greater and therefore solar PV was not effective for the higher density schemes. As per the revised CfSH standards zero carbon requirements, where technologies are not able to meet the zero carbon requirements, an allowable solutions could be defined to compensate for unachieved carbon reductions. This is typically benchmarked against the carbon market. For the case studies typically CHP and solar PV were able to meet ZCH requirement through the allowable solutions which were estimated at £50/tonne CO_2[30].

5.43. The following section highlights the differences the identified technologies have on the viability of the development appraisal case studies with sensitivity analysis conducted in Appendix F.

On-site options

5.44. For each of the case studies, Appendix F (Sections F5 to F10) 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 types and policy targets. The tables reflect the substantial carbon saving offered by solar PV as compared to CHP and solar thermal, which is evaluated in further detail in Appendix F (Section F5 to F10)

5.45. In general, with all technologies the cost per sq.m and the cost per unit gradually decrease as the size of the development increases when comparing within minimum technology thresholds. However, there is no clearly quantifiable reduction for economies of scale and this cost reduction shall differ from project to project, hence the consultants have assumed a flat rate for all scales of projects.

Summary of current and future viability with renewable and low carbon technologies

5.46. Sensitivity Testing was conducted (see Appendix G Section G2 &G3) to assess the highest achievable compliance with CfSH with the adoption of renewable technologies across the case studies. The case studies were price sensitivity tested across Hot, Moderate and Cold markets, where Moderate was considered the market benchmark as an average sales value across postcodes. Hot markets represents the highest spectrum of each housing type and were typically at 17-23% premium over the average Moderate market sales values, while Cold markets where typically 16-22% less than Moderate market values and represented the lowest spectrum of pricing in the market.

5.47. The additional costs of the Fabric Energy Standard and the additional LZC technologies required to meet CfSH targets were added to the outputs of the viability assessment of each case study, in order to derive the impact the potential policy targets would have on viability. Each case study was evaluated to meet minimum compliance (CfSH cost over + fabric energy costs).

[30] Current Pricing for allowable solutions is £46/tonne benchmark adopted for estimating Zero Carbon Homes – Zero Carbon Hub

5.48. For the purpose of this study, it has been assumed that a developer's return must be above 20% for a scheme to be viable. The following tables show whether case studies can achieve this developers return, so for case studies where this return is achievable they are shown in green, while case studies where this is not achievable have been shown in red and case studies where developer's returns have been treated as borderline (within 1% of 20%) are shown in amber. Borderline cases are more project specific and the viability may differ depending on the mix of housing types chosen in each project.

5.49. This section summarises the viability of using different renewable and low carbon technologies across the case studies in 2012, 2013 and 2016. The viability assessment across all case studies tests whether CfSH standards can be met as minimum requirement plus the use of renewable and low carbon technologies to reach zero-carbon homes standards. Appendix G provides the full outputs from this assessment.

Table 10. Viability for CfSH compliance in 2012, 2013 & 2016 in Hot markets

2012 - Current Market	Hot Market					
Minimum Compliance with CfSH Level 3 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH3(Minimum Compliance)						
CfSH3 + connected CHP	N/A	N/A				
CfSH4(Minimum Compliance)						
CfSH4 + connected CHP	N/A	N/A				
CfSH4 + Solar PV						
CfSH4 + Solar Thermal						
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						
2013 - *(Based on projected sales CAGR 4.9% and costs CAGR 4.18%)*[31]:	Hot Market					
Minimum Compliance with CfSH Level 4 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH4(Minimum Compliance)						
Cfsh4 + connected CHP	N/A	N/A				
Cfsh4 + Solar PV						
Cfsh4 + Solar Thermal						
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						
2016 - (Based on projected sales CAGR 4.9% and costs CAGR 4.18%):	Hot Market					
Minimum Compliance with CfSH Level 5 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						

5.50. **Hot markets:** Hot markets typically consisted of post codes CM16, IG10 and IG7 broadly located along the M11 commuter corridor to London and Epping the case studies as seen in Table 10 were typically viable for CfSH levels 3, 4 and 5 minimum compliance. In Hot markets all renewable and low carbon technologies are viable to achieve CfSH zero carbon compliance.

[31] Sales Compounded Annual Growth Rate (CAGR) based on average of East of England Mix-adjusted annual house price change, average from 2002-2012 & Cost CAGR based on average BCIS General Building Cost Index - 2000-2012

- **CfSH Level 3 in 2012:** All case studies are able to meet the requirements of CfSH Level 3. The additional viability of CHP technology was achievable over the CfSH Level 3 minimum compliance. This was applicable for CS3 to 6 where the scale of the development allows a CHP Scheme.
- **CfSH Level 4 in 2012, 2013:** All case studies are able to absorb the requirements of CfSH4 and include the additional renewable technology options (CHP where applicable, solar thermal, solar PV).
- **CfSH Level 5 in 2012, 2013 and 2016:** All case studies are able to absorb the requirements of CfSH Level 5 and include the additional renewable technology options (CHP where applicable, solar thermal, solar PV) and allowable solutions at £50/tonne CO_2 to achieve Zero Carbon Homes.

Table 11. Viability for CfSH compliance in 2012, 2013 & 2016 in Moderate markets

2012 - Current Market	Moderate Market					
Minimum Compliance with CfSH Level 3 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH3(Minimum Compliance)						
CfSH3 + connected CHP	N/A	N/A				
CfSH4(Minimum Compliance)						
CfSH4 + connected CHP	N/A	N/A				
CfSH4 + Solar PV						
CfSH4 + Solar Thermal						
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						
2013 - (Projection)	Moderate Market					
Minimum Compliance with CfSH Level 4 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH4(Minimum Compliance)						
CfSH4 + connected CHP	N/A	N/A				
CfSH4 + Solar PV						
CfSH4 + Solar Thermal						
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						
2016 - (Projection)	Moderate Market					
Minimum Compliance with CfSH Level 5 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						

5.51. **Moderate markets:** Moderate markets typically included RM4 located along the M25 commuter corridor. As seen in Table 11, all the case studies were able to achieve CfSH Level 3 and Level 4 minimum compliance with the exception of CS6 which could only achieve CfSH Level 3 minimum compliance. CS2 and CS3 were able to achieve CfSH Level 4 minimum compliance and include solar PV or solar thermal renewable technologies. CS3 was able to achieve the higher non-energy and fabric energy costs of CfSH Level 5 minimum compliance.

- **CfSH Level 3 in 2012:** All case studies were able to meet the requirements of CfSH Level 3 minimum compliance. Over the CfSH Level 3 minimum compliance, CHP technology was achievable for only CS3.
- **CfSH Level 4 in 2012, 2013:** All case studies were able to achieve CfSH Level 4 minimum compliance with the exception of CS6. CS2 and CS3 were able to include additional renewable technologies as well. Based on 2013 projected rates, all case studies were able to achieve CfSH Level 4 and use additional renewables (CHP where applicable, solar thermal, solar PV). CS1, CS4 and CS6 are borderline viable for adopting more expensive technologies like solar PV and due to higher density development lacking sufficient roof area in the case of CS4 and CS6. CS6 suffered some viability issues due to the additional investment of land for employment which was not assessed for CfSH appraisal for development value. However, this is expected to be project specific and will be treated as an isolated case as employment is expected to generate its own value and contribution to renewable energy.
- **CfSH Level 5 in 2012, 2013 and 2016:** Only CS3 was able to achieve CfSH Level 5 minimum compliance with all other case studies unviable. In 2013 projected rates, CS2 and CS3 are able to achieve CfSH Level 5 minimum compliance and with renewable technologies. In 2016 projections, all case studies are able to achieve CfSH Level 5 minimum compliance and use renewable technologies and allowable solutions to reach zero carbon compliance.

Table 12. Viability for CfSH compliance in 2012, 2013 & 2016 in Cold markets

2012 - Current Market	Cold Market					
Minimum Compliance with CfSH Level 3 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH3(Minimum Compliance)						
CfSH3 + connected CHP	N/A	N/A				
CfSH4(Minimum Compliance)						
CfSH4 + connected CHP	N/A	N/A				
CfSH4 + Solar PV						
CfSH4 + Solar Thermal						
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						

2013 - (Projection)	Cold Market					
Minimum Compliance with CfSH Level 4 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH4(Minimum Compliance)						
CfSH4 + connected CHP	N/A	N/A				
CfSH4 + Solar PV						
CfSH4 + Solar Thermal						
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						

2016 - (Projection)	Cold Market					
Minimum Compliance with CfSH Level 5 Building Regulations	CS1	CS2	CS3	CS4	CS5	CS6
CfSH5 (Minimum Compliance)						
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	N/A	N/A				
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon						
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon						

5.52. **Cold markets:** Cold markets included CM17, CM5 and EN9 that are beyond the M11 corridor north and east of the District. None of the case studies as seen in Table 12 were able to achieve CfSH compliance. This is due solely to the significant lower sales values of developments in Cold markets, and the effect of the 40% affordable housing expectation. A revision in the affordable housing percentage should be considered in these markets

- **CfSH Level 3 in 2012**: All case studies were found to be unviable
- **CfSH Level 4 in 2012, 2013**: All case studies were found to be unviable
- **CfSH Level 5 in 2012, 2013 and 2016:** All case studies were found to be unviable

5.53. As seen above CfSH Level 5 Zero Carbon Homes requirement met by renewable technology requirements was only viable in Hot market areas. For most cases, solar PV was able to achieve a reduction for zero carbon requirements, while CHP and solar thermal required allowable solutions to meet zero carbon. Moderate market areas were able to achieve CfSH Level 5 Zero Carbon Homes requirements by 2016. Further details on the viability of each option across case studies have been included in Appendix G Sections G2 & G3.

Policy implications

5.54. **Affordable Housing impact:** The affordable housing requirement has a minimal impact in Hot markets because the market generates higher sales values which result in a higher GDV that is able to absorb the 40% affordable housing requirement. However Moderate areas are close to the development viability threshold across all case studies and can achieve minimum compliance CfSH Level 3 across all case studies. The Cold markets are unviable across all case studies with the current 40% affordable housing threshold. The less favourable economic climate results in lower sale values, and there might be a need to consider an exchange between affordable housing and carbon compliance.

5.55. **Market Pricing:** With over 45% sale price variation between the highest and lowest sales values across the District adopting a uniform carbon policy across the District may not be appropriate. This means that in certain locations or markets in the District it may not be possible to deliver all new residential development meeting CfSH Level 3 requirements currently, Level 4 requirements by 2013 and Level 5 Zero Carbon Homes requirements by 2016. Based on the initial post code assessment (Appendix G), we can determine broad locations where pricing of Hot, Moderate and Cold can be determined. However, further analysis would be required to determine location specific policy suggestions or this could be determined on a case-by-case basis.

5.56. **Allowable solutions:** Depending on the location and achievable affordable housing, the rate for allowable solutions could be raised for larger projects (i.e. over 50 units) to encourage them to use new technology rather than financially contribute to allowable solutions. Currently the minimum requirement of £50/tonne CO_2 over 30 years appears to have a minimal impact on developer margins and therefore provides limited incentive to develop renewable energy on-site. The allowable solutions may be revised to consider varying impact based on size of the project in order to encourage larger projects to develop on-site provisions.

5.57. **Housing Densities &Types:** As seen with the SHMA assessment, the District typically has a higher concentration of housing types with only 15% being apartments. CS4 and CS5 case studies have helped to explore contrasting development densities to evaluate whether higher developer returns and higher carbon standards could be achieved with higher densities.CS4 considered a mix of apartments and houses to assess a higher density (60dph) while CS5 explored a lower density urban expansion (27dph). As seen in Appendix G, developer returns and CfSH were similar for both CS4 and CS5 and hence the higher demand on energy created no clear advantage for CS4. However, it is expected that higher density schemes may help support public transport in some areas and this can help to reduce carbon emissions from transport. However, there is no clearly definable advantage to encouraging or discouraging an increase in housing densities. Higher densities do not necessarily increase the range of LZC technologies that are viable, as although the increased density increases the GDV for the developer it would also increase the energy demands of the scheme and would require additional renewable and low carbon technologies to compensate that may be constrained by physical space (i.e. insufficient roof area for solar PV).

5.58. **Renewable Technology Hierarchy:** Where the viability of a scheme can be proven to be relatively viable, and can accommodate a combination of renewable technologies, it is recommended that the Council makes any requests for additional technologies based on a hierarchy. Such an approach would enable the maximum amount of carbon emissions reductions to be achieved, where there is sufficient revenue in a development scheme. It is suggested that a hierarchy for renewable technologies should be:

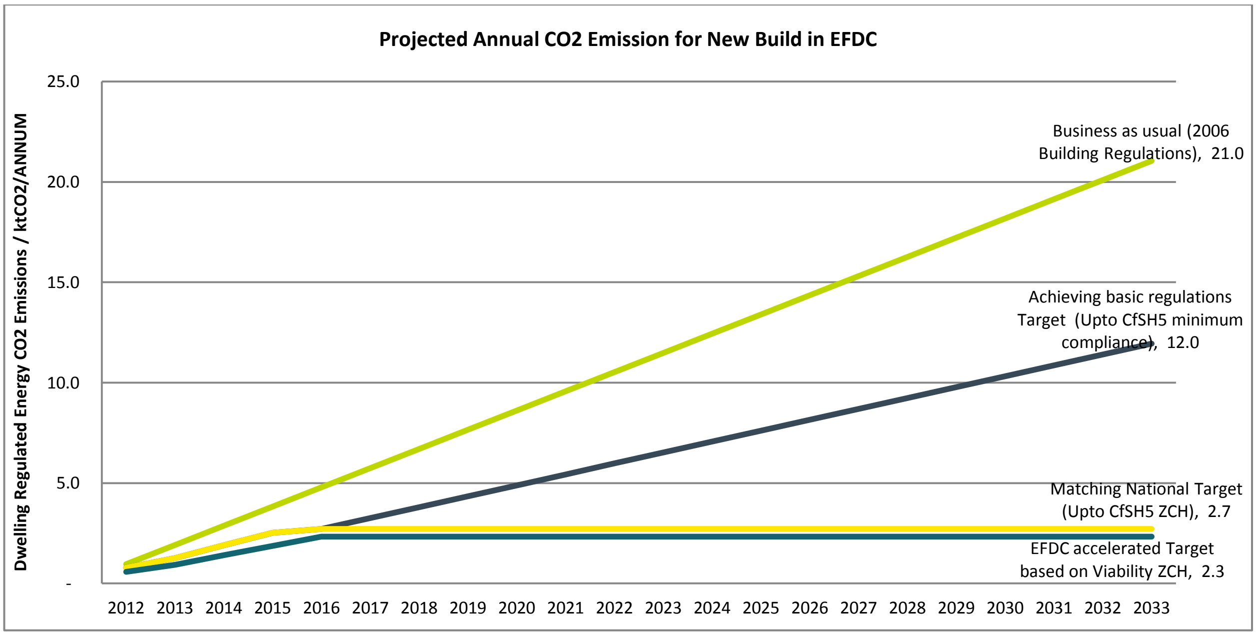
- CHP connections;
- Solar PV and solar thermal technology; and
- Allowable solutions

Projected carbon savings in new build

5.59. Based on the assessment discussed in this chapter, a theoretical projection of the estimated annual carbon emission savings from new housing up to the end of the EFDC planning period in 2033 was undertaken. As seen in Figure 47 by complying with the minimum Building Regulations which are expected to match the requirements of CfSH Level 5 minimum compliance by 2016, all residential new build is expected to add an additional 12 kt CO_2e per annum to the District's carbon emissions (3.7% of current Domestic emissions).

5.60. However, the implementation of micro-generation and CfSH is expected to have a significant impact on carbon emissions from new build. By projecting that in 2016 the Building Regulations standards and CfSH Level 5 Zero Carbon Homes requirements including on-site micro-generation will be implemented, the carbon emission will add only 2.7 kt CO_2e per annum (0.8% of 2010 Domestic emissions) at the end of the planning period as all new homes would be Zero Carbon Homes from 2016 and hence have a minimal impact. If the CfSH Level 5 Zero Carbon Homes standards are implemented across Hot market areas immediately, the resultant CO_2e would be additional 2.3 kt CO_2e per annum by 2033. For the purpose of comparison, if all new build were to be built to the 2006 Building Regulations standard, the resultant impact CO_2e would be an additional 21 kt CO_2e per annum.

Figure 47. Projected annual CO_2 emissions during the planning period



Chapter 6: Assessment of potential from retrofit of existing buildings

Chapter purpose

- To assess the potential opportunity for CO_2e savings through retrofit of existing domestic stock.
- To introduce current and future government programmes to support domestic retrofit.
- To determine the total potential carbon emissions savings through domestic retrofit in the District.
- To highlight key issues for Epping Forest District Council to address to ensure feasibility of implementing retrofitting.

Chapter summary

As seen by the baseline assessment in chapter 3, the domestic carbon emissions in Epping Forest are above the regional average. This chapter has assessed the opportunity for retrofitting residential development in order to increase the standards of energy efficiency and to adopt renewable and / or low carbon technologies to achieve reductions of CO_2e within the District. The key findings of the section are as follows:

The introduction of the Green Deal is expected to support the acceleration of retrofit energy efficiency improvements. The Green Deal being a new framework to enable firms to offer consumers energy efficiency improvements to their homes, community spaces and businesses at no upfront cost, and recoup payments through a charge in instalments on the energy bill. This funding mechanism shall be supported by recent changes to the Energy Act 2011, and the new Energy Company Obligations (ECO) for tackling hard to reach retrofits in deprived and older challenging properties that cannot be covered by the Green Deal.

It is estimated that the dwelling stock in the District that is in need of efficiency improvements includes: 4,703 homes without loft insulation, 17,495 without cavity wall insulation and 7,349 without double glazing.

The energy efficiency improvement options such as loft insulation, solid wall insulation etc. are evaluated in Table 16. The opportunity for CO_2e reduction through retrofit of various energy saving measures across the Districts existing housing stock is as follows:

- Central heating – 1.08 kt CO_2e per annum
- Loft insulation – 2.7 kt CO_2e per annum
- Cavity wall insulation – 7.7 kt CO_2e per annum
- Double glazing – 4.84 kt CO_2e per annum
- Solid wall insulation – 8.7 kt CO_2e per annum

This is total potential carbon saving of 25.02 Kt CO_2e per annum, or approximately 8% of 2010 domestic carbon emissions.

Of these measures cavity wall and loft insulation serve as the most cost effective efficiency improvements in reducing carbon emissions.

The projection of CO_2e from retrofit just from cavity wall and loft insulation (in Figure 51) demonstrated a potential annual saving of 12-13.5 kt CO_2e (2.5% of 2010 emissions) by 2020 covering the entire housing stock in need of improvement. This may be further accelerated through active participation of the Green Deal and ECO to achieve up to 15 kt CO_2e (3 % of 2010 domestic emissions) by 2017.

The current solar PV penetration within the District is below the national average and the Green deal is expected to encourage the take up of retrofit renewable and low carbon technologies with the options discussed in detail in Appendix A.

6. Assessment of potential from retrofit of existing buildings

Introduction

6.1. As seen in chapter 5 new developments can be developed to meet relevant sustainability standards (CfSH) and renewable energy targets in certain market conditions. However, existing domestic housing forms a significant contribution to the District's current and future overall CO_2 emissions. This chapter assesses the potential for carbon savings from retrofitting of existing buildings with energy efficiency measures and renewable energy mirco-generation, and considers the opportunity and challenges of current Government programmes and policies.

Domestic carbon emissions

6.2. As seen in Table 13 Epping Forest District is above the national average for domestic CO_2 emissions, but to make any significant in-roads in reducing these, there is a need to tackle the existing stock through retrofit to address energy efficiency and/or by installing renewable energy through micro-generation so that energy requirements are partly met from renewable energy sources.

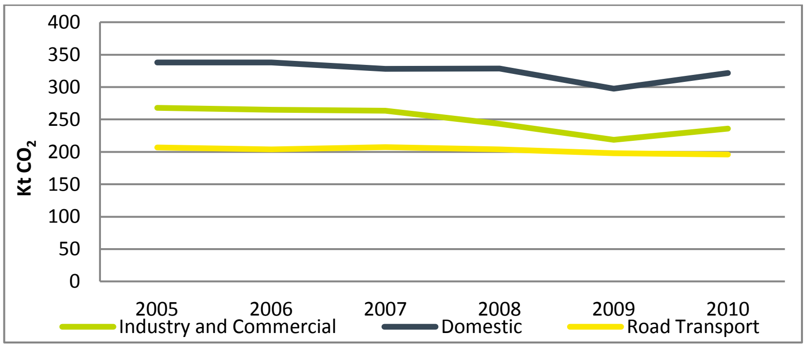
Table 13. Epping Forest and National annual CO_2 emissions 2010

Source	Epping Forest		National	
	Emissions in kt CO_2	**%**	**Emissions in kt CO_2**	**%**
Industry and Commercial	236.13	31%	168,485	41%
Domestic	321.89	43%	146,525	36%
Road Transport	195.89	26%	96,873	24%
Total	753.91		411,883	
Population('000s, mid-year estimate)	124.7		62,263	
Per Capita Emissions (t)	6		6.6	

Source: DECC Local Authority CO_2 Emissions

6.3. A reduction in energy trajectory would require a substantial implementation of energy efficiency measures in the existing stock, in order to support an overall carbon emission reduction strategy. Figure 48 highlights Epping Forest's Domestic CO_2 emissions as the main emission driver. In addition, private housing stock constitutes close to 85% of total housing stock.

Figure 48. Epping Forest CO_2 emissions trend 2005-10



Source: DECC Local Authority CO_2 Emissions

Summary of current Government programmes

6.4. There are a number of previous, current and proposed Government initiatives and policies aimed at reducing carbon emissions from the household sector, they are detailed below.

6.5. The Energy Act 2011 provides the starting point for provision of energy efficiency measures for domestic and non-domestic properties, and improves the current framework to enable and secure low carbon energy supplies. The Energy Act included amendments to the Gas Act 1986, Electricity Act 1989 and the Utilities Act 2000 to enable changes to the new Energy Company Obligations (ECO) and introduction of the Green Deal (described below).

Green Deal

6.6. The Green Deal framework is expected to support and promote the installation of efficiency measures funded by a charge on energy bills to reduce the need for consumers to pay upfront costs. This framework along with the ECO replaces the Community Energy Saving Programme (CESP) and Carbon Emissions Reduction Target (CERT) used in the past. The scheme had a soft launch in October 2012 with a £200 million Government incentive to kick start the programme and is expected to offer a one-off payment for customers taking up the Green Deal between the launch and March 2014.

6.7. The Green Deal funds energy efficiency improvements in full, where the “Golden Rule” is met. The “Golden rule” is that cost savings on a consumer’s energy bill are equal to or greater than the cost of the efficiency measure. There may be efficiency measures that are more costly and these could be part funded by Green Deal with the remaining funding covered by new Energy Company Obligations (ECO) which is discussed below. The funding covers insulation, heating and hot water, glazing and micro-generation. The Green Deal Registration and Oversight Body (GDROB) emphasize the installation processes rather than the point of manufacturing of these measures. The GDROB offers further support and guidance for organisations and individuals to take part as assessors, providers, installers and as certification bodies for Green Deal accreditation.

6.8. The Private Sector Housing Strategy 2012 – 2015 (PSHS 12-15) suggests the opportunity to use the Green Deal to accelerate energy efficiency improvements. In practice, there will be strong incentives and varied opportunities for EFDC to engage with and deliver the Green Deal, in particular the ability to attract new sources of finance (from Green Deal providers) to benefit local communities and businesses. Chapter 9 provides more detail on how EFDC might get involved with the Green Deal. The Green Deal framework offers an increased opportunity for active partnerships with energy companies and others in delivering energy efficiency improvements to individual households and community wide.

Energy Company Obligations

6.9. The Government has placed obligations on energy suppliers to reduce the energy use in the domestic sector and associated carbon emissions, originally through the introduction of Supplier Obligations (SOs). Mandatory targets to implement energy efficiency options were given to suppliers based on a domestic customer base threshold.

6.10. The Energy Act 2011 enabled changes to the Supplier Obligation scheme to form the new Energy Company Obligations (ECO) that covers Affordable Warmth Obligations, Carbon Savings Obligations and Carbon Saving Communities Obligations. Through ECO the Government hopes to target the challenging areas of household carbon reductions which include solid wall properties (typically pre 1919), hard to treat cavity walls and low-income households.

6.11. This scheme is expected to be used in conjunction with the Green Deal and expects a contribution by suppliers of £1.3 billion a year spread between carbon savings (75%) and Affordable Warmth (25%) Obligations. The Energy Company Obligation (ECO) (which works in tandem with the Green Deal) set targets for energy companies to reduce carbon and provide costs savings on heating for low income households and vulnerable households. Carbon savings include: 20.9 million lifetime tonnes, focusing on hard to treat homes, in particular measures that cannot be funded by the Green Deal; and 6.8 million lifetime tonnes focusing on provision of insulation measures and connections to district heating in areas with low incomes.

Feed in Tariff

6.12. The Feed-in Tariffs (FITs) scheme was introduced in April 2010, under powers in the Energy Act 2008. The objective of FITs is to encourage deployment of additional small scale (less than 5 MW) low carbon electricity generation, particularly by organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market.

6.13. FITs allows people to invest in small scale low carbon electricity, in return for a guaranteed payment from an electricity supplier of their choice for the electricity they generate and use, as well as a guaranteed payment for unused surplus electricity they export back to the grid.

6.14. FITs work alongside the Renewables Obligation (RO) – which is currently the primary mechanism to support deployment of large scale renewable electricity generation – and the Renewable Heat Incentive (RHI) which supports generation of heat from renewable sources at all scales.

6.15. The small scale low carbon electricity technologies that are eligible for FITs include:

- wind
- solar photovoltaics (PV)
- hydro
- anaerobic digestion
- domestic scale micro CHP (with a capacity of 2 kW or less)

6.16. The FIT scheme has undergone a number of key changes since its launch in April 2010 these include:

- A reduction in the tariff lifetime for new solar PV installations and extensions from the current 25 years to 20 years.
- New energy efficiency requirements for solar PV installations with a total installed capacity of 250 kW or less.
- The introduction of a multi-installation tariff for solar PV installations where the FIT Generator (owner of the renewable energy technology) or nominated recipient receives FIT payments for 25 or more other installations.
- A digression mechanism for solar PV installations which allows for the periodic reduction in tariffs on the basis of deployment.

6.17. The current FITs payment rates are set out in Appendix C.

Renewable Heat Incentive

6.18. The Renewable Energy Strategy 2009 showed that heat could contribute up to 12% towards meeting the 2020 National CO_2 emission reduction target. The Renewable Heat Incentive program (RHI) is expected to encourage the installation of renewable heat technologies in houses and other buildings as this will tie into the Green Deal framework of financing through savings in energy bills. The scheme is set up to encourage uptake of renewable heat technologies among all householders, communities and businesses through the provision of financial incentives. The RHI provides payments to industry, businesses and public sector organisations in support of renewable heat generation (through technologies such as heat pumps, biomass boilers and solar thermal). The scheme will be expanding to offer the scheme to individual households in summer 2013.

Warm Front and Decent Homes

6.19. The Warm Front scheme and The Decent Homes programme have both successfully improved 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 housing compared with private rented and owner-occupied housing.

6.20. The Warm Front scheme provided grants to vulnerable and low income households for energy efficiency measures including improving central heating, the scheme came to an end in January 2013. In September 2012, amendments to the eligibility criteria of the income-based benefits scheme were introduced to factor in the forthcoming Affordable Warmth Obligation of the ECO.

Also the qualifying Standard Assessment Procedure (SAP) threshold for property is increased from 55 to 63 raising the minimum threshold for energy efficiency and environmental performance of buildings.

Table 14. Summary of funding schemes

Scheme	Buildings Included	Measures Included in the scheme	Funding Arrangements
Green Deal	Residential (private and social) Commercial	Energy efficiency measures • Insulation • Heating • Draught proofing • Double glazing Micro-generation • Solar PV • Solar thermal • Heat pumps • Biomass boilers • Mirco-CHP	Householder / occupier or business apply for funding from Green Deal Provider
Energy Company Obligation (ECO)	Residential (private and social) Low income areas Rural communities Hard to treat (older properties)	Energy efficiency measures • Insulation • Heating	Householders apply for funding from energy suppliers
Feed in Tariff (FITs)	Residential (private and social) Commercial Other uses	Micro-generation (up to 5 MW) • Micro-CHP • Wind • Solar PV	Householder / occupiers or business and public sector organisations receive payment (from energy suppliers) for electricity produced and for electricity exported
Renewable Heat Incentive (RHI)	Residential (private and social) – available summer 2013. Commercial Other uses	Micro-generation • Solar thermal (up to 200 kW) • Heat pumps • Biomass boiler	Householder / occupiers, business and public sector organisations receive payment for heat produced from Ofgem (the scheme administrator)
Renewable Heat Premium Payment	Residential (private and social	Micro-generation • Solar thermal (up to 200 kW) • Heat pumps • Biomass boiler	Householders can claim one of grants prior to the introduction of RHI for residential (in summer 2013)

Historic programme transition

Renewable Heat Premium Payment Phase 2

6.21. The Renewable Heat Premium Payment Phase 2 continues from Phase 1 using conventional one-off grants designed to contribute towards meeting the costs of installing renewable technologies in houses. This is expected to be in place until domestic customers are eligible for the RHI scheme outlined above. The scheme offers grants for solar thermal, heat pumps (air to water, ground source and water source heat pump) and biomass boilers. Phase 2 is more stringent with regards to heat pump installations breaking grant payment into 80% upfront and 20% at the end of the scheme. The scheme has been extended to the end of March 2014, and will then be replaced with the RHI.

EEC Primary Investment Measures

6.22. The original Energy Efficiency Commitment (EEC) involved the first iteration of Supplier Obligations commitments for improving energy efficiency. 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 compact fluorescent 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 and CESP

6.23. The EEC was replaced with the Carbon Emissions Reduction Target (CERT) which ran from 2008 to 2012.The CERT programme involved a change of scope from the EEC scheme, where along with energy savings, carbon emission reductions are required including: the amount of electricity generated or heat produced by micro-generation; and the amount of heat produced by any plant which relies wholly or mainly on wood.

6.24. In March 2011 the Government extended the scheme till December 2012 and increased the lifetime carbon savings target to 293 Mt CO_2 (an increase of 68%). The scheme has been refocused on supporting insulation measures that can deliver deeper carbon and energy savings. The scheme will eventually be replaced when the Green Deal is active.

6.25. The Community Energy Saving Programme (CESP) is a £350 million project that aims to offer free and discounted energy efficiency measures including central heating and insulation and is expected to have around 160 low income communities across the UK. This could also support initiatives for community heating and is expected to run till the end of 2012, when it shall eventually be replaced by the Green Deal and ECO when they are officially launched (expected sometime in 2013).

Local authority responsibility for energy efficiency

HECA

6.26. 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:

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

6.27. In July 2012 new guidance was issued under the HECA that required local authorities to publish a report on their plans to achieve energy efficiency improvement by March 2013. The new guidance is expected to encourage local authorities to identify key opportunities that could attract potential funding partners to work with the authority and other local community groups.

CRC Energy Efficiency Scheme

6.28. The CRC Energy Efficiency Scheme is a Government initiative to reduce CO_2 emissions from large and medium sized public and private sector organisations (this includes local authorities where they meet the qualification criteria). Organisations are eligible based on their half hourly electricity use; they are eligible for CRC if they consumed more than 6,000 MWh per year of half hourly metered electricity during 2008. Organisations required to participate must monitor their energy use and purchase allowances, for each tonne of CO_2 they emit that falls within the scheme. The more CO_2 an organisation emits that falls within the scheme, the more allowances it must purchase. This will provide a direct incentive for organisations to reduce their energy use emissions.

6.29. Following the submission of an initial ‘footprint’ report on energy use, the CRC participants are required to submit an annual report of emissions. The scheme aims to encourage organisations to develop energy management strategies and to promote a better understanding of energy usage and help organisations to save money on energy by reducing energy bills.

6.30. The scheme is administered by the Environment Agency on behalf of DECC, and further guidance on the scheme is provided on the Environment Agency’s website[32].

Method for assessing energy efficiency

Ecohomes XB

6.31. One of the challenges for the Council 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.

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

6.33. EcoHomes XB 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 constraints and practicalities facing existing housing.

6.34. EcoHomesXB has been developed by Building Research Establishment (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 prioritise maintenance and refurbishment works.

6.35. Unlike other BREEAM schemes, EcoHomesXB does not give a rating of pass, good, very good and 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. In June 2012 BRE launched the new BREEAM Refurbishment scheme for domestic buildings with assessment and guidance. In addition non-domestic scheme has been launched with a call for pilot projects.

Profile of existing building stock and its energy performance

6.36. The English Housing Condition Survey (EHCS) is a national physical survey of the existing housing stock in England, and is commissioned by the DCLG. The EHCS merged with the Survey of English Housing (SEH) 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. In addition, the EFDC’s Private Sector House Condition Survey 2011 (PSHCS 2011) examines private sector housing market. The private sector housing

[32] http://www.environment-agency.gov.uk/business/topics/pollution/126698.aspx

market constitutes 85% of housing within the District and was used to validate the assumptions at a local level.

6.37. 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 Epping Forest District. This section identifies an estimate of those dwellings within the District's housing stock that have inefficient energy use and would benefit from energy efficiency measures.

6.38. The EHCS (2010-11) data reveals the proportion of dwellings without central heating, without loft insulation, cavity wall insulation and double glazing. It has been assumed that this proportion can be related to the District based on derived estimates. As such, the probable proportions and number of different housing tenures without central heating, loft insulation, cavity wall insulation and double glazing are shown in Table 15 below. For loft insulation the consultants have considered all lofts without insulation or with less than 50 mm as these are in most need of improvement. Glazing was estimated based on households with none or less than half of their windows double glazed.

Table 15. Estimated dwellings in need of selected improvement

Priority Area	Tenure		
	Owner Occupied	Social Rented	Private Rented / Living Rent free
Total Dwellings	40,558	8,729	4,852
% Distribution	75%	16%	9%
Total and % in need of selected improvement			
Without central heating (Census 2001)	994	49	67
% of total	2%	1%	1%
Without loft insulation (EHCS - No Insulation and Less than 50mm)	2,961	1,048	694
% of total	7%	12%	14%
Without cavity Wall Insulation (EHCS)	13,100	2,881	1,514
% of total	32%	33%	31%
Without double glazing (and units with Less than half double glazing) (EHCS)	4,826	1,859	694
% of total	12%	21%	14%

Source: Derived from English Housing Condition Survey 2010-11 (EHCS) and Neighbourhood Statistics

Carbon savings and indicative retrofit cost estimates

6.39. 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.

6.40. The potential savings and indicative unit costs are illustrated in Table 16. Details are provided for a range of potential energy saving measures, along with their corresponding installation costs and savings (fuel cost and carbon emissions) and the approximate cost per kilogramme of CO_2 saved. The table is ordered by the cost / kg CO_2 saved with the cheapest at the top of the table and the most expensive at the bottom.

Table 16. Energy efficiency options[33]

Measure	Costs	Net Savings		Cost Efficiency[34]
		Fuel Cost £/yr	kg CO_2 /yr	Cost £ / kg CO_2
Draught proofing (tank insulation top up)	£15	Around £40	Around 170kg	£0.11
Draught proofing (pipe Insulation)	£10	Around £15	Around 60kg	£0.21
Loft insulation (DIY 0 – 270mm)	50 to 350	Up to £175	Around 720kg	£0.61
Loft insulation (professional 0 – 270mm)	100 - 350	Up to £175	Around 720kg	£0.61
Cavity wall insulation	100 - 350 (including £250 with subsidy from energy suppliers)	Up to £135	Around 550kg	£0.80
A rated (gas condensing boiler) in place of conventional boiler (from range upgrade from SAP energy efficiency band G & D[35])	£2,300	£150 (for band D) - £300 (for bad G)	420kg (for band D) to 1,220kg (for band G)	£2.36
Solid wall insulation (external) - to U value of 0.35W/M2k	£5,500 to £8,500	Around £445	1.8 tonnes	£4.72
Double glazing up to A (Estimated 16.9 sq.m of window area)	£3,380	Upton £160	820kg	£5.15
Solid wall insulation (internal) - to U value of 0.45W/M2k	£9,400 to £13,000	Around £445	1.9 tonnes	£6.84

Source: Energy Saving Trust

6.41. Of the measures identified insulation (wall and loft) are the two measures which should be initially addressed due to their cost/benefit attributes and significant contribution to CO_2e savings. 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.

6.42. Epping Forest District has a relatively small proportion of the building stock which is pre-1919 (11.8% of the total). There is no data available on how many of these are solid wall construction, or how many have been treated with internal or external insulation. This type of building stock provides additional opportunities, whilst these buildings typically consume 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. To calculate the maximum potential CO_2 saving from solid wall insulation it is assumed that all pre 1919 housing in the District is solid wall construction and it is assumed that given the cost of solid wall insulation that very few properties will have been treated (5%). Assuming savings of 1.8 tonnes $C0_2$ per dwelling if the remaining properties were treated this could save a total of 8.7 kt CO_2 per annum (this assumes efficiency improvements achievable would vary from house to house so CO_2 savings is based on 80% of highest achievable savings).

6.43. Aggregate CO_2 savings for all priority area categories are set out in Table 17. It shows that replacing all conventional boilers in the District with A rated boilers could save a net figure of over 1.1 Kt CO_2 per annum. By ensuring all single glazed windows are replaced by A rated double glazing, the District could save approximately 4.8 Kt CO_2 per annum. Loft insulation in homes, ranging between 50 mm and 270 mm, could reduce the District's carbon emissions by over 2.7 Kt CO_2 per annum. Similarly, cavity wall insulation would reduce carbon emission by 7.6 Kt CO_2 per annum. When the potential savings from this gives total potential carbon savings of 16.2 Kt CO_2 per annum, which is 5% of 2010 domestic carbon emissions.

[33] Data based on energy saving trust benchmark benefits on a 3 bed semi-detached house.
[34] This is a broad estimate based on 80% of maximum CO2 efficiency achieved and should be considered as an indicative guide as there will be significant variation depending on the physical design details of the housing development the quality of efficiency improvement.
[35] The SAP energy efficiency band measures energy efficiency of a home between G (least efficient) to A (most efficient)

Table 17. Potential CO_2 reductions if improvements are made[36]

Priority Area	Tenure: Owner Occupied	Tenure: Social Rented	Tenure: Private Rented / Rent free	Net Savings: Total Fuel Cost £/yr	Net Savings: Total CO_2
				£/yr	kg CO_2 /yr
Central heating (boiler upgrade)					
Carbon emission savings (kt CO_2 /yr)	0.97 Kt	0.05 Kt	0.07 Kt		1.08 Kt
Estimated fuel cost saving (£/yr)	£178,836	£8,761	£12,070	£199,666	
Loft insulation (EHCS - from no insulation and less than 50 mm)					
Carbon emission savings (kt CO_2 /yr)	1.71 Kt	0.60 Kt	0.40 Kt		2.71 Kt
Estimated fuel cost saving (£/yr)	£414,506	£146,654	£97,135	£658,296	
Cavity wall Insulation (EHCS)					
Carbon emission savings (kt CO_2 /yr)	5.76 Kt	1.27 Kt	0.67 Kt		7.70 Kt
Estimated fuel cost saving (£/yr)	£1,414,838	£311,117	£163,490	£1,889,445	
Double glazing (and units with Less than half)					
Carbon emission savings (kt CO_2 /yr)	3.17 Kt	1.22 Kt	0.46 Kt		4.84 Kt
Estimated fuel cost saving (£/yr)	£617,785	£237,999	£88,809	£944,594	

Source: Atkins Estimates based on Energy Saving Trust and EHCS

6.44. In addition the new ECO is expected to allow supplier subsidy and Green Deal finance to align and offer consumer a more integrated support. The Green Deal approach recovers funding through a charge on energy bills that avoids the need for consumers to pay upfront costs. Table 18 is a broad estimate of the potential annual cost savings through efficiency improvements at 80% of the maximum potential for households if the respective technologies are considered as discussed above. The annual cost savings could be approximately £195,000 for central heating boiler upgrade, £650,000 for loft insulation, £1.8 million for cavity wall insulation and £940,000 for double glazing.

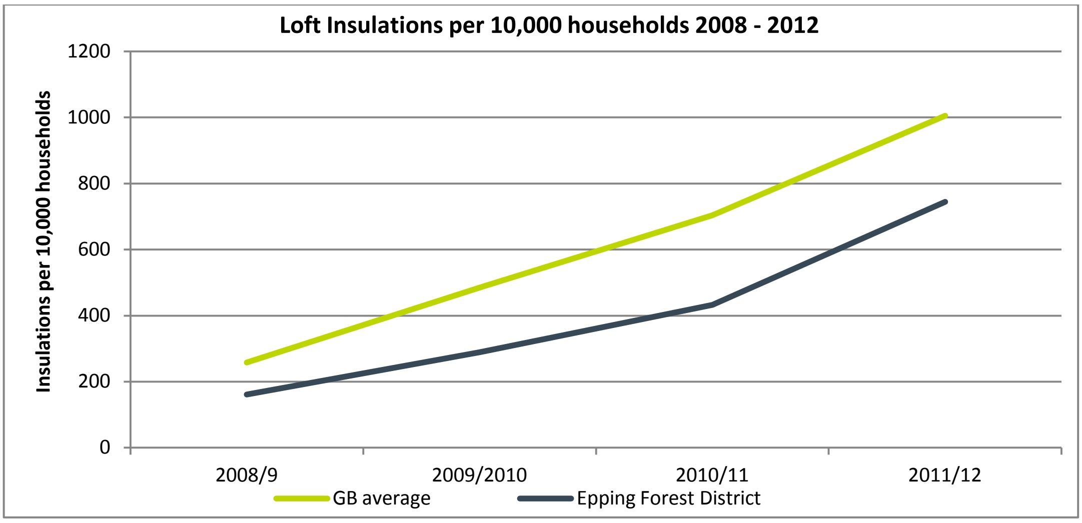
6.45. As per the broad estimate of households in Table 16, a theoretical estimate of the total expenditure for efficiency improvement measures is around £2.5 million for central heating, £1.6 million for loft insulation, £6 million for cavity wall insulation and £24 million for double glazing. Over the lifetime of the Local plan this would require approximately £1.75 million per year for deployment over a 20 year period. This is expected to give 3-5 year payback period if adopting Green Deal principles for loft and cavity wall insulation. However longer periods are expected from central heating and double glazing. These estimates are broadly indicative and shall differ based on housing types, size of units, and physical constraints of implementation within existing homes.

Current pace of adoption

6.46. EFDC's PSHCS 2011 states that the average SAP rating for private sector housing was 54, which is better than the national average for private housing of 51 (the higher the rating the more energy efficient the building). However, when assessing the penetration of loft and cavity wall insulation against the national average over the last 4 years, Epping Forest the last 4 years (Figures 49 and 50) has an opportunity to align with the national average.

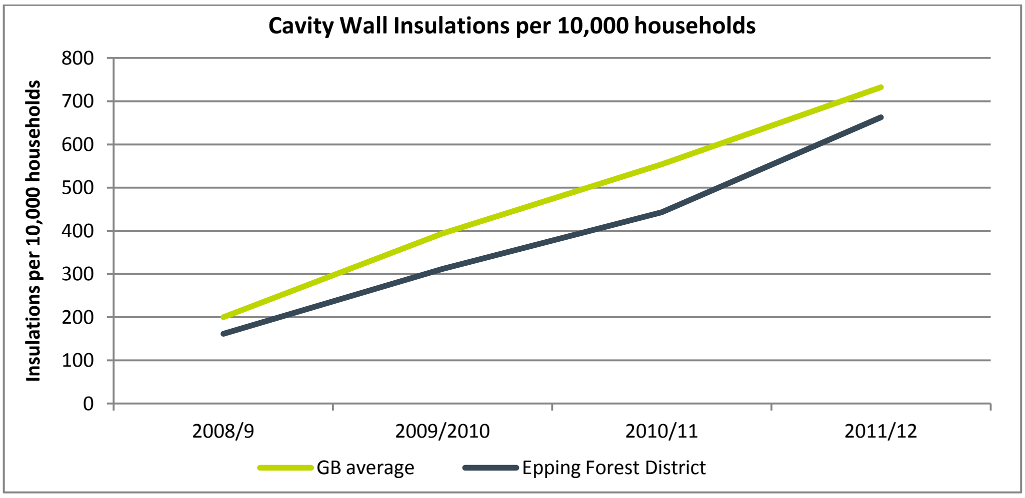
[36] Estimates based on energy saving trust benchmark benefits on a 3 bed semi-detached house. As efficiency improvements achievable would vary from house to house the fuel cost and CO2 savings is based on 80% of highest achievable savings.

Figure 49. Penetration of loft insulation: comparison between UK average and Epping Forest



Source: DECC

Figure 50. Penetration of cavity wall insulation: comparison between UK average and Epping Forest

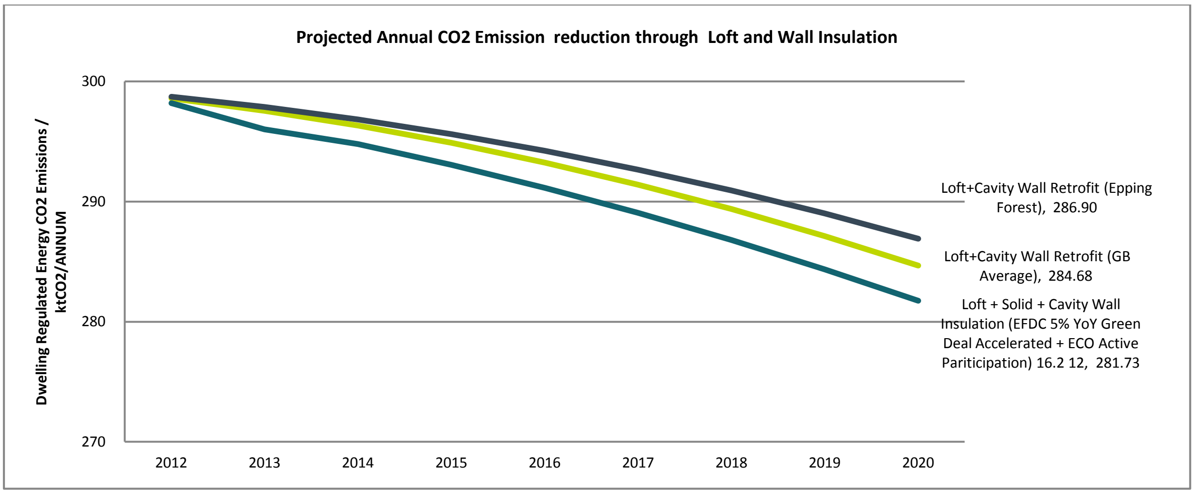


Source: DECC

Potential carbon savings

6.47. Figure 51 projects forward the current rates of take up for cavity wall and loft insulation (shown in Figures 49 and 50) to estimate the length of time it would take to treat all currently untreated homes. If current rates of take up continue, in 8 years all stock would be treated leading to potential carbon emission savings of 3% by 2020. Furthermore, Green Deal and ECO initiatives are expected to accelerate the take up rate (5% year on year estimated – note the level of take will depend on how actively Green Deal is pursued in the District). If active participation is ensured through ECO, and initiatives all treatment of all solid wall homes (typically pre-1919 properties) emissions are expected to reduce by 3.5%, and if the District matches the UK average take up rate this could be achieved by 2017-18.

Figure 51. Projected Annual CO2e reduction through loft and wall Insulation[37]



Source: Consultants

Retrofitting renewable energy solutions to existing properties

6.48. The opportunities within the District relating to the existing stock would be to retrofit renewable energy generation to properties as a home improvement or through refurbishment. Appendix A provides detail on renewable energy and low carbon technologies including: a brief description of the technology; technology considerations; indication of installation costs; indication of power generation capacity; retrofit and installation issues; key advantages and potential funding sources. The key issues relating to retrofit of renewable and low carbon technologies are discussed below.

Technical and cost issues

6.49. 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 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 associated cost implications. In this case, retrofitting renewable solutions in commercial or public sector buildings become more convenient as part of a major refurbishment.

6.50. 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

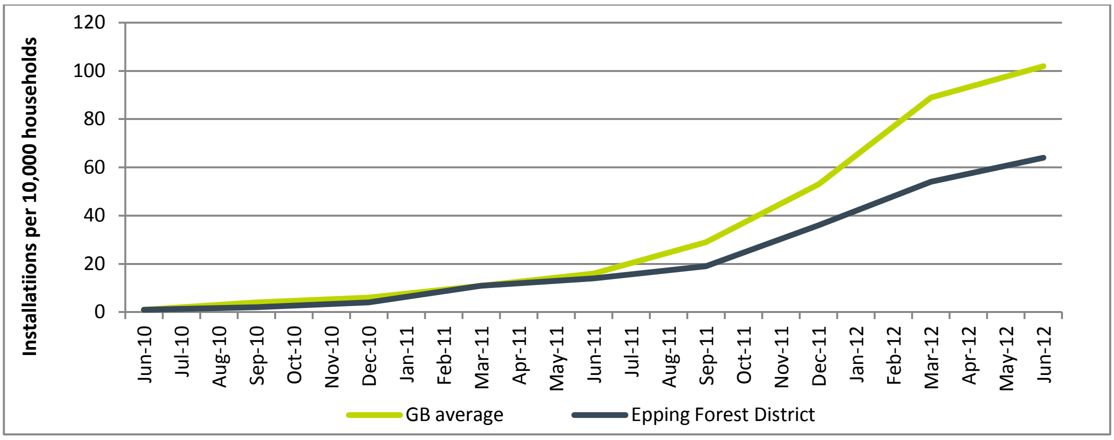
6.51. These systems require optimal positioning of the collector surface. Building orientation and available surfaces for retrofit present opportunities as well as challenges for a successful retrofit. solar PV offers the most opportunities, as these systems can be integrated with windows, skylights, 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[38]. Orientation should be within 30° east or west of south, with orientation towards south being ideal. Adjacent

[37] By 2020 the total housing stock would be exhausted for Loft and Wall insulation based on estimated projections and does not reflect the planning period up to 2033.
[38] 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

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 the earth's rotation, whilst deciduous trees may present a variable obstruction due to the above factors and seasonal growth and loss of foliage. Whilst diurnal and seasonal shading can be accurately simulated (using simulation software) to assess viability, 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.

6.52. Furthermore the active adoption of solar PV and other renewable sources on existing dwellings appears not to match national averages on take up. The current domestic penetration within Epping Forest shows an opportunity for EFDC to encourage active adoption especially considering the proportion of Terraced, Semi-detached and Detached houses that offer a larger roof area for solar PV deployment.

Figure 52. Penetration of solar PV: comparison between UK average and Epping Forest



Source: DECC

Biomass boilers, CHP and biomass CHP

6.53. 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 local air quality, biomass boilers would probably not represent an appropriate renewable energy option. These issues are specifically relevant in conservation areas due to the visibility 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 appropriate space restrictions may lead to a decision to use pellets, as this fuel has a much higher volumetric energy density than woodchip. This 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.

6.54. Natural gas CHP and biomass CHP have greater requirements beyond stand alone heat systems, because the plant requires more space than biomass 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

6.55. 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 kilo Watts 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.

Ground source heat pumps and air source heat pumps

6.56. Ground source heat pumps (GSHP) present 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 under floor 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.

6.57. Air-source heat pumps (ASHP) 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 under floor 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

6.58. The changes to the General Permitted Development Order (GPDO) in 2011 mean that certain types of micro renewables do not require planning permission. The NPPF encourages the installation of renewable technologies within developments.

Solar thermal and solar PV

6.59. 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

6.60. 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

6.61. Small wind systems should involve written permission from the relevant planning authority. A proposed 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.

Ground source heat pumps (GSHP) and air source heat pumps (ASHP)

6.62. 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.

Installation on non-domestic premises

6.63. The recent amendments to allow the technology options on non-domestic premises within specific limits. This includes solar PV, GSHP, water source heat pumps (WSHP), flues for biomass systems and CHP systems and structures for housing biomass boilers, anaerobic digestion systems, hydro turbines and associated waste and fuel stores.

Chapter 7 Assessment of potential from low carbon transportation initiatives

Chapter purpose

- To assess the current transport sector emissions from road transport in Epping Forest District and provide a comparison against other Essex authorities.
- To assess future transport emissions discussing the factors that will influence future levels of emissions in the District, including travel demand, transport measures and vehicle type and efficiency.
- To highlight the transport measures that are within the District's influence that are likely to be most effective in reducing future carbon emissions.
- To identify the potential carbon savings that could be achieved in the District over the plan period.

Chapter summary

This chapter has considered current road transport emissions in Epping Forest District, potential influences on future emissions (including travel demand, transport schemes/measures and vehicle efficiency) and the most effective local action measures for reducing emissions. The key findings include:

- Overall surface transport emissions in Epping Forest District are high, representing the highest level of emissions from a single authority in Essex. However, motorway traffic accounts for over two-thirds of transport emissions in the District, but is considered to contribute to national rather than local authority emissions.

- Transport emissions within the local authority remit contribute 26% to District emissions. Emissions from road transport have been reducing since 2007, though the rate of decline stagnated in 2010. Economic recovery could also reverse this trend.

- Future emissions levels will be influenced by a wide range of factors, categorised into influences on traffic (including influences on travel demand and potential transport measures) and influences on average emissions rate.

- European/national action to promote reductions in emissions from new vehicles will have a significant impact on emissions. However the net impact of low carbon vehicles through the 2030s and beyond will depend significantly on the carbon intensity of electricity generation (and therefore on measures in the energy sector).

- Other influences include a wide range of possible transport measures drawing from plans and strategies that include objectives to reduce carbon emissions, along with other, potentially conflicting, objectives.

- Recent studies have considered the most effective forms of local action to reduce carbon emissions and suggest that the following measures are likely to be the most effective form of action available to EFDC:
    - development planning related measures, tied in with the ongoing development of the 2014 Local Plan;
    - eco-driving programmes; and
    - measures to support low carbon vehicles locally

.

- Detailed modelling and forecasting would be required to calculate the impact of proposed measures. However, the TRACS analysis allows a simple, broad estimate of potential impacts, suggesting that strong implementation of local action that can be influenced by the District can achieve emissions reductions in the in the order of 10%.

7. Assessment of potential from low carbon transportation initiatives

7.1. When considering emissions within the scope of influence of local authorities, road transport emissions contributed 26% of Epping Forest District's overall CO_2 emissions in 2010. This includes emissions from cars, motorcycles, vans, trucks on all roads apart from motorways. If all emissions are considered and motorways are included (DECC full dataset), the share of the transport sector in 2010 was much higher, at 52% of CO_2 emissions in the District.

7.2. The key factors to understand and reduce transport sector emissions are:

- The amount of kilometres driven by each vehicle (number of trips, length of trips).
- Vehicle efficiency, vehicle speeds and driving efficiency (eco-driving) and loading (for example, smaller cars generally emit less CO_2 than larger vehicles per mile driven).
- The fuel used to power the vehicle (for example, electric vehicles do not have tailpipe emissions – although there will be some emissions related to the electricity they use).
- The mode share for the area: how people make their journeys (for example, travelling by car or by bus will emit more CO_2 than walking or cycling).

7.3. This chapter only considers carbon emissions from road transport and the measures that can be introduced to reduce carbon emissions from road transport, it does not consider carbon emissions from other forms of transport such as air travel or rail travel (London Underground and national rail). It should be noted that these forms of transport will generate carbon emissions within the District. However, identifying the amount of emissions that 'originate' in the District from these sources is an issue. EFDC has limited or no control over the carbon emissions generated from these sources, therefore investigation of carbon emissions from these modes of transport are not included in this study.

Current transport sector emissions

7.4. DECC figures[39] show that total land transport emissions in the Epping Forest District in 2010 amounted to nearly 605kT. This accounted for 18% of total land transport emissions across Essex and represented the highest level of emissions generated by a single authority within the county (Figure 53). However, this includes emissions from motorway traffic. When considered over the five years between 2005 and 2010, total transport emissions from the District ranked 215th highest out of a total of 380 local authorities in the UK.

7.5. The total emissions equated to 4.8 tonnes per capita per annum, which is over double the Essex average of 2.4 tonnes per capita per annum and places Epping Forest District second only to Uttlesford (6 tonnes per capita) in terms of per capita transport emissions amongst Essex authorities (Figure 54).

7.6. However, these total emissions reflect the presence of long stretches of two major motorways within the district (the M25 and M11) which generate over two thirds of total emissions. Motorways are considered to be part of the national transport network and the emissions they generate are therefore considered beyond the remit of Local Authorities by DECC[40].

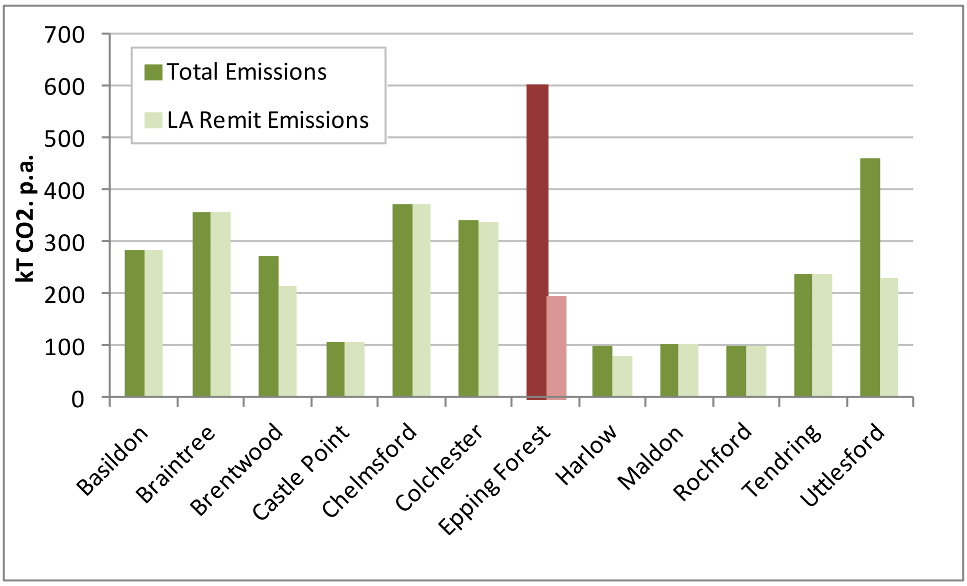
7.7. As outlined in chapter 3, if consideration is limited to emissions within the remit of Local Authorities, Epping Forest District generated just over 195 kt per annum in 2010, accounting for 7% of the Local Authority remit total emissions generated in Essex and lying seventh out of the county's twelve authorities in the ranking of total emissions, as shown in Figure 53. This total

[39] *DECC Local Authority Full Local CO2 emission estimates (2005-2010); http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/data/data.aspx*
[40] *Source: DECC Local Authority Subset Local CO2 emission estimates (2005-2010) http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/data/data.aspx*

equates to 1.6 tonnes per capita per annum, falling just below the County average of 1.9 tonnes per capita per annum and again lying seventh in the ranking of Essex authorities (Figure 54).

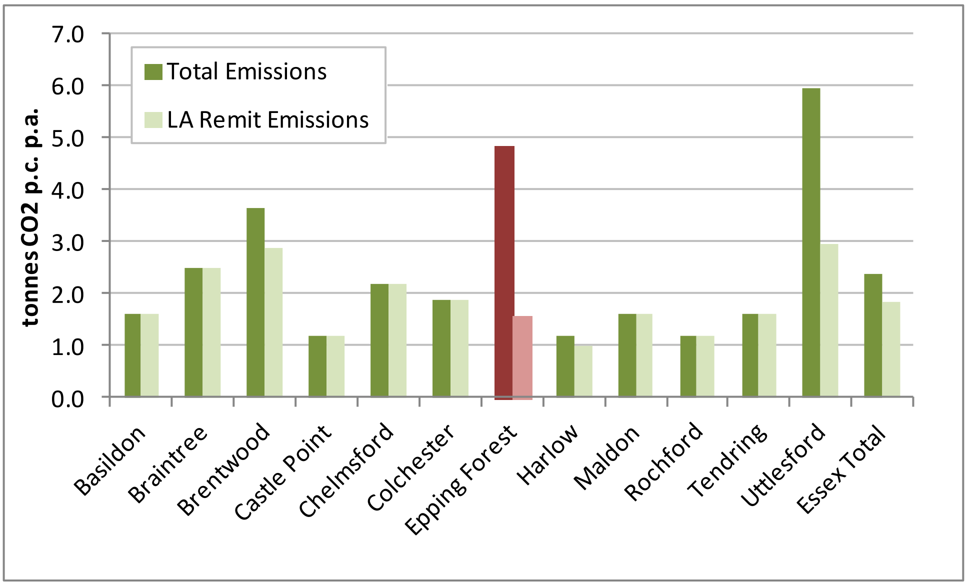
7.8. Even without the national network emissions, transport emissions in the District are significant, accounting for 26% of total Local Authority remit emissions identified by DECC for 2010.

Figure 53. Total land transport Emissions in Essex districts, 2010 (kt CO_2)



Source: DECC, 2012

Figure 54. Land transport emissions per capita in Essex districts, 2010 (t CO_2 p.c.)

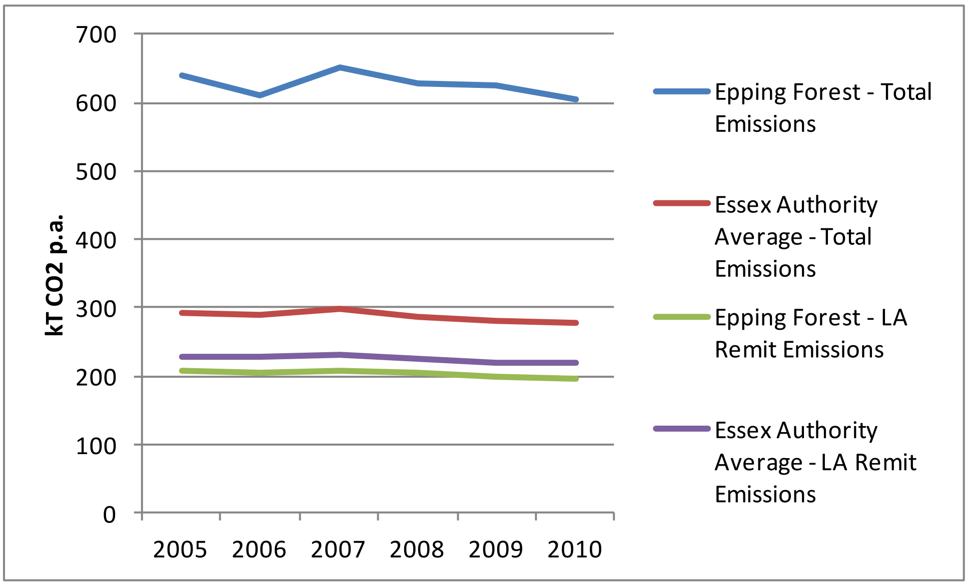


Source: DECC, 2012

7.9. As mentioned in chapter 3 there has been a general pattern of slight decline in emissions within Epping Forest District between 2005 and 2010, both on the national and local network and in absolute and per capita terms, with some evidence of stagnation between 2009 and 2010.

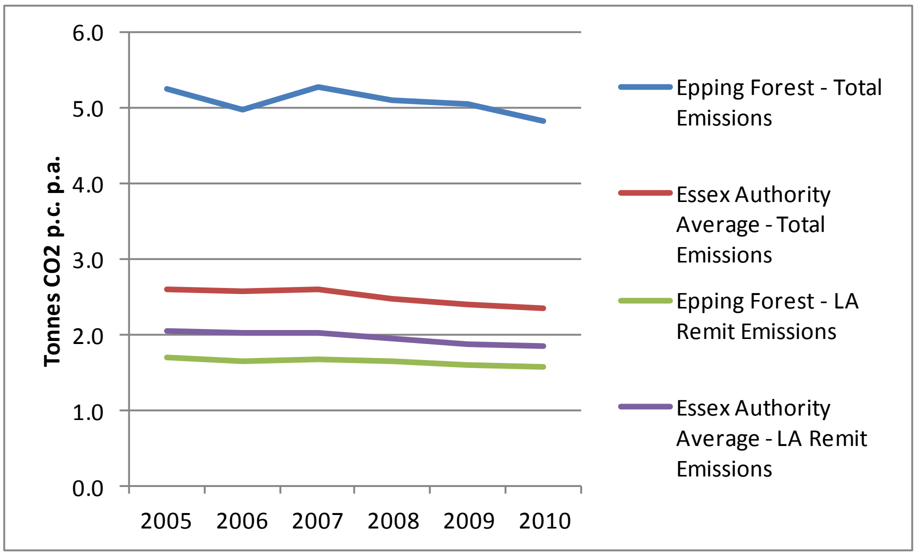
7.10. As Figures 55 and 56 show, this pattern is consistent with the pattern in Essex as a whole. The Committee on Climate Change (CCC) 2012 progress report[41] also identifies a similar pattern nationwide. The report attributes the recent decline to improved vehicle efficiency and reduced travel associated with the economic recession and to the offsetting effects of improved efficiency of car travel and increased distance travelled by heavy goods vehicles (HGVs) and light goods vehicles (LGVs). This leads the CCC to warn that there is a risk of emissions increasing with economic recovery as people potentially purchase higher emitting vehicles and travel further again.

Figure 55. Epping Forest District and Essex authority average land transport emissions, 2005 - 2010 (kTCO_2.)[42]



Source: DECC, 2012

Figure 56. Epping Forest and Essex authority average land transport emissions per capita, 2005-2010 (t CO_2 p.c.)



Source: DECC, 2012. Note: Total Emissions include motorway emissions, LA Remit Emissions are emissions from traffic on those roads that local authorities

[41] Meeting Carbon Budgets – 2012 Progress Report to Parliament Committee on Climate Change, June 2012
[42] Does not consider highway transport passing through the LA.

Future transport sector emissions

7.11. Future transport emissions in the District will be primarily influenced by two key factors:

- Changes in traffic levels; in turn influenced by:
  - changes in travel demand; and
  - transport measures/schemes (influencing transport behaviour);
- Changes in vehicle efficiency/type (i.e. average emissions per kilometre travelled).

7.12. The following sections provide further detail on each influence and its likely impact on emissions.

Travel demand

7.13. Travel demand change will be driven by the forecast change in population and employment in the District, along with location of development (and its impact on length of journeys) and population characteristics such as age, vehicle ownership and disposable income (linked to economic conditions as discussed above).

7.14. Development growth is forecast for Epping Forest District, although the scale and location are subject to the ongoing consultation for the revised 2014 Local Plan and therefore the jobs and housing growth numbers are not yet finalised. The Issues and Options for the Local Plan document[43] released as part of the consultation highlights that forecasts will be subject to variation but indicates growth in the order of 3,960 additional jobs and approximately 10,000 extra dwellings between 2011 and 2033,[44].

7.15. These local influences will be the primary determinant of growth on the local transport network. In contrast, travel demand on the motorways and other national roads will be influenced by wider factors across the county, region and further afield and so will be likely to grow in line with forecasts for the wider region.

7.16. The DfT's Road Transport Forecasts 2011[45] provide forecast traffic levels for future years for each road type in each region. Table 18 below sets out the forecast for the East of England showing estimated future traffic levels on national and local roads in 2020, 2025 and 2030 in terms of a percentage increase from 2010 levels.

7.17. The second half of the table provides an indication of the equivalent forecast of traffic growth in Epping Forest District over the same time period, calculated for this study on the basis of the discussion above and a comparison of forecast growth in the number of trips in the District and the rest of the East of England given by TEMPRO (the DfT's tool for forecasting trip numbers on the basis of development forecasts)[46], adjusted to reflect more recent views of likely development levels in the District.

7.18. The figures show that although forecast traffic growth for local road in the District is below the regional average, the increase forecast on local and particularly national roads remains significant, with associated implications for traffic related emissions.

[43] Planning Our Future: Community Choices: Issues and Options for the Local Plan, Consultation Document, July 2012, Epping Forest District Council

[44] Note the forecast growth in housing units is considerably larger than the levels cited in the Essex Transport Strategy: the Local Transport Plan Essex, June 2011. This relied on indicative current permissions only, amounting to just over 1,120 dwellings

[45] Road Transport Forecasts 2011, Results from the Department for Transport's National Transport Model http://www.dft.gov.uk/publications/road-transport-forecasts-2011/

[46] TEMPROv5.4 https://www.dft.gov.uk/tempro/downloads.php. This is not the most recent version of TEMPRO (v6.2) but has been used for consistency with the DfT Road Traffic Forecasts 2011

Table 18. Forecast traffic growth, East of England and Epping Forest District *(Source: DfT National Road Transport Forecasts, 2011 and TEMPRO v5.4 adjusted*[47]

Road Type	% change from 2010		
	2020	**2025**	**2030**
DfT Figures: East of England			
*National Roads**	19%	33%	42%
Local Roads	8%	18%	31%
Total	12%	23%	35%
Estimated Figures: Epping Forest District			
*National Roads**	19%	33%	42%
Local Roads	4%	10%	17%
Total	14%	25%	34%

Future transport measures and schemes

7.19. A number of bodies have the potential to influence the implementation of transport measures and schemes in Epping Forest District in future years, with associated impacts on transport emissions.

7.20. At the largest geographic scale, the DfT and Highways Agency will be responsible for any changes to the national network (i.e. rail and the motorway and trunk road network). The key current proposals[48] influencing the national roads in the District are:

- **M25 Later Upgraded Schemes: Section 5, Junctions 23-27:** This section of the motorway passes through the District. A managed motorway all lane running scheme that permits continuous hard shoulder running, effectively widening the M25 from three lanes to four. Construction is expected to start in 2013 with the opening year by 2015; and
- **A14 Cambridge to Huntingdon Improvement:** Replacing the previous A14 Ellington to Fen Ditton scheme which was withdrawn following the Comprehensive Spending Review (CSR)[49]. A study was completed following the withdrawal of the previous scheme and concluded that capacity improvements on the A14 would address problems in the vicinity of the scheme, but could make north-south routeing via the M11-A14-A1(M) more attractive and amplify forecast stress and delay on these links (which could therefore have a negative impact on emissions in the District). It is also noted that the new road scheme is expected to involve tolling[50] which could result in strategic reassignment from the M11 to the A1 to allow a toll free route to the north of England.

7.21. Conditions on the national road network also affect the adjoining local road network (although it should be noted conditions on the national road network are beyond the control of the District Council). For instance, anecdotal evidence suggests congestion and subsequent pollution is an issue when there are problems on the M11 or M25 (both of which pass through the District) which lead to traffic diverting onto local routes. National proposals to improve reliability on the strategic network should therefore result in fewer diversions through the District, as well as improving

[47] The 2011 Road Transport Forecasts are based on forecasts of trip numbers from TEMPRO v5.4. Estimates of local traffic growth in Epping Forest District have been made on the basis that the ratio between the local traffic growth rates in the District and region would be the same as the ratio between the estimated growth in trip ends in the District and region. Regional trip end growth was taken directly from TEMPRO v5.4 (to be consistent with the 2011 DfT Traffic Forecasts). The District's trip end growth was derived by adjusting the TEMPRO forecasts for greater consistency with current views on likely development growth (3960 jobs between 2011 and 2033 and 10,000 additional houses). Traffic on national roads in the District was assumed to grow at the same rate as forecast across the region on average by the DfT

[48] A scheme to widen the M11 from three to four lanes has also been previously planned but it was announced in the 2011 CSR that no major highway schemes were planned for the M11 until at least 2021.

[49] http://www.dft.gov.uk/publications/spending-review/

[50] http://www.dft.gov.uk/news/press-releases/dft-press-20120718b/

conditions on the national roads. It is not possible without modelling (which is beyond the scope of this study) to assess what impact of these schemes would have on traffic and therefore carbon emissions.

7.22. Local and national roads are also influenced by the presence of Stansted Airport just to the north of the District in Uttlesford. Although the airport is well served by public transport links to London, car is the dominant mode for access for journeys from within Essex. Therefore, although Stansted is part of the national transport infrastructure, changes in transport provision for it will influence traffic levels within Epping Forest District.

7.23. At the County level, the key influence on future transport measures will be the Essex Transport Strategy 2011[51]. This is a fifteen year vision for transport which forms part of the Essex's 2011 Local Transport Plan, along with a three year implementation plan which is yet to be published online.

7.24. The Strategy identifies:

- Five intended outcomes:
    - Provide connectivity for Essex communities and international gateways to support sustainable economic growth and regeneration.
    - Reduce carbon dioxide emissions and improve air quality through lifestyle changes, innovation and technology.
    - Improve safety on the transport network and enhance and promote a safe travelling environment.
    - Secure and maintain all transport assets to an appropriate standard and ensure that the network is available for use.
    - Provide sustainable access and travel choice for Essex residents to help create sustainable communities.
- Fifteen policies to achieve the stated outcomes, which include:
    - Integrated planning.
    - Carbon reduction.
    - Promoting sustainable transport.
- Other issues such as congestion and network resilience, connectivity, freight movements and safety.
    - Key priorities by geographical area. Of these, the most relevant for Epping Forest District are those for the West Essex local centres (which include Epping and Loughton), inter urban routes and Stansted airport as summarised in the Figure 57.

7.25. The Strategy also identifies a wide range of potential measures under each policy heading that could be applied across Essex to support the delivery of the desired Strategy outcomes.

7.26. Of the range identified, the most relevant in the context of carbon reduction include the promotion of sustainable transport options through provision of cycling, walking and public transport options, travel planning, information provision and actions to improve ticketing and interchange. Careful co-ordination with the local planning authorities to mitigate the travel demand and car use associated with planned new developments is also highlighted as a priority. Promotion of low carbon vehicles through support for required infrastructure (again in association with local planning authorities) and through leading by example using the Council's own fleet is also identified as a key area for activity. Finally, improving traffic flow through the use of Intelligent Transport Systems (ITS)[52] is identified as a good way of alleviating congestion and associated emissions.

7.27. These measures are all featured under the Strategy policies to reduce carbon emissions and promote sustainable transport. However, it is important to highlight that measures identified to help achieve other outcomes, such as those to help improve connectivity or alleviate congestion

[51] Essex Local Transport Plan 2011 – Essex Transport Strategy: the Local Transport Plan Essex, June 2011.
[52] ITS involves the use of electronics, computing and communications systems to monitor a range of information on traffic conditions and combine the information to determine and then communicate, in real-time, appropriate strategies to improve the conditions(for instance recommending changes in signal settings, speed limits or use of diversion routes).

are likely to promote increased travel and emissions, offsetting some of the reductions potentially achieved by the carbon reduction measures.

Figure 57. Essex Transport Strategy, priority measures for west Essex local centres, inter-urban areas and rural Areas

Measures to promote use of alternative transport modes: ○ Providing for and promoting access by sustainable modes of transport to development areas (for the forecast 1,120 new dwellings by 2021 and 3600 new jobs by 2031). ○ Improving passenger transport connections to and between the local centres, key services and Harlow. ○ Improving the attractiveness and usability of streets and public spaces (public realm measures). ○ Improving cycling and walking routes and promoting their greater use. ○ Improving connections to London, working with Transport for London to make best of and manage access to Underground links (including the links to the Central Line within Epping Forest). ○ Lobbying Government for improvements to West Anglia rail services. ○ Improving access to Stansted Airport from within West Essex by sustainable forms of travel.	Measures to promote connectivity/reliability: ○ Improving links with surrounding rural areas. ○ Lobbying Government for improvements to journey time reliability on the M11 corridor. Measures for rural areas: ○ Support the economy of rural towns/villages. ○ Provide support for access to services. ○ Minimise the impact of transport on the character of the area. Future transport measures in the district will also be influenced by the actions of the Harlow Stansted Gateway Transport Board which brings together partners including Hertfordshire County Council, Harlow, East Hertfordshire and Epping Forest district councils, the operators of Stansted Airport and local public transport operators to develop a combined approach to transport in the area.

7.28. Within Epping Forest District itself, the Council's own influence on transport is strongly linked with that of the county, as identified in Essex's Transport Strategy which highlights the need to co-operate with districts for key measures, such as planning and low carbon vehicle support.

7.29. Both the current Epping Forest Local Plan[53] and consultation documents for the revised 2014 plan[54] (to tie in with the Government's recently introduced NPPF) emphasise the importance of integrating land use and transport planning and promoting sustainable transport in development decisions, through decisions that reduce the length of journeys required and promote viable alternatives to car use.

7.30. Identified measures to help achieve these aims include decisions on:

- Development location and density – one of the twelve core planning principles of the NPPF states that planning should "actively manage patterns of growth to make the fullest possible use of public transport, walking and cycling, and focus significant development in locations which are or can be made sustainable". The Solutions London and Wider South East study[55] considered the impact of various land use scenarios on associated transport patterns and resulting CO_2 emissions in the south east of England. The current (in 2009) spatial strategy for the area was assessed to result in a 34% increase in emissions by 2031, mainly due to additional car travel and congestion. A "Compact City"

[53] Epping Forest Local Plan, Adopted 1998 and Alterations, Adopted 2006 http://www.eppingforestdc.gov.uk/index.php/home/file-store/category/174-alterations-2006
[54] http://www.eppingforestdc.gov.uk/index.php/contact-us/consultation/planning-our-future/local-plan-process
[55] http://www.suburbansolutions.ac.uk/documents/Case%20Study%20London%20&%20WSE%20-%20Final%20Report%20RevA%20Aug12.pdf

option achieved a 1% reduction in transport emissions and a "Dispersal Option", following market demand, resulted in a 1.8% increase in transport emissions.

- Promotion of mixed use development and the provision of services (shopping, leisure, etc.) in rural areas to reduce travel. A recent study[56] to determine the impact of land use scenarios on car ownership and mode choice found that areas with a short walk to amenities are associated with a 6% decrease in the share of distance travelled by car compared with areas with a medium walk to amenities, and an 11% decrease compared with areas with a long walk to amenities.
- Adjusting permitted levels of parking provision for developments (maximum car parking standards) is also identified as a possible means through which to influence travel choice. Although this needs to be implemented in conjunction with public transport, walking and cycling services and infrastructure to avoid high car parking demand resulting in parking management issues.

7.31. The planning process can also be used as a means through which to support county level transport planning and promotion of sustainable transport options, through planning conditions and agreements requiring the development and implementation of travel plans, support for car clubs and car sharing for new developments and developers' contributions for transport infrastructure provision. For example, some planning authorities require developers (depending on the size and the expected impacts of the proposed development) to provide funding for a travel plan coordinator or to establish a bus service to the new site.

7.32. Finally, at the smallest scale, Epping Forest within the District (and crossing into London) also has its own transport strategy for 2009 to 2016, released in 2008[57] to recognise the particular needs of and pressures on the Forest. It was developed through a partnership between Essex County Council, the City of London Corporation and the London Boroughs of Redbridge and Waltham Forest and focuses particularly on cycling and horse-riding provision, including traffic calming and road closures to car traffic to provide a quiet environment for cycling and riding.

Vehicle efficiency and type

7.33. The influences outlined above will affect the future level of traffic in the district. Future emissions will also be affected by the type and efficiency of vehicles making the journeys and therefore the emissions produced per kilometre. These factors are currently largely influenced at the European and national level but will have a significant impact on emissions levels and the impact of other measures.

7.34. In its recent report on potential for Local Authority action on carbon reduction[58], the Committee on Climate Change suggested that 80% of transport abatement potential identified for 2020 in its scenarios results from forecast improvements in fuel and carbon efficiency of vehicles.

7.35. The Transport and Carbon study (TRACS) [59] for the East of England Development Agency in 2009/2010 also highlighted the significance of vehicle efficiency and type for future emissions.

7.36. The study considered the emissions from transport in the region for a Business as Usual (BAU) scenario and for scenarios with different levels of intervention to reduce transport carbon.

7.37. The BAU consisted primarily of the impacts of forecast employment and population growth and large scale committed transport schemes (as they stood in 2009)[60], with only limited change in the average efficiency of the vehicle fleet (assuming the continued introduction of current vehicle

[56] Dargay, Land Use and Mobility in Britain, 2009 as quoted in Committee on Climate Change, October 2009 Progress Report

[57] Epping Forest Transport Strategy proposals 2009-2016.

[58] How local authorities can reduce emissions and manage climate risk. Committee on Climate Change, May 2012

[59] East of England Transport and Carbon Study (TraCS), Final Report, November 2009 and Supplementary Report, April 2010 The study was commissioned to quantify the current and future impact of transport on total carbon emissions in the East of England and consider how transport could contribute to the regional target of a 60% reduction in emissions across all sectors by 2031 (relative to 2009

[60] Forecasts were based on the Reference Case from the East of England Regional Transport Model (EERM). This included the assumptions (current in 2009) for planned growth of housing and economic development, transport schemes and investment and highway travel costs. EERM is a strategic model so its results were supplemented with a spreadsheet model to allow a better reflection of local trips.

types). Forecast traffic growth in the region was 45% between 2006 and 2031 (compared to 35% between 2010 and 2030 in the current DfT forecasts described above) and the BAU scenario led to forecast emissions growth of 22% across the East of England or 19% in Essex (district level forecasts were not produced) (Table 19).

7.38. Scenario 1 then primarily considered the impact of meeting committed European targets for vehicle emissions reductions (which are broadly consistent with the measures included in the current Committee on Climate Change (CCC) scenarios, including meeting a target of an average 95 g CO_2 per km for new cars produced in 2020).

7.39. The results suggested a 9% to 17% reduction in total land transport emissions (including those associated with electricity generation) compared to the BAU in 2031, reducing 2031 emissions to be much closer to 2006 levels. The range of results reflects different possible assumptions on the carbon intensity of electricity generation (varying between current intensity and 50% of current intensity).

Table 19. Estimated forecast emissions from transport for Essex and East of England (BAU) (Source: TRACS, 2009/2010)

Area	Emissions ($MtCO_2$ pa)			% Increase (2006 to 2031)	
	2006	2031 (forecast) BAU	2031 (forecast) Scenario 1*	BAU	Scenario 1*
Essex	3.0	3.6	3.0 to 3.4	19%	-2% to 8%
East of England	13.2	16.3	14.0 to15.5	23%	1% to12%

** The range for Scenario 1 reflects different possible assumptions on the carbon intensity of electricity generation, varying between current intensity and 50% of current intensity*

Summary of influences on future transport emissions

7.40. The previous sections highlight the fact that there will be a wide range of influences on future emissions levels in the District.

7.41. Travel demand is likely to increase as a result of the forecast growth in households and employment, as well as changing characteristics of the population (such as vehicle ownership), leading to likely emissions growth.

7.42. As discussed, the impact of transport measures and schemes proposed in the District is likely to be mixed. Some measures, particularly those to meet objectives related to connectivity, accessibility and congestion relief are likely to lead to increased emissions. However, the need to promote sustainable transport options and reduce transport related emissions is recognised as an objective in the strategies and policies in force at each geographical level and therefore a wide range of measures are proposed which would act to mitigate carbon emissions and offset the growth.

7.43. The ongoing action to reduce emissions from new vehicles (to meet European targets) will also have a significant impact on reducing emissions, as described above. The CCC suggest that, in the short term to medium term (up to 2020), action affecting vehicle efficiency (driven at the European level) will have the most significant impact on emissions, accounting for about 80% of the total carbon reductions achieved in 2020 in the CCC proposed scenarios to meet the carbon budgets. However, local action remains very significant over all time scales, both to achieve the additional 20% of abatement in 2020 and to set in progress the changes that need to build up to support the larger reductions in emissions required over the longer time frame. This includes establishing the infrastructure and support for electric vehicles which form a key part of the CCC’s 2030 scenarios and the cumulative effect of measures related to development patterns and behaviour change which also become increasingly significant in the CCC scenarios.

7.44. The next section provides a summary of those initiatives that could be undertaken or influenced at the district level that have the greatest potential to reduce carbon emissions.

Low carbon transport initiatives

7.45. There have been a number of recent studies into the most effective forms of action at different geographical scales to mitigate carbon emissions. In particular, the CCC published its report How local authorities can reduce emissions and manage climate risk in May 2012 (considering measures in all economic sectors) and the 2009/2010 Transport and Carbon Study for EEDA considered the issue specifically for the transport sector in the East of England. Both studies identify measures that are generally already acknowledged in the Essex Transport Strategy and consultation papers for the 2014 Epping Forest Local Plan. However, the range of potential actions identified in the documents is wide and their definitions can be imprecise. This section therefore provides further evidence to help prioritise action to achieve emissions abatement.

Committee on Climate Change (CCC) May 2012 report

7.46. The Committee on Climate Change report focuses particularly on three categories of measure:

- promoting sustainable travel;
- planning and designing new developments; and
- promoting low carbon vehicles.

7.47. A number of measures are suggested to help promote sustainable travel, in particular promoting ‘Smarter Choices’ (i.e. use of sustainable travel options) through measures such as travel plans, car clubs and walking and cycling infrastructure improvement. Improved public transport provision, local parking standards and efficient freight logistics are also identified as potentially significant contributory measures.

7.48. The report recommendations on planning and designing new developments focus on increasing the density and size of urban areas to improve potential for successful provision of alternative modes to car and to reduce the need for travel. The NPPF also recognises the opportunity for carbon reduction provided through locating new development in sustainable locations.

7.49. The CCC recommendations on low carbon vehicles focus particularly on supporting the uptake of electric vehicles as their scenarios for the achievement of the national carbon targets include up to 100% penetration of electric cars and vans in 2050. This requires 100% of new vehicles purchased to be electric by the second half of the 2030s, implying considerable progress in the nearer future. The Report suggests three key mechanisms for promoting uptake:

- Rolling out charging infrastructure – to help promote confidence in the technology and encourage early adoption.
- Provide incentives for low carbon vehicles – for instance through parking spaces (reserved spaces or reduced rates for low carbon vehicles), use of dedicated road lanes or bus lanes.
- Supporting the purchase of hybrid and electric buses.

7.50. The Report also identified a role for authorities to lead by example, with suggested approaches including purchase of low carbon vehicles for the authorities own fleet and requiring contractors to do the same.

7.51. The CCC analysis suggests that, if implemented successfully, these local authority measures would form the key mechanisms through which the 20% of transport carbon abatement in 2020 associated with behaviour change would be achieved. They would also help to establish changes that would contribute to greater levels of abatement in later years.

7.52. However, it is important to note that this list includes measures open to all local authorities, including those that would need to be led by Essex County Council. The primary areas in which the District could take direct action would be through development planning, rolling out of charging infrastructure, incentivising low carbon vehicles through parking measures and leading by example in relation to low carbon vehicles. For the other measures, Essex County Council would be likely to lead with EFDC playing a supporting or lobbying role.

EEDA TRACS study

7.53. The EEDA TRACs study looked at the impact of a similar range of measures and included an assessment of the relative cost effectiveness of each measure in terms of carbon abatement achieved against costs to the public sector (using marginal abatement cost curve analysis). Table 20 below summarises the results for those measures considered in the study for which district level action could potentially have a significant effect, ordered in terms of cost effectiveness.

7.54. The analysis is based on impacts at the regional rather than district level so can be considered a broad indication of potential only. However, it helps to identify the relative effectiveness of different measures and therefore those on which it would be potentially effective to focus resources to reduce carbon emissions.

Table 20. Cost effectiveness and abatement potential of initiatives for emission reduction across the East of England (Source: TRACS 2009/2010)

Measure	Cost per tonne removed (£/tonne)*	% change in emissions achieved at a regional level**
Car clubs	1	0.5%-1.0%
Support for low carbon vehicles	5	2.5%-3.0%
Land use planning	13	1.0-1.5%
Community hubs	27	<0.5%
Efficient driving training	50	2.0%-2.5%
Smarter Choices programme	76	0.5%-1.0%
Public parking charge increases	213	<0.5%
Cycling infrastructure	239	1.0-1.5%
Walking infrastructure	1,798	<0.5%

**2009 prices/values **net effect of reduction in tailpipe emission and increase in emissions associated with electricity generation, where relevant.*

7.55. For the purposes of TRACS, the measures listed were defined in the following ways:

- **Car clubs:** further development and promotion of car clubs, providing access to short term hire cars thereby reducing the need for personal car ownership, promoting use of efficient vehicles and leading to payment for cars at time of use, typically decreasing their use. This measure is likely to be co-ordinated at the county level but the District could directly support the start up of clubs and their marketing and use (for instance promoting use amongst staff and contractors) and encourage their establishment through development decisions The Car Plus Best Practice Guidance for Local Authorities[61] identifies the following criteria for areas where car clubs work well *"a parking problem (e.g. parking congested terraced streets) or restrictions or control of parking, good alternative transport options, and car clubs can be designed in at an early stage of residential development planning"*. Car clubs are also more likely to become financially sustainable if they are available to domestic users and business users (on mixed use sites or in town centres where council staff or other employees can use the cars to travel on business during the day and residents can use the cars on evenings and at weekends). Car clubs have successfully been established in other authorities with large rural areas including Cornwall and Shropshire[62].
- To support the creation of a car club EFDC could include the creation or a contribution towards the creation of a car club within planning conditions for new developments. The Council could also support the creation of a car club by providing free parking spaces for the cars, early financial support to establish the club and using the cars for staff business

[61] http://www.carplus.org.uk/resources/reports/best-practice-guidance/
[62] http://www.carplus.org.uk/our-work/car-clubs-in-england/cornwall/the-plan/

travel. Several car clubs already operate in London and it might be possible to link to one of these club operators to provide cars in Epping Forest[63].

- **Support for low carbon vehicles**: including incentives and the procurement of low carbon vehicles in the public sector. As identified above, EFDC could incentivise low carbon vehicles through parking measures (free or low cost parking for low emission vehicles) and encourage their use through the provision of charging infrastructure for electric vehicles (potentially funded through Section 106 or Community Infrastructure Levy funding) The Council could also demonstrate the use of low carbon vehicles in its own fleet by procuring hybrid or electric vehicles (or vehicles using other alternative low carbon fuels where relevant)[64]. Various programmes are available from the Government to support the purchase of low carbon vehicles[65].
- **Land use planning**: As noted above, planning decisions can increase the density of development, enable mixed use developments or encourage developments in sites already accessible by sustainable transport modes (minimising travel need and increasing the viability of public transport, walking and cycling). The Council could also require evidence of minimising carbon emissions from new developments. EFDC has direct responsibility for the planning decisions required and the ability to support low carbon transport through its Local Plan.
- **Community hubs**: increasing the level of services and facilities in towns / villages / neighbourhoods to an appropriate level commensurate with the size of settlement, thus reducing the need for residents of the towns and their catchments to travel. The idea is to create centres in rural and small urban centres which can act as a focus for remote working as well as other services such as health, education, shopping, delivery, post office and financial services. The hubs would incorporate ICT and remote office facilities and storage of e-commerce deliveries. They can also act as the focal point for car clubs if implemented in these areas. This would rely to a large extent on planning decisions which lie within EFDC's control.
- **Efficient driving training:** driving training programme targeting car and van drivers and promoting efficient driving behaviour (such as changing patterns of acceleration and braking). On average, eco-driving training leads to fuel economy improvements with a significant long-term effect of 5-10% (reduction in fuel use and resulting emissions) under everyday driving conditions[66]. EFDC could promote its own programme of driver training, targeting Council staff and contractors or support wider programmes for drivers in the area.
- **Smarter Choices programme**: implementing behaviour change measures such as travel planning, personalised marketing, car sharing, sustainable travel campaigns, flexible working, supported by measures such as walking/cycling and public transport improvements and land use planning. The measures would be likely to be co-ordinated through the Essex County Council (for instance through travel planning officers) but the District could make significant contributions through support to campaigns and inclusion of requirements such as travel planning as part of development approval. Smarter Choices programmes have been implemented in selected "Sustainable Travel Towns" in the UK. The travel behaviour change achieved in the towns involved a combination of mode shift (with unchanged destination); switch of destination and mode (e.g. replacing a medium length car trip with a shorter journey by foot, bike or bus); and trip evaporation (not making a trip at all). At the aggregate level, roughly a 7% reduction in car use (including car driver and car passenger trips) was from a net reduction in trips[67]
- **Public parking charges:** significant increases in charges (increases of between 75% and 200%, depending on existing levels, were considered in TRACS) and in the number of trips charged (through a reduction in free spaces available). This lies fully within the control of EFDC for public car parks, although it is noted that it would result in significant travel cost increases and therefore could face political and deliverability issues.

[63] For a list of existing car clubs see http://www.carplus.org.uk/car-sharing-clubs/list-ofcar-clubs/
[64] For more information on options available to local authorities, see http://www.racfoundation.org/assets/rac_foundation/content/downloadables/going_green-hanley-121011.pdf
[65] See https://www.gov.uk/government/policies/reducing-greenhouse-gases-and-other-emissions-from-transport/supporting-pages/ultra-low-emission-vehicles
[66] Source: Sharpe, R.B.A. (2009) Technical options for fossil fuel based road transport Paper produced as part of contract ENV.C.3/SER/2008/0053 between European Commission Directorate-General Environment and AEA Technology plc
[67] Source: The Effects of Smarter Choice Programmes in the Sustainable Travel Towns, Summary Report, Sloman at al. for DfT, 2010

- **Cycling and walking infrastructure**: increased investment to provide new route options or improve their attractiveness, potentially supported by lower speed limits, car free zones and Smarter Choices. Whilst this would tend to be led by the County Council, EFDC could make a significant contribution through requiring investment as part of developer contributions associated with new developments and through identifying potentially viable additions to the network. Inevitably walking and cycling will be more effective in the District's urban areas. However, EFDC should ensure that there are safe and easy cycle routes and long distance walking routes linking rural areas to other parts of the District. The key issue will be for EFDC to require new developments (which are likely to be urban infill sites or urban extensions) to incorporate new, high quality walking and cycling infrastructure into the development to support sustainable modes of transport. EFDC could also promote community-wide events, such as walking groups, community challenges and walkathons, and sessions like "Bike to work" weeks, workplace challenges and activities aimed at children and families[68].

7.56. Table 20 shows that local initiatives such as car clubs and efficient driving training can provide a cost effective method of reducing carbon emissions from road transport. Land use planning and the associated measure of community hubs are also cost effective, although their impact takes time to build up.

7.57. Increases in public parking charges represent a further key lever that lies within the control of the Council. However the TRACS analysis suggested that, at the regional level, the impact was relatively limited. The cost was also potentially relatively high if the measure was not carefully specified; due to the potential loss in net revenue if the decrease in revenue from deterred trips exceeds the gains from the increased charges. The relative impact on carbon reduction would be greater if considered at the District level only but the issue of cost would remain.[69]

7.58. Although Smarter Choices, cycling and walking infrastructure provision are likely to be largely influenced at the county level, the District Council would have the scope to liaise with the County Council and promote the measures, along with low carbon vehicles, through lobbying and through development decisions and contributions (which could also be used to support car clubs).

Priorities for action

7.59. The CCC and TRACS analysis suggests that the development planning process represents one of the most effective means through which EFDC could act to reduce transport emissions. Direct planning measures (promoting development locations and mixes which reduce the need to travel and promote the viability of alternatives to car use) were identified as effective by CCC and both effective and cost effective by TRACS. In Epping Forest District alternatives to the car are likely to be mainly walking, cycling and car sharing, but public transport could have a role. There are a reasonable number of existing bus routes to build in (e.g. 20 to 25 within Loughton, all be it some relatively low frequency) and Census[70] data suggests that the number using the bus to travel to work is only two-thirds the regional average, so there is scope for improvement. The impact of this is likely to vary significantly between rural and urban areas, so it will be important to ensure that any improvements to the bus network take account of where maximum benefit (in terms of increased usage) is likely to be achieved.

7.60. Additionally the development process can be used to support other effective and cost effective measures which are likely to be driven by county level activity, such as car clubs, low carbon vehicles and Smarter Choices. The promotion of walking and cycling infrastructure might also be relevant but the TRACS analysis suggests that it does not score well in terms of cost effectiveness for the public sector, if fully funded by the public sector.

7.61. The ongoing development of the 2014 Local Plan for the District provides a valuable opportunity for implementing these measures. This will be challenging given that the District has significant

[68] See 2013 NICE guidance: http://www.nice.org.uk/newsroom/pressreleases/NICESupportLocalGovWalkingCyclingChange.jsp

[69] As traffic affected by parking charges would account for a higher proportion of total trips than at the regional level where all trips on strategic as well as local roads are included

[70] 2001 census – 2011 data not yet available

rural areas. The key to achieving success will be to ensure that the Local Plan, infrastructure planning and Local Transport Plan, are all developed together to ensure the transport measures are deliverable and helping to achieve the future direction of growth in the District.

7.62. Of the other actions available to district councils, the TRACS analysis suggests that measures to promote eco-driving and other measures to promote the uptake of low carbon vehicles should form key priorities. As discussed above, low carbon vehicle incentives could include use of parking spaces or charging regimes and increased uptake of vehicles in the Council's fleet.

7.63. The measures identified here are directed towards traffic and emissions considered by DECC to be in the Local Authority remit, rather than national motorway traffic and emissions. However, the District could also act to reduce 'national' emissions by continued lobbying (potentially through the Local Economic Partnership) of central authorities to further improvements to the strategic road network. However, the impact of this in terms of reducing carbon emissions is likely to be limited.

7.64. The priorities described above have been identified solely on the potential of each measure to reduce transport carbon emissions cost effectively. It is important to note that each measure is likely to have several other impacts with either positive or negative impacts on other objectives. For instance, Smarter Choices have positive impacts on issues such as air quality and physical fitness, whereas parking charge increases have potentially negative impacts on social equity. These factors need consideration in ultimate decision-making for action plans.

Potential scale of impact

7.65. It is not possible to derive a detailed estimate of the emissions impact of the identified measures without a comprehensive forecasting and transport modelling exercise to reflect the scale and complexity of the issues involved. Variables to be represented would include the wide range of potential impacts on baseline emissions and of each measure considered (which would depend on factors such as the nature and location of implementation).

7.66. However, the TRACS analysis provides a basis for a broad indication of the potential scale of impact and has been used to provide a broad estimate of future emissions in Epping Forest District in three scenarios (Table 21):

- Business as Usual – including population and employment growth and national schemes but limited vehicle improvement (TRACS BAU);
- European Union vehicle measures – BAU + measures to meet EU vehicle emission targets (and follow on trends) (TRACS Scenario 1);
- With local action – European vehicle measures + a representation of strong implementation of the most effective areas of local action to which the District Council could make a significant, if not sole, contribution (i.e. the top six measures from Table 21 - derived from TRACS Scenario 3).

Table 21. Indicative estimate of potential Impact of measures on transport CO_2 emissions in Epping Forest by 2030

	Scenario		
	A) BAU	B) European Vehicle Measures	C) Local Action (supported by District Council)
Incremental change in emissions in 2030	n/a	-15% (B/A)	-10% (C/B)
Net change in emissions from 2010	20%	5%	-5%

7.67. The second column in the table shows that, under the BAU scenario, CO_2 emissions are forecast to be approximately 20% higher than 2010 levels by 2030.

7.68. The third column re-emphasises the importance of vehicle type and efficiency as introduction of the European action to improve vehicle efficiency in Scenario B reduces CO_2 emissions by about 15% in 2030, limiting growth from 2010 to approximately 5%.

7.69. The final column shows that local action strongly implemented or supported by district action also has the potential to achieve a significant impact on CO_2 emissions in 2030. In the figures shown it reduces 2030 emissions by nearly 10% (incremental change from Scenario B), taking emissions from being 5% greater than 2010 levels (with the European vehicles measures scenario) to 5% lower than 2010 levels.

7.70. However, these figures must be considered to indicate scale of impact only. As described, they are based on the estimates of the percentage impact of each local measure at the regional scale. Local impacts will vary as the impacts of the measures depend on a number of factors including area type and road type[71]. The results should therefore be considered as indicative only, identifying the fact that local action has the potential to achieve a significant impact on transport emissions, although it remains a challenge to meet this potential.

[71] The estimates of emissions under the BAU and European Vehicle Measures are also based on simple assumptions, derived from the relationship between traffic and emissions and between the two scenarios, in the TRACS analysis for the region.

Chapter 8: Policy recommendations

Chapter purpose

- To set out policy recommendations to secure reductions in carbon dioxide emissions in the District and promote deployment of low carbon and zero carbon energy production in appropriate locations.

Chapter summary

This chapter brings together the findings of this study and sets out the overall carbon savings that could be achieved in the District up to 2033 as a result of actions related to new development, retrofitting of existing buildings and through sustainable transport measures. In total the annual carbon savings will be approximately 7% of 2010 emissions.

Further savings will be achieved as a result of changes to the energy mix which feed the national grid. However, the effect of these savings in Epping Forest District cannot be quantified, and are beyond the control of the District Council.

Policy recommendations

The chapter has set out a series of policy recommendations that will help the Council to achieve carbon reductions over the lifetime of the Local Plan. These policies include

- Sustainable buildings policies that recommend the implementation of CfSH for residential buildings, and implementation of BREEAM for non-residential buildings.
- A policy setting out the District's Green House Gas reduction target based on the findings set out in this study.
- Renewable energy targets could be set for residential or non-residential development. However, it is not recommended that a renewable energy target is set given that sustainable buildings standards would require some level of renewables to meet the carbon reduction targets and the level of renewables on-site is therefore better decided through the Carbon Budget Statement approach.
- A policy that supports an energy hierarchy approach.
- Policies that support decentralised energy networks and renewable energy schemes where appropriate.
- A policy that introduces the requirement for Carbon Budget Statement to be submitted alongside planning applications for large schemes. This identifies the level of carbon reductions that can be achieved within a development.

Monitoring

In the future the Annual Monitoring Report should collate information on carbon reduction and 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 in the District.

8. Policy Recommendations

Introduction

8.1. Chapter 2 of this report provides a summary of national, regional and local policies and guidance relating to renewable energy. This section identifies how the Epping Forest Local Plan and development management process can be used to secure reductions in carbon dioxide emissions in the District and promote deployment of low carbon and zero carbon energy production in appropriate locations.

Scale of the opportunity

8.2. The scale of opportunity for carbon reduction in the District has been identified in the preceding chapters as follows:

- Chapter 4 considered the potential carbon reductions as a result of large scale carbon reduction measures. This concluded that opportunities are likely to be limited.
- Chapter 5 considered the potential carbon savings generated from new build developments, new build development will lead to an increase in CO_2 emissions. This will happen until all new homes are built to Zero Carbon Homes standards. If the Council introduce the Zero Carbon Homes at an accelerated rate annual emissions from new development would be 2.3 kt CO_2 per annum, as opposed to 12 kt CO_2 per annum if the CfSH is introduced in line with the national approach (see figure 47).
- Chapter 6 has considered the total potential CO_2 savings from retrofitting energy efficiency measures from existing domestic buildings. This has shown that there is potential to save 25.02 kt CO_2 per annum.
- Chapter 7 has shown that the potential savings from transport measures could be 5% on 2010 emissions. This is equivalent to 9.79 kt CO_2 per annum.

8.3. Table 22 shows the carbon savings that will be generated from various sources and compares this against 2010 emissions. Overall between 2012 and 2033 it is estimated that some 51.40 kt of CO_2e can be saved from actions taken directly in the District by households, businesses and the public and community sector. This represents a reduction from 753.91 kt CO_2 per annum in 2010 to 702.51 kt CO_2 per annum (this is a 7% reduction on 2010 emissions).

Table 22. Summary of opportunities for greenhouse gas emissions reductions

Sources	2010 Emissions in kt CO_2	Potential Savings kt CO_2	Estimated annual emissions following savings kt CO_2	Factors
Industry and Commercial	236.13	18.89	217.24	Energy Efficiency Saving expected to match Domestic
Domestic (existing stock)	321.89	25.02	296.87	Efficiency Improvement on Existing Stock (Retrofit)
Domestic (new build over plan period)	n/a	-2.3	2.3	New Build ZCH Efficiency Savings would lead to an increase in CO_2 but at a lower rate of increase than would happen if only basic CfSH standards are achieved.
Road Transport	195.89	9.79	186.09	Improvement in Transport
Total	753.91	51.40	702.51	
Population('000s, mid-year estimate)	124.7		146.12	
Per Capita Emissions (t)	6		4.81	

8.4. Additional savings will accrue within the District as the energy mix available to consumers through the national grid shifts towards a higher proportion of LZC energy sources in line with the Government's target. This will mean that the total level of carbon savings will be higher than the 7% identified in the table above. However, these carbon savings generated from changes to the energy mix are beyond the control of the Council.

Meeting the requirements of the National Planning Policy Framework

8.5. The NPPF identifies that planning plays a key role in (i) helping shape places to secure radical reductions in greenhouse gas emissions and (ii) supporting the delivery of renewable and low carbon energy and associated infrastructure. There are three key requirements in the NPPF that policies on carbon reduction should meet:

1. Policies should set out to secure low carbon development and reductions in greenhouse gas emissions.

8.6. The NPPF states that "To support the move to a low carbon future, local planning authorities should:

- plan for new development in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards." (Paragraph 95).

2. Policies should promote appropriate development of renewable and low carbon energy generation.

8.7. The NPPF states that "To help increase the use and supply of renewable and low carbon energy, local planning authorities should recognise the responsibility on all communities to contribute to energy generation from renewable or low carbon sources. They should:

- have a positive strategy to promote energy from renewable and low carbon sources;
- design their policies to maximise renewable and low carbon energy development while ensuring that adverse impacts are addressed satisfactorily, including cumulative landscape and visual impacts;
- consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources;
- support community-led initiatives for renewable and low carbon energy, including developments outside such areas being taken forward through neighbourhood planning; and
- identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers." (Paragraph 97).

3. The policy approach needs to be feasible and viable and account for the effect of other policy requirements

8.8. The NPPF states "Pursuing sustainable development requires careful attention to viability and costs in plan-making and decision-taking. Plans should be deliverable. Therefore, the sites and the scale of development identified in the plan should not be subject to such a scale of obligations and policy burdens that their ability to be developed viably is threatened. To ensure viability, the costs of any requirements likely to be applied to development, such as requirements for affordable housing, standards, infrastructure contributions or other requirements should, when taking account of the normal cost of development and mitigation, provide competitive returns to a willing land owner and willing developer to enable the development to be deliverable." (Paragraph 173).

8.9. Chapter 5 has considered the viability of developments when achieving CfSH with the inclusion of renewable energy and low carbon technologies. This has revealed the feasibility and financial viability of opportunities for greenhouse gas reduction and deployment of LZC technologies either on a stand-alone basis or in conjunction with other forms of development. As part of this viability testing this study has considered the cost of other policy burdens (in addition to CfSH), including affordable housing requirements and developer contributions.

8.10. Guidance within the NPPF is reinforced by other policies at national level set out within the Government's Low Carbon Strategy and Climate Change Strategy. Recent changes including the introduction of market incentives such as the FITs and Low Carbon Cashback as well as regulatory changes to Building Regulations and the CfSH. These changes have provided positive conditions for enabling implementation of the national ambitions for carbon reduction. The Council's local plan policies can help to achieve these ambitions, but will need to be revised to reflect the updated national policy context and to take account of the evidence in this study.

Policy recommendations

8.11. Based upon the analysis and conclusions of the preceding chapters of the report and the guidance set out within the NPPF we recommend the following approach towards establishing a robust policy framework within the Epping Forest Local Plan for securing greenhouse gas reductions for new development and seeking enhanced renewable energy production in the District. A reasoned justification follows the suggested approach.

8.12. Policy recommendations are set out for:

- Sustainable buildings – residential;
- Sustainable buildings – non-residential;
- Greenhouse gas reduction target;
- Renewable energy targets for residential buildings;
- Renewable energy targets for non-residential buildings;
- Decentralised energy networks;
- Renewable energy schemes;
- Sustainable transport; and
- Carbon Budget Statement.

Sustainable buildings policy

8.13. The first strand of the suggested approach is to include a policy which ensures that new development within the District meets with the principles of sustainable development and particularly for sustainable buildings through carbon reductions and renewables.

8.14. The adopted Epping Forest Local Plan saved Policy CP5 highlights the opportunities for sustainable buildings and key requirements. However, this policy will need to be revised, and it is recommended that the Council links its policy approach to implementation of national codes and standards (CfSH and BREEAM) which provide certainty to applicants of the Council's requirements and a clearer basis for implementation of the Council's policy aspirations for sustainable buildings. The policy may need to provide some flexibility to account for changes in standards in the future.

8.15. For residential development a key mechanism contributing towards delivery of sustainable development is for proposals to comply with the CfSH. The viability work tested implementation of the CfSH as a whole not just the fabric energy elements of the CfSH (which is mandatory) and this was shown to be viable if implemented in the District.

8.16. The Fabric Energy Standard part of the CfSH is mandatory and implemented through Part L of the Building Regulations which defines the minimum standards to be met. Building Regulations are being updated in line with the Government's trajectory for implementing CfSH with Level 3 implemented in by 2011, CfSH Level 4 by 2013 and CfSH Level 6 Zero Carbon by 2016.

8.17. The other components of CfSH are not incorporated into Building Regulations and relate to the following issues:

- energy and CO_2 (Other components not relating to the Fabric Energy Standard including the Dwelling Emission Rate and LZC technologies);
- water;
- materials;
- surface water runoff (flooding and flood prevention);
- waste;
- pollution;
- health and well-being;
- management; and
- ecology.

8.18. To receive CfSH accreditation, applicants have to achieve a minimum number of credits. There are a number of mandatory and optional credits which can be combined to meet the requisite scores for different levels of the CfSH. The details of the CfSH are updated periodically.

8.19. The costs of compliance with both the Fabric Energy Standard and the whole of the CfSH have been considered in the feasibility and viability analysis included within this report. This considers the potential for applying the CfSH in different areas of the District which vary in terms of housing market conditions.

8.20. The analysis has been based upon a number of development appraisal case studies which are representative of the range and type of sites identified within the Council's SLAA. The approach has considered the technical feasibility, costs of bringing sites to market and potential options for implementation of the CfSH and potential on-site low carbon and renewable energy options including decentralised energy networks. The assessment of viability has also accounted for other planning obligations required to address the impact of development and the other development needs of the District. The study has also considered how policy requirements relating to implementation of the CfSH and renewable energy interact with other policies likely to be included within the Epping Forest Local Plan in order that the expected supply and pace of housing development shown in the Council's 5 year housing trajectory and the provision of affordable housing is not inhibited.

8.21. **Recommendation:** Based upon this analysis (set out in chapter 5) it is recommended that the Council includes a Local Plan Policy which covers implementation of all aspects of the CfSH in line with the Government's escalator targets for incremental increase of the CfSH levels to Level 6 by 2016. The policy should allow an exception. Compliance could be varied if it can be demonstrated that the costs of compliance would impact adversely on the viability of development such that the scheme could not proceed. A suggested development management approach to apply this policy approach is outlined later in this chapter (see section on Implementation of low carbon and renewable energy policies paragraphs 8.79 – 8.105).

8.22. It is recommended that the policy applies to development proposals of 15 or more residential units throughout the District and encouraged for smaller schemes to maximise the opportunities for sustainable buildings in the District. The threshold of 15 units has been identified to align with other policy considerations relating to affordable housing and not add undue costs of compliance and administration for small schemes. The analysis has shown that in viability terms the CfSH could be met for schemes of 1 or 2 units.

8.23. At present it is shown that CfSH Level 3 can be delivered in Hot and Moderate market areas accounting for the Council's 40% affordable housing target and other policy requirements. It can be achieved in other areas at lower affordable housing levels (at a level of 15% affordable housing).

8.24. The consultants have also modelled the effect of CfSH Level 4 when it is scheduled to be introduced in 2013. It is viable in Hot and Moderate market areas accounting for the Council's 40% housing target apart from schemes of greater than 500 units where the returns are on the margins of viability.

8.25. The consultants have also modelled the effect of CfSH Level 5 and Level 5 Zero Carbon Homes when they are scheduled to be introduced in 2016. They will be viable only in Hot and Moderate market areas accounting for the Council's 40% affordable housing target.

Non-residential development

8.26. In addition to residential led schemes it is also appropriate for the Council to encourage non residential development to incorporate sustainable building standards, secure reductions in greenhouse gas emissions and promote renewable energy generation.

8.27. Schemes that incorporate commercial development, or indeed employment land, are likely to more viable than residential developments due to the lack of costs that are associated with affordable housing provisions and certain planning obligations.

8.28. The Government has not yet defined a mandatory zero carbon standard for non residential development but has reiterated its intention to do so.

8.29. **Recommendation:** It is recommended that the Council encourages applicants for non-residential development to comply with the latest national standards for zero carbon development for non-residential development (at the time of writing the Government had not published a national standard for non-residential buildings, but it is anticipated that this will be published soon). In addition the Council should set out an expectation that proposals should comply with the relevant BREEAM buildings standard. Different ratings systems are defined for different categories of development such as education, healthcare, industrial offices and retail. The ratings system follows a similar approach to CfSH whereby various mandatory and optional credits can be accrued to achieve different ratings based on the level of credits. It is recommended that BREEAM "Very Good" standard is applied as the minimum standard which proposals should achieve. Based upon national studies, the costs of compliance to BREEAM "Very Good" are likely to achievable for most new non residential development proposals. If applicants are able to demonstrate that the costs would compromise the viability of proposals the Council could accept a lower level of compliance (i.e. to BREEAM "Good" standard).

8.30. It is recommended that the policy is applied to non residential schemes proposals over 1,000 sq.m.

Greenhouse gas reduction target policy

8.31. The Council's Climate Change Strategy does not include a long term greenhouse gas reduction target. The current strategy adopted in 2009 identified a target for reduction over the period of 2009-2011 of 8%. The Council is currently in the process of reviewing its strategy.

8.32. The scale of opportunity for reasonable greenhouse gas emission reductions in the District in the residential sector (new development and retrofit), transport, and the likely scale of opportunity for commercial and industrial development is summarised in chapter 4.

8.33. Overall the Consultants have highlighted the opportunity to secure a reduction of 51.40 kt of CO_2e based upon actions taken by households, businesses, public sector and other energy consumers in the District.

8.34. **Recommendation:** The Council should include its stated ambitions for greenhouse gas emissions reduction (measured in terms of CO_2 equivalent (CO_2e)) within its Local Plan Policies or refer to the relevant upcoming climate change strategy. The policy should identify the mechanisms for implementation of the policy in conjunction with:

- New development (through compliance with policies for sustainable buildings and renewable energy described elsewhere in this section).
- Encouragement for retrofit of existing buildings to improve energy efficiency.
- A sustainable transport policy (see below) (and supporting strategy/implementation plan).
- Support for appropriate stand-alone renewable energy and low carbon technology projects which would displace energy generated from non renewable sources.

8.35. The target should be District wide and should reflect the scale of opportunities identified in this study (see Table 8.1). The District target should be for a reduction of 7 % of CO_2 based on 2010 levels. This target should not be translated to a site based target, as the Carbon Budget process outlined below (see Paragraphs 8.79 to 8.105) would establish an appropriate level of CO_2 savings for individual sites.

Inclusion of a renewable energy generation target policy

8.36. As part of this study the consultants have assessed the feasibility and potential for renewable energy facilities to be incorporated within development. Renewable energy facilities represent an optional credit within CfSH. However, it should be noted that to reach higher levels of the CfSH (Level 5 and above) some form of low or zero carbon technology is likely to be necessary to achieve the standard which will necessitate wider uptake of renewable energy than in the past. Although the potential exists for the Council to include a policy prescribing that developments make appropriate provision for renewable energy provision, this is not recommended as the focus for policy should be on carbon reduction through the implementation of CfSH. By using the Carbon Budget approach (see paragraphs 8.79 to 8.105), this would allow the potential for carbon reduction to be identified and this may require on-site renewables or low carbon technology to be included in the development.

8.37. This study has modelled the effect on viability within Epping Forest District of proposals incorporating renewable technologies to meet household energy requirements over and above the costs for the Fabric Energy Standard and other elements of the CfSH.

8.38. At present one or more renewables technologies can be delivered in conjunction with CfSH Level 4 in Hot market areas accounting for the Council's 40% affordable housing target and other policy requirements. It can be achieved in other areas at lower affordable housing levels. In addition, one or more renewables technologies can be delivered in conjunction with CfSH Level 5 Zero Carbon Homes in Hot market areas accounting for the Council's 40% affordable housing target and other policy requirements. It can be achieved in other areas at lower affordable housing levels.

Renewable energy requirements for non-residential development

8.39. Energy consumption patterns are more concentrated and intense than those of residential units. The specific opportunities for on-site renewables generation and CO_2 savings are influenced very much by specific user requirements. As with residential developments the level of carbon reductions that can be achieved would be identified through a Carbon Budget Statement approach set out later in this section (see paragraphs 8.79 to 8.105), to inform the Council on the levels of energy that are required by such developments and to identify the potential savings which can be secured.

8.40. The package of regulation and incentives included within the Government's Renewable Energy Strategy 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.

Opportunities for decentralised energy networks policy

8.41. As part of this study an assessment has been made of the potential for CHP and Decentralised Energy Networks. At present there is an installed capacity of 9.9 MW in the District associated with the glasshouse industry.

8.42. As described in chapter 4 (see paragraph 4.73) the consultants have reviewed the potential opportunity for wider uptake for decentralised energy networks in the District based upon a review of heat demands (see chapter 3 paragraphs 3.21 to 3.25 and 3.30 to 3.34 for review of heat demands) to identify existing areas with sufficient heating loads to underpin establishment of a local network. CHP needs high heat demand to be feasible.

8.43. The conclusion of this assessment identified that the glasshouse industry (see paragraphs 4.96 to 4.99) represented the most significant opportunity for wider take up of decentralised energy within the District with potential savings of 146,000 CO_2 te per annum if all businesses were to deploy CHP technologies. It should be noted that a wide variety of factors will influence the potential and rate of uptake. The opportunities within industrial areas and town centres represent limited opportunities due to the feasibility of implementing a scheme, these areas also lack a catalyst for such a project (such as a regeneration of a housing estate nearby or a large scale redevelopment of a commercial area) which would enable a co-ordinated approach necessary for such a network to be established.

8.44. CHP represents one of the potential technologies relevant for residential led schemes of any size as there are different sized technological solutions. The establishment of decentralised energy networks linking consumers from beyond a single scheme is likely to represent one of a number of options which should be considered for larger residential schemes.

8.45. Standalone provision of CHP plants connected to residential development should normally have a minimum of 150 homes in the scheme for this to be a technically feasible solution. This is because CHP is sized on the hot water demand of the properties, which provides the suitable base load for energy requirements. On-site CHP may normally be appropriate for mixed use schemes whereby sufficient base load (provided by commercial, industrial, community uses) and hot water/heat demand allow a CHP system to operate efficiently. If there is insufficient base load especially during the day, then any unused heat will not be utilised. Decentralised energy networks are likely to be an effective solution in situations where the average density of development exceeds 50 dph unless significant non residential heat anchors are present.

8.46. **Recommendation.** It is recommended that the Council supports the deployment of CHP and decentralised energy networks in the District and highlights the opportunities when these should be considered as an option by applicants. In general for CHP this will be on sites of 150 residential units or more. For decentralised energy networks, this may be suitable where developments are on average over 50 dph. These networks will work best where there are multiple sites (including other uses such as schools or colleges, hospitals etc) that can also be connected into the district energy network.

Energy Hierarchy policy

8.47. To guide applicants through the process of selecting appropriate LZC technologies and to assess the scale of opportunity the Council could set out an energy hierarchy to support implementation of its policies relating to renewable energy.

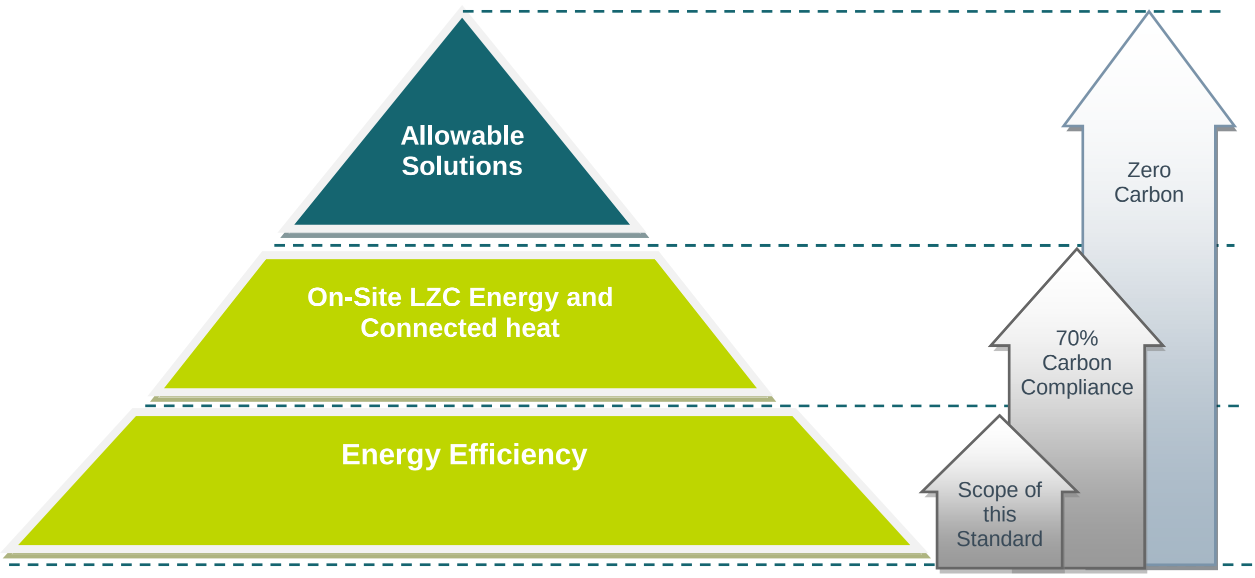
8.48. **Recommendation:** An energy hierarchy approach is outlined which sets out the sequence of potential technology choices. The preference is to use technologies at the top of the hierarchy, in order to implement recommended council policies.

8.49. It is suggested that a hierarchy for LZC technologies should be as follows:

- Non-energy fabric provision (energy efficiency measures), in line with the Part L Building Regulations of the relevant CfSH.
- Combined Heat & Power connections and options for on-site CHP.
- Other means of LZC technology to reduce emissions. These may include the types of LZC technology where it is feasible, such as:
    - solar PV and solar thermal technology;
    - biomass Heating;
    - biomass CHP;
    - ground Source heat pumps; or
    - air Source heat pumps; and
    - wind Turbines.
- Allowable solutions (see paragraph 8.51 for more detail).

8.50. This hierarchy is portrayed in the figure below:

Figure 58. LZC Hierarchy



Allowable solutions

8.51. Allowable solutions are intended to account for the carbon emissions that are not expected to be achieved on-site through carbon compliance. 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 those from cooking and appliances.

8.52. It is possible that other policy objectives may preclude the installation of some renewables technologies due to site conditions or where installation would cause significant effects which may limit the potential to meet the requirements of the higher levels of CfSH. The circumstances where this may arise are:

- 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 be 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 insufficient space to install ground source heat pumps and other solutions are not appropriate.

8.53. In these circumstances it may be appropriate to meet the shortfall in 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 programmes in the District.

8.54. Programmes may include local energy efficiency programmes which the Council may establish linked to the Green Deal, to retrofit of the existing building stock, invest in renewable technology or fund the enhancement of CHP infrastructure in the District to implement the Local Plan. This could be run by an energy service company (ESCO) or a climate investment fund.

8.55. Depending on the location and achievable affordable housing, the rate for allowable solutions should be raised for larger projects to encourage them to use new technology rather than financially contribute to allowable solutions. Currently the cost of allowable solutions range from £50 to £100 per tonne of carbon over 30 years this does not have a significant impact on viability.

The allowable solutions may be revised to consider varying impact based on size of the project in order to encourage larger projects to incorporate on-site provision.

8.56. Money collected from allowable solutions should be directed towards a fund that will pay for a programme of renewables or energy efficiency measures that would be retrofit to existing properties and could be linked to Green Deal (see chapter 9 for further detail on Green Deal). Those measures that are most cost effective and would have the greatest benefit in terms of total CO_2 savings include loft insulation and cavity wall insulation (7.7 kt CO_2 per annum). The Council should also consider measures that would assist with energy efficiency savings for hard to treat properties in particular solid wall properties. If in future a community district heating scheme comes forward or is developed the Council may wish to direct funds from allowable solutions to help support this. It is recommended that the Council do further work to review the potential options for this fund in terms of how the fund is structured and how the money is allocated.

Consideration of site specific, area or more prescriptive development targets

8.57. The consultants have considered the need and potential for different targets to be established on the basis of the size of development, its location or even on a site specific basis.

8.58. Considering the characteristics of the District and the nature of residential and non-residential development anticipated within the development pipeline for the District there is not a strong case for site or area specific targets to be established.

8.59. The feasibility and viability assessment has considered a range of different development types to account for the differences in scheme size and density to consider the effect on viability. The findings show that whilst there is some variability of the impact of the proposed policy, the differences are not significant enough to support a more tailored approach.

8.60. A practical approach towards development management has been suggested (see paragraphs 8.79 to 8.105) to implement the policy which accounts for the situation in which the policy may not be feasible (due to lack of suitable technology or due to other policy constraints (e.g. listed buildings, conservation area, Green Belt) which may limit potential to meet the full requirements of the policy on-site.

Proposals for renewable energy schemes

Renewables resource

8.61. An assessment of renewable and low carbon energy resources available in the District has been undertaken. Chapter 4 summarises the scope for large scale deployment of renewables, whilst chapter 5 looks at opportunities for micro-generation.

8.62. The main technologies which have potential for widespread application in the District for sites of all sizes are:

- Solar PV – opportunities for micro-generation through retrofit and new build;
- Solar thermal - opportunities for micro-generation through retrofit and new build;
- Heat pumps - opportunities for micro-generation through retrofit and new build ; and
- CHP (individual building) opportunities through new build with 50 or more residential units and large commercial developments with sufficient heat demands.

8.63. In addition there is potential for the establishment of local decentralised energy networks (CHP systems) in conjunction with major new residential development proposals (see chapter 5) and there may be some limited potential in relation to the glasshouse industry which is well represented in the District (see chapter 4). Smaller opportunities may also exist in connection with major commercial and retail development, and major health and education projects which may come forward.

8.64. The scale of renewable and low carbon energy resources available within Epping Forest is sufficient that the District can fully contribute towards meeting national targets (80% reduction in greenhouse gas emissions by 2050 and CO_2 reductions of 34% by 2020). To exploit this resource, those developing renewable and low carbon energy will need to take into account the conditions required to support deployment of these technologies including: physical characteristics, wider planning policy considerations and property market dynamics and viability issues.

8.65. In most situations there is likely to be a choice of renewable energy technologies which can be deployed. However, the potential deployment of large standalone wind turbines is relatively limited within a District such as Epping Forest, because there are large areas of the District that are designated as Green Belt, there are constrained areas where wind turbines could interfere with aircraft communications and the level of physical wind resource although sufficient for small or medium scale turbines would not support large scale wind deployment (refer to chapter 4 of this report for further details).

8.66. The deployment of biomass heating and CHP is dependent on having a sustainable feedstock source and transportation strategy. In addition, it is important that emissions from biomass heating/CHP facilities do not have a significant impact on air quality.

8.67. **Recommendation:** The Local Plan should include a criteria based policy outlining the considerations (including impact on historic environment, Green Belt, landscape, townscape or visual impact, ecological designations, local air quality and residential amenity) which will be taken into account in assessing renewable energy proposals either as stand-alone proposals or integrated with other types of development.

8.68. The purpose of the policy would be to contribute towards national 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 low carbon development and renewable energy generation which may be secured. These benefits include: job creation in industries related to the supply and installation of local carbon and renewable energy generation; and reductions in fuel poverty by reducing the costs associated with powering and heating homes.

8.69. 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 – see chapter 4 regarding issues related to grid connections) provided that the following considerations are addressed and there are no significant adverse impacts on:

- Historic environment including townscape, conservation areas (Abbess Roding, Abridge, Baldwins Hill, Bell Common, Blake Hall, Chigwell Village Coopersale Street, Copped Hall, Epping, Great Stony School, High Ongar, Hill Hall, Lower Sheering, Matching, Matching Green, Matching Tye, Moreton, Nazeing and South Roydon, Royal Gunpowder Factory, Roydon Village, Staples Road, Waltham Abbey, Upshire, York Hill), Registered Parks and Gardens and the character or setting of listed buildings (including over 1,300 listed buildings 16 Grade I listed and some 323 locally listed buildings);
- Green Belt
- Landscape, townscape or visual impact (in terms of their siting, layout, design);
- Ecological designations (Sites of Special Scientific Interest, Special Protection Areas, and Special Areas of Conservation);
- Local air quality (a key consideration for biomass heat and biomass CHP); and
- Residential amenity in respect of noise, dust, odour and traffic generation.

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

8.71. For biomass energy projects, the need to transport feedstocks 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.

8.72. In terms of considering appropriate technologies for specific sites the Council should consider preparing additional guidance which could be adopted as a Supplementary Planning Document (SPD).

Sustainable transport policy

8.73. The Council currently has a saved Policy CP9 encouraging sustainable transport.

8.74. Chapter 7 of this report has considered current road transport emissions in Epping Forest District, potential influences on future emissions (including travel demand, transport schemes/measures and vehicle efficiency) and the most effective local action measures for reducing emissions.

8.75. **Recommendation:** It is recommended that an updated sustainable transport policy incorporates explicit reference to the measures and opportunities to secure reductions in greenhouse gas emissions from the transport sector (as set out below).

8.76. Opportunities for reductions in future emissions levels will be influenced by a wide range of factors categorised into influences on traffic (including influences on travel demand and potential transport measures) and influences on average emissions rate. European and national action to promote reductions in emissions from new vehicles will have a significant impact on emissions. However, the net impact through the 2030s and beyond will depend significantly on the carbon intensity of electricity generation (and therefore on measures in the energy sector). Other influences include a wide range of possible transport measures drawing from plans and strategies that include objectives to reduce carbon emissions, along with other, potentially conflicting, objectives.

8.77. Recent studies have considered the most effective forms of local action to reduce carbon emissions and suggest that the following measures are likely to be the most effective form of action available to EFDC:

- Development planning related measures, tied in with the ongoing development of the 2014 Local Plan:
    - Car clubs – developed and or promoted by the Council by providing parking spaces for the car club, promoting use amongst staff, and requiring developers to contribute to creation of a car club.
    - Land use planning – encourage the minimisation of travel and increase viability of walking and cycling by promoting higher densities and mixed uses in appropriate areas.
    - Support for low carbon vehicles – require provision of charging infrastructure for electric vehicles in new developments or require s106 or CIL funding towards providing charging points.
    - Community hubs – plan for and encourage increased level of services in towns, villages and neighbourhoods to reduce the need to travel.
    - Cycling and walking infrastructure – support for car free or home zone areas in new development, and require new developments to include cycle and walking infrastructure.
    - Eco-driving programmes.
- Efficient driving training – promoted to Council staff or support wider programmes.
- Measures to support low carbon vehicles locally:
    - Council procurement – use of low carbon vehicles in the Council's own fleet.
    - Council incentives – free or reduced cost parking for low carbon vehicles.

8.78. Detailed modelling and forecasting would be required to calculate the impact of proposed measures. However, the TRACS analysis allows a simple, broad estimate of potential impacts, suggesting that strong implementation of local action (identified above) that can be influenced by EFDC can achieve emissions reductions in the order of 10% (on 2010 levels).

Implementation of low carbon and renewable energy policies

8.79. The Council should adopt a practical approach to implementing policies set out in the Local Plan. There are three key issues to address:

8.80. **Ambitious but viable** – the policies and priorities described in the Local Plan should seek to maximise the opportunities which are available for minimising energy use and securing carbon emissions reductions. The range of available business models and financial products is expanding which enable establishment costs for LZC technologies to be recouped over the operational life of the development removing the costs to the developer at the point of development and the effect on overall scheme viability.

8.81. Where the viability of a scheme can be proven to have sufficient returns (above 20% developer return), there is an opportunity to achieve greater CO_2 reductions than required by the minimum requirements of the current CfSH level. This approach to assessing development viability already occurs for schemes that are required to provide affordable housing, so this type of approach should be extended to consider the viability of CO_2 reductions in larger schemes (schemes with over 15 residential units or schemes with over 1,000 sq.m of commercial floorspace).

8.82. **Feasible** – ensuring that suitable LZC technologies are deployed taking account of renewable energy resources in the District and local context. Where physical space or other or policies constrain opportunities, then allowable solutions could be considered.

8.83. **Deliverable** – for LZC technologies to be successful it is important that adequate arrangements are in place for their long term management and maintenance. This should be dealt with through conditions. For micro-generation this should be straightforward, for larger area wide district heating or CHP this will be more complex. The developer will need to show that management and maintenance of the scheme has been properly considered and that an appropriate management regime will be established.

8.84. A balanced approach should be taken by the Council in considering what may be achieved at particular sites and locations within the District acknowledging that market conditions vary, and that policies relating to low carbon development should not compromise the delivery of economic development or homes within the District.

8.85. In order to support the implementation of the policy, it is recommended that a Carbon Budget Statement is prepared by applicants to establish what the potential level of (i) the CfSH and carbon emissions reduction and (ii) renewable energy generation which can be delivered in conjunction with development. Details of the suggested process are outlined below. It is recommended that a SPD is prepared to provide guidance to applicants.

8.86. The Carbon Budget Statement approach set out below can provide the basis for determining the level of carbon emissions reductions appropriate to individual sites. This approach embeds the consideration of the overall costs of meeting the targets within an open book approach to development appraisal to ensure that requirements do not compromise the viability of schemes to a point at which development would not proceed. The Council will need to consider training officers, to ensure that they are capable of making decisions based on the information within the Carbon Budget Statement.

8.87. The Carbon Budget Statement would provide the platform for an informed discussion between the applicant and the Council of the opportunities and limitations associated with particular sites and the overall package of development costs and economic, social and environmental benefits offered by proposals to secure sustainable development.

8.88. The Carbon Budget Statement could form part of a Sustainability Statement or Design and Access Statement prepared by applicants.

Justification

8.89. This approach offers flexibility to avoid the upfront capital investment costs of installing LZC technologies impacting on overall scheme viability or the supply of new homes including affordable housing and other requirements for infrastructure necessary to make development acceptable. At the same time developers are encouraged to try harder to maximise carbon emissions reductions which can be secured in conjunction with development to lock in lower per capita carbon dioxide emissions.

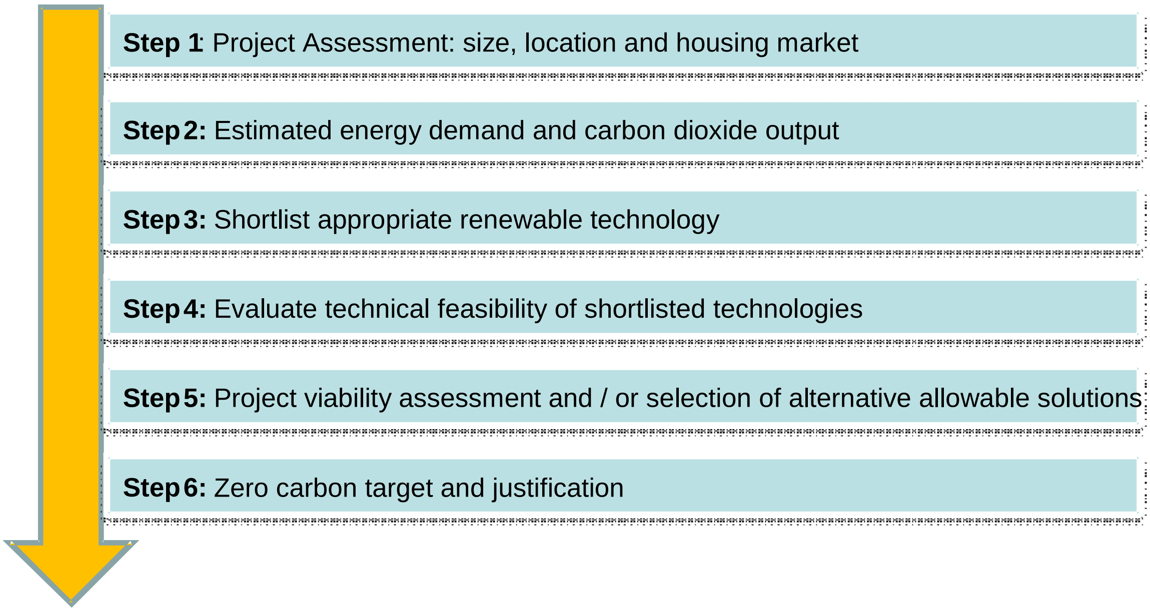
Carbon Budget Statement

8.90. The Carbon Budget Statement should be used to establish the potential for carbon emissions reduction from building performance and potential for deployment of LZC technologies. The strategy to deliver carbon emissions savings should:

- Consider how improved building performance and sustainable construction can secure emissions savings.
- Consider how potential on-site (or within close proximity) carbon reduction can be achieved.
- Demonstrate that costs and potential benefits have been considered including interaction with other policy requirements.
- Demonstrate that full consideration has been given to the potential delivery options.
- Demonstrate that where emissions savings are shown not to be possible on-site (as a result of viability or technical feasibility) commuted sums will be paid toward off-site renewable energy or low carbon technology schemes or energy efficiency programmes.

8.91. The key steps to be followed in preparing a Carbon Budget Statement are outlined in the flow diagram and explained below.

Figure 59. Carbon Budget Statement approach



Step 1: Project Assessment:

8.92. The project assessment identifies the location, size, land use and housing market that the development is located within. These details would help to establish the broad carbon emission reductions which may be secured. The nature of the proposed development and its housing market location will impact on the technologies, costs and revenues associated with the project and hence the viability of the project.

Step 2: Estimated energy demand and carbon dioxide output:

8.93. The entire development emissions should be calculated by predicting the annual energy demand and CO_2 of each phase of the project using Chartered Institute of Building Services Engineers (CIBSE) TM46 Energy Benchmark[72], which are good performance benchmarks for the non-residential elements and full SAP for the residential elements. Adjustments should be made for reductions in building energy demands reflecting the appropriate Building Regulations alongside the national targets; this assumes that the CIBSE benchmarks are based on pre 2010 Building Regulations. The energy and CO_2 benchmarks are calculated using the expected energy

[72] Energy Benchmarks, CIBSE, 2008 (available to purchase from www.cibseknowledgeportal.co.uk)

demand and split between heating and electricity for the entire development phased by the year that each phase is completed.

Step 3: Shortlist appropriate renewable technology:

8.94. A shortlist of renewable technologies that are appropriate to the development should be drawn-up which also considers aesthetics, design and any other constraints or opportunities that are specific to the development.

Step 4: Evaluate technical feasibility of shortlisted technologies

8.95. The deployment of a variety of energy-saving and renewable technologies will help to achieve the energy demands and the associated CO_2 reduction for each phase of the project. As such the Carbon Budget Statement should show that the technical feasibility of a range of options relevant to the site has been considered.

8.96. The technical feasibility of the renewable technology should be assessed by calculating the costs of establishment, connection and finance costs. These costs should be scaled by project size and reflect expected economies of scale. The lifetime cost per tonne of displaced CO_2 should be used to inform the baseline economic cost of the proposal.

8.97. Some sites will be constrained meaning that allowable solutions might be required to meet some or part of the electricity and heating requirements. Where this is the case the Carbon Budget Statement should identify the annual amount of electricity (kWh) and or heating (kWh) that will be met by on-site renewables.

Step 5: Project viability assessment and / or selection of alternative allowable solutions:

8.98. The viability of the development would need to be assessed considering the effect of:

- overall construction costs;
  - buildings;
  - infrastructure;
  - costs of LZC technology and requirements of the CfSH;
- planning obligations;
  - affordable housing;
  - school places;
  - community facilities;
  - open space.

8.99. The applicant should show that the technologies that they intend to deploy in the development (as determined in the technical feasibility assessment in step 4), are of benefit to the end-user when the following are considered: whole life costs, developer benefits, local benefits and environmental cost benefits. A high level business case should demonstrate the long-term commercial viability of the proposals over the technology payback period, demonstrating total indicative revenues and other benefits derived.

8.100. In assessing viability applicants will need to show that they have considered potential revenue streams that are available to support LZC technologies including: the Renewable Obligations Certificates (ROCs), Feed-In Tariffs (FITs), Renewable Heat Initiatives (RHI) and other relevant Government incentives.

Step 6: Carbon target and justification

8.101. The development would need to identify and justify the site wide carbon reduction which can be delivered and compare this with the requirements of the Local Plan policies. This would need to be demonstrated in the Planning Application, there will be a need to show that technology options have been reviewed to optimise project carbon reductions (in £ per tonne CO_2 saved). Where developments are not able to meet the requirements of the Local Plan, alternative allowable solutions would need to be proposed and justified.

8.102. The Carbon Budget Statement should form part of the Sustainability Statement and be considered during pre-application discussions in order to scope out potential carbon reduction options prior to the detailed design of proposals. This approach ensures that the range of options is not narrowed prematurely, and that opportunities are incorporated early on in the design of the development. It cannot be assumed that one technology is better than another in terms of carbon savings or costs, often the choice of technology will be dependent on what is most suited to the site specific circumstances.

8.103. **Recommendation:** It is recommended that a Carbon Budget Statement is prepared for all large scale developments which include: residential schemes of 15 or more units and commercial development of 1,000 sq.m or more.

Development Management

Use of conditions and planning obligations

8.104. Planning conditions or planning obligations can be used to secure the provision and long term management and maintenance of those aspects of a development required to ensure compliance with Local Plan policies.

8.105. Where there are existing decentralised energy supply systems, or firm proposals, the Council can expect proposed developments to connect to an identified system, or be designed to be able to connect in future.

8.106. In allocating land for development, the Council can consider how the proposed development would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

8.107. The Council should require compliance with CfSH and the establishment of appropriate renewable energy infrastructure through the use of conditions linked to, and justified by, the Sustainability Statement or Design and Access Statement for larger schemes.

8.108. The Council should consider contributions towards renewable energy infrastructure on a case-by-case basis.

8.109. To secure energy and CO_2 emissions reduction from decentralised and renewable and low carbon energy sources, the Council may seek to set specific requirements from developers.

Establishment

8.110. Where firm plans exist for the establishment of decentralised energy networks (at present there are none planned in the District but this could change over the lifetime of the Local Plan), there could be a requirement for contributions towards the establishment of energy generation infrastructure. It is suggested that applicants for planning permission 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.

8.111. 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.

8.112. Planning obligations could be required towards establishment of facilities where centralised renewable energy generation facilities serving the site are provided off-site.

Connection

8.113. This may require installation of pipe work 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.

8.114. 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

8.115. 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 for major developments).
- Identification of how maintenance of renewables infrastructure will be dealt with (i.e. service charges etc.). The Council may also wish to seek contributions to secure the provision and longer-term management and maintenance.
- Where it is proposed that biomass boilers should contribute towards meeting CO_2 emissions reduction targets these facilities should comply with environmental regulations. Where the residual impact of such facilities would have a significant impact on air quality, then developers could 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 could be sought for the costs associated with monitoring of renewable energy facilities.

8.116. 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

8.117. 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.

Smart Grid

8.118. A smart power grid allows for two way communication between the electricity grid and customers. By using new technologies (such as smart meters) the electricity grid can respond more efficiently to changing electricity demands. The smart grid allows real time monitoring and control capability so that consumers can have a better understanding of the electricity they use and suppliers have a better understanding of consumer needs. The benefits of the smart grid are that transmission can be more efficient, management costs can be reduced, demand for energy can be reduced, renewable energy generation (including micro-generation) can be more easily integrated into the grid, and the costs of electricity to consumers can be reduced.

8.119. Developers may install smart meters into their developments. Provision of smart meters can provide credits towards CfSH that can go towards the criteria assessing the energy efficiency ratings of a building. Some smart meters can assess the energy use for heating, where these are installed they gain more credits than those that only monitor electricity use.

Requirements for inclusion in Design and Access Statements

8.120. Design and access statements 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.

Potential for Local Development Orders

8.121. Where there are proposals to establish local energy networks the Council should give positive consideration to the use of local development orders (LDO) to secure renewable and low carbon energy supply systems.

8.122. 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 pipe work and ancillary equipment.

8.123. 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

8.124. Government guidance identifies that effective monitoring and review are 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.

8.125. In future the Annual Monitoring Report (AMR) should collate information on carbon reduction and 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 in the District.

8.126. The AMR 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 housing delivery.

Summary

8.127. Overall between 2012 and 2033 it is estimated that some 51.40 kt of CO_2e can be saved from actions taken directly in the District by households, businesses and the public and community sector. This represents a reduction from 753.91 kt CO_2 per annum in 2010 to 702.51 kt CO_2 per annum. This is a 7% reduction on 2010 emissions. The current EU target is for a 20% reduction in CO_2 emissions from 1990 levels by 2020, and the current UK target is a 34% reduction in CO_2 emissions from 1990 levels by 2020. Although not directly comparable due to the timescales and baseline, it provides some context as to the contribution that Epping Forest District could make towards national and European targets.

Chapter 9: Implementation and Delivery

Chapter purpose

- To set out recommendations on implementation and delivery mechanisms including:
  - Green Deal;
  - Planning obligations; and
  - Energy Service Companies (ESCOs).

Chapter summary

This chapter sets out recommendations on the funding and delivery mechanisms that can be used to support the implementation of the approaches identified in this study. The chapter provides recommendations on: Green Deal; Planning obligations, CIL, a green energy fund and ESCOs.

The implementation of Green Deal in the District will promote energy efficiency and renewable retrofit for homes and businesses. This could help to achieve substantial carbon savings. The Council could help to implement the Green Deal by taking on an active role in delivery of the scheme. However, there are various models for Green Deal delivery and the model that EFDC choose to follow will depend on the degree to which the Council wants to actively engage with the Green Deal; the Council's aspirations on carbon reduction and fuel poverty and the Council's attitude to risk.

In some circumstances it might not be possible to meet low carbon requirements on-site without recourse to allowable solutions off-site. The allowable solutions element of a zero carbon building is likely to take the form of a contribution to off-site energy infrastructure. The Council will have a crucial role to play in identifying what infrastructure will be funded by contributions to allowable solutions and delivering them. These contributions could be held in a green energy fund and used to fund energy efficiency improvements in existing homes. Those measures that are most cost effective and would have the greatest benefit in terms of total CO_2 savings include loft insulation (2.7 kt CO_2 per annum) and cavity wall insulation (7.7 kt CO_2 per annum).

Decentralised energy networks provide a good opportunity for carbon reduction savings particularly in new residential areas (this will be the key opportunity in the District). To implement these networks there is a need to put in place a business model. There are various business models that can be applied. The two traditional models that have been used to achieve this are ESCOs and CEMs.

9. Implementation and delivery

Introduction

9.1. This chapter sets out recommendations on the funding mechanisms that can be used to support implementation of the approach identified in the previous chapters. It also looks at what potential there is for EFDC to use other mechanisms for the implementation and delivery of low carbon and renewable energy approaches, which could include a Green Energy Fund or an Energy Service Company (ESCO).

9.2. There is no one tailor-made solution to the delivery of low carbon and renewable energy projects. 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.

9.3. This chapter deals with three key implementation and delivery mechanisms that include: i) Green Deal and how the Council might help to deliver the Green Deal in Epping Forest District; (ii) planning contributions, Community Infrastructure Levy (CIL) and a Green Energy Fund and how this can be used to deliver off-site low carbon and renewable energy projects; and (iii) Energy Service Companies (ESCOs) and how these could potentially be used to deliver area wide renewable energy solutions.

Green Deal

9.4. The Energy Act 2011 set out provisions for the introduction of the Green Deal and a new Energy Company Obligation (ECO) which replaces the existing Carbon Emissions Reduction Target (CERT) scheme and the Community Energy Saving Programme (CESP). This reflects the need for a major change in energy efficiency of existing domestic and non-domestic buildings to ensure that the country meets its CO_2 reduction targets.

9.5. The Green Deal aims to move away from previous top down energy efficiency schemes so that it can respond to consumer needs. By introducing a new financial mechanism for funding energy efficiency improvements, the Green Deal removes one of the key barriers to wider take up of energy efficiency measures, namely the upfront cost of measures. The essence of this new financial mechanism is that private companies (or Green Deal Providers) finance the upfront energy efficiency investments and then recoup the payments through energy bills. Green Deal Providers could be energy providers but others could also apply to become Green Deal Providers. However, money provided through the scheme is paid back to the Green Deal provider by those paying the electricity bills (householders or business occupiers) through their electricity bills. Payments are only made while the consumer stays at the property (either residence or business premises), with the new bill payer taking up payments when they move in. The “Golden Rule” of the Green Deal is that payments attached to energy bills (for the energy efficiency measures) cannot exceed the expected savings on energy bills generated by that payment. The total amount repaid will depend on the cost of the energy efficiency measures installed and will include interest at a rate set by the Green Deal Provider, but the repayment amount must not exceed the “Golden Rule”.

9.6. As well as the carbon savings and the savings to consumers that the Green Deal will promote, the Green Deal is establishing a new market which will help drive investment into energy efficiency. Many types of organisation are anticipated to get involved in the market, and for this reason the Government has specifically not set out a single business model which Green Deal Providers have to follow.

9.7. The Green Deal does not have a specific target that Green Deal Providers have to meet. However, the Energy Company Obligation (ECO) (which works in tandem with the Green Deal) set targets for energy companies to reduce carbon and costs savings on heating for low income households and vulnerable households.

Green Deal Journey stages and roles

9.8. In order to consider the potential models of involvement that EFDC could follow in implementing the Green Deal in the District it is crucial to consider the stages in the Green Deal Journey; the roles that are played in the Green Deal at each of these stages and how local authorities could potentially be involved. These are set out as follows.

Table 23. Green Deal Journey stages

Journey Stages	Purpose	Roles	Potential Local Authority (LA) involvement
Generate consumer interest	By attracting consumer interest the consumer begins the journey on the Green Deal. Without consumer interest and awareness of the benefits the Green Deal will not be successful in the area.	Could be promoted by the Green Deal Provider, Installers or other Partners	LA could generate interest with residents and businesses within their area through their existing links with them.
Green Deal Assessment	It is not possible to enter into a Green Deal agreement or install measures without a Green Deal Assessment. Energy efficiency measures are defined. These must be capable of improving energy performance of a building.	Must be carried out by an accredited assessor	LA could act as accredited assessor, but this would require resources and training
Cost Quote	Green Deal Provider provides quote for the finance for the measures. Level of finance available depends on the 'Golden Rule' Measures under Green Deal will work with ECO so that measures for hard to treat homes that can be fully funded under Green Deal can be supported.	Consumer takes the Green Deal Assessment to an authorised Green Deal Provider for a quote for the finance.	Potential role to be played in identifying hard to treat homes, and homes in fuel poverty.
Green Deal Plan	Provides a contract between the consumer, the improver and the Green Deal Provider, setting out finance terms and duration of instalments. For domestic properties these are regulated under consumer credit agreements (CCA).	Green Deal Providers will need to be licensed under the CCA	LA would need to be an authorised Green Deal Provider to do this or work with a Green Deal Provider.
Arrange for installation of Green Deal Measures	Installations need to be to a high standard to ensure that the purposes of the Green Deal are being met.	Accredited Installers (Green Deal Quality Mark required)	LA could potentially act as an accredited installer, or it could work with accredited installers.
Green Deal Finance provided	Finance is provided by the Green Deal Providers to the installers for the works to avoid upfront payment by providers.	Green Deal Provider – must be authorised by the Secretary of State to provide finance	LA would need to be an authorised Green Deal Provider or the LA could partner with a Green Deal Provider (for this element of the scheme) to achieve this, or act in partnership with other local authorities.
Aftercare	To avoid potential problems with installation or issues with the Green Deal Plan.	Green Deal Provider responsible for rectifying problems compensating customers and seeking redress from installers (as necessary).	LA could provide aftercare depending on the Green Deal Model it chooses, or this could be outsourced.
Payment Collection	Collected through electricity bills. This enables charges to be transferred to new owners and allows costs to be spread.	Payment from consumer to electricity suppliers, then passed on to Green Deal Provider	LA would not need to collect payments.

Source: Consultants

9.9. The Green Deal Provider could operate under a variety of models including:

- One Stop Shop – The Green Deal Provider is assessor, installer and provides the finance.
- Partnership model – Green Deal Provider provides finance and acts as intermediary between consumers, assessors and installers.

- Green Deal Provider as face of Green Deal – The Green Deal Provider acts as the face of the scheme but all other aspects of the Green Deal are outsourced to one or more company.
- Green Deal Provider as CCA counter signatory – outsource all other aspects of scheme.

9.10. These potential models of delivery are not exhaustive and the Government's intention is not to prescribe a particular model type. Green Deal Providers must meet the requirements and obligations of the scheme, but have the freedom to develop their own model. The Green Deal has only recently launched, at the time of writing there is not any financing or delivery model in place in the District.

Potential models for financing and delivery

9.11. There are three broad approaches that EFDC could take to the delivery of the Green Deal. These include:

- Council as Provider – The Council would become a Green Deal Provider raising finance (either on its own or as a group of authorities) and would deliver the Green Deal to local residents and businesses.
- Council as Partner – The Council would act as a partner to one or more commercial Green Deal Provider. The Council could assume one or more of the roles in Table 23 but would not act as a Green Deal Provider.
- Council as Promoter – The Council would help to facilitate the Green Deal in its area. This could be providing support to Green Deal providers or helping to channel consumers to the Green Deal provider.

9.12. If EFDC wants to be fully involved in the implementation of the Green Deal in its area, it should choose to operate as a provider. However, there are clearly greater risks involved in operating in this way, not least the financial risk to the Council. There are advantages for the Council from greater involvement with Green Deal that include: the ability to control and drive forward Green Deal in a way that will help to meet the Council's wider strategic priorities; linking Green Deal with other funding streams to generate wider benefits; potential to reinvest revenue streams into local projects; and the ability to establish local supply chains that generate jobs locally.

9.13. The Energy Saving Trust report Local Authority Large Scale Retrofit: A Review of Finance Models (2011) assessed six models of delivery that local authorities might want to consider in taking forward ECO and Green Deal. The study highlighted the key features, benefits and risks of each model. The models are briefly summarised below:

- Local authority marketer, assessor and facilitator – the local authority promotes the benefits of the scheme and receives a finder's fee for referrals to the Green Deal assessor.
- Outsourced model – local authority appoints approved provider to finance, promote and install equipment to local authority owned assets. Income may be generated to the local authority (via the Feed in Tariff).
- Public sector financed model – 100% of the capital from the local authority, but private sector partner used to undertake all operational aspects of the project, this could be a trading company that is set up by the local authority to operate the project.
- Public / Private finance model – the local authority procures a delivery partner to deliver the programme. Financed by a mix of local authority and bank finance.
- Market led and market dependent – little local authority action. Local authority may support initiatives and provide information to the community.
- The retrofit guaranteed fund – finance provided by high street banks. The model is de-risked by government body or interested party establishing a guarantee fund.

9.14. The first four are public sector led while the last two are private sector led. Further details on the features, benefits and risks of each model are set out in Local Authority Large Scale Retrofit: A Review of Finance Models Report (2011).

9.15. Without further work to fully appreciate what the Council's aspirations are with regards to the implementation of the Green Deal it is not possible to advise whether EFDC should seek to implement one particular model for Green Deal delivery. The Council should therefore undertake further work which should seek to define the following:

- The degree to which the Council desires to actively engage with Green Deal.
- The Council's aspirations for carbon reduction and how these relate to social and private housing, non-domestic buildings and their own building stock.
- The Council's aspirations regarding fuel poverty.
- The Council's aspirations regarding dealing with hard to treat homes (those with solid walls).
- The Council's desired exposure to risk through Green Deal, this should be considered against the potential benefits of greater involvement with Green Deal.
- The Council preference for working with other local authority partners to deliver Green Deal.
- The Council preference for working with private partners to deliver Green Deal
- Potential sources of finance that the can the Council unlock.
- The Council's current budget for establishing a Green Deal delivery model.
- The Council's in house skills base to develop a Green Deal delivery model.

9.16. The approach developed will depend largely on what the Council aspirations are and the level of risk that the Council is willing to take on. These are decisions that the Council will need to consider at a corporate level. As such this is beyond the scope of the Local Plan to define.

Planning obligations, CIL and Green Energy fund

9.17. Chapter 5 sets out that in some circumstances it might not be possible to meet low carbon requirements on-site without recourse to allowable solutions. Also other policy objectives may preclude the installation of some renewable technologies due to site conditions. In these circumstances it is appropriate to meet the shortfall in energy demand and associated CO_2 reductions through off-site allowable solutions. The allowable solutions element of a zero carbon building is likely to take the form of a contribution to off-site energy infrastructure. The Council will have a crucial role to play in identifying what infrastructure will be funded by contributions to allowable solutions and delivering allowable solutions.

9.18. 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. Prior to the adoption of a CIL in Epping Forest District contributions for allowable solutions would need to be collected through section 106 commuted sums collected by the Council and held in a green energy fund that would be directed towards local energy efficiency programmes. This could be used to retrofit the existing building stock, invest in renewable technology or fund the development of CHP infrastructure in the District.

9.19. Some of the green energy fund should be directed towards improving energy efficiency in existing building stock as this can have significant benefits in terms of CO_2 reductions (as set out in chapter 5). Those measures that are most cost effective and would have the greatest benefit in terms of total CO_2 savings include loft insulation (2.7 kt CO_2 per annum) and cavity wall insulation (7.7 kt CO_2 per annum). These measures should therefore be prioritised. The Council should also consider measures that would assist with energy efficiency savings for hard to treat properties in particular solid wall properties. These are more expensive to insulate but the CO_2 savings could be substantial. There is also scope to link the treatment of hard to treat properties with the ECO.

9.20. CIL payments can be used to fund energy systems identified in local infrastructure plans anywhere in the District. Whereas there are restrictions on Section 106 with infrastructure needing to be directly related to a development, and with the advent of CIL there are now restrictions on how section 106 funds can be pooled.

Energy Service Company

9.21. There are a number of business models that might be applicable for the implementation of area-wide renewable energy solutions – although all are ultimately about managing business risk and capital investment.

9.22. Traditional models that may be 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.

Definition of an ESCO & CEM company

9.23. The European Parliament Directive 2006/32/EC on Energy End-Use Efficiency and Energy Services (Energy Services Directive) defines 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.

9.24. 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

9.25. 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 is typically owned by the parties taking the initial risk. The corporate structure may affect the sources and types of funding available.

9.26. 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 CO_2, whilst the ESCO and CEM can make use of their market knowledge and market presence and their economies of scale to secure a better deal in the market place. This is of benefit to both the end user and the ESCO and CEM in terms of lower costs for the end user and higher returns for the ESCO and CEM.

Purpose of an ESCO and CEM

9.27. 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.

9.28. 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 CHP generator 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

9.29. The financing options for the CHP generating equipment can be divided into two key groups Capital Purchase or Operating Lease. For both groups there are different ways of financing the projects and each have particular issues, these are set out in Table 24.

Table 24. Possible funding methods for CHP projects

Funding Method	Financed by	Issues
Capital Purchase or 'on balance sheet'	Internal Funds	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	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 – hire purchase	CEM becomes the legal owner of the assets once all payments have been made.
	Leasing - finance lease ('full payout')	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.
Operating Lease or 'off balance sheet'	Equipment Supplier	Leasing package as an alternative to outright purchase where the supplier designs, installs, maintains, and operates the CHP, the technical risk is transferred to the equipment supplier, and the price risk is with the CEM. Typically the supplier will purchase the fuel, account for the CO_2, buy the heat and power and may supply the CEM at a discounted energy price.
	Energy Services Company	ESCO typically designs, installs, finances, operates and maintains 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 to 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 funding	There may be 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 may be available to statutory bodies through DECC Salix funding[73] or through other finance initiatives.

Source: DECC CHP Focus; http://chp.defra.gov.uk/cms/

Footprint and Impact

9.30. The footprint of a typical CHP engine is dependent 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 15 m long by 3 m 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.

[73] DECC is the Department of Energy and Climate Change – Salix loans are provided for energy efficiency projects that pay for themselves within five years through lower energy bills.

9.31. The flue stack and potential noise are 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 MW is between 0.5 and 10 acres and depends on feedstock and storage. Smaller units may be housed in temporary containers.

Considerations and beneficiaries of wide area developments

9.32. The future direction of growth in Epping Forest District is not clear as the Local Plan is only in an early stage of development and therefore the growth strategy for the District is not yet decided. However, it is clear from analysis of the District's SLAA that proposed developments are likely to be for predominantly housing development with some small scale supporting commercial / industrial development.

9.33. There could be one or two larger urban extensions in the District that are developed over time, which have some potential for a decentralised energy network. Area wide 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.

9.34. 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 may be 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.

9.35. The opportunities in Epping Forest District are likely to be in a new build environment where larger urban extensions are developed. There appears to be only limited potential to add other opportunities such as heat networks and efficiency projects to existing commercial or public buildings.

9.36. 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 new 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 its standard end-user electricity supply contract.
- Access the electricity distribution grid through a substation which may be physically located within the development area and will be under the control of the local Distribution Network Operator (DNO).

9.37. If other opportunities to establish CEMs occur this model allows additional plant to be brought into existing CEMs or new CEMs to be established depending on the technology and stakeholder requirements.

Appendices

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Appendix A. Renewable energy generation technologies and low carbon technologies

A.1. Overview of renewable energy generation and low carbon technologies

A1.1 Renewable energy (or zero carbon) technologies transform a renewable energy resource into useful heat, cooling, electricity or mechanical energy. A renewable energy resource is a natural resource which cannot be exhausted or can replenish over time through natural processes. 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, as some resources are preferential to others.

A1.2 Low carbon technologies include energy efficiency measures and methods for reducing the energy consumed in the provision of a good or service. Systems such as heat recovery ventilation, combined heat and power of fossil fuels, and heat pump systems all fall into the low carbon category.

A1.3 This appendix provides information on a number of renewable energy technologies and low carbon technologies these include:

- Renewable technologies
  - solar - thermal
  - solar - photovoltaic
  - wind power
- Low carbon technologies
  - heat pumps
  - biomass
  - CHP plants

A1.4 For each technology the following information is provided:

- a brief description of the technology;
- technology considerations;
- indication of installation costs (including payback period);
- indication of power generation capacity;
- retrofit and installation issues,
- key advantages; and
- potential funding sources.

A1.5 Some technologies operate at both the large scale and micro-generation scale and these are clearly defined within the table below. Although the tables set out typical payback periods these are indicative because future fuel price increases are unknown and therefore payback cannot be calculated accurately and renewable energy equipment can add to the value of the property (this is not included in the payback period). Payback periods will also be dependent on current incentive schemes (which are subject to change). The efficiency of the system and the energy efficiency of the house / building will also have an impact on payback period.

A1.6 The appendix has not included hydro power as this is not considered viable or feasible in Epping Forest District.

A.2. Renewable energy generation and low carbon technologies

A2.1 The following tables identify renewable energy generation and low carbon technologies.

Solar thermal

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
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. The heated water can be used for space heating, domestic water heating, agricultural and commercial use. 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. 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. **Flat plate panels** **Evacuated tube panels**   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 are more efficient they are more expensive than flat plate.	South or south west facing, un-shaded pitched roof is optimal. Can be installed on flat roofs (with a frame) or vertical facades. Requires 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 are more efficient but slightly more expensive and more susceptible to breakages than flat plate collectors. Should provide all the hot water requirements in summer but an additional source of heat may be required in winter.	Typical single dwelling: £2,000 - £2,500 (flat plate) £3,000 - £3,500 (evacuated tube). Typical payback 6 – 15 years	Typical 4 sq.m system can produce 50% of typical family hot water over the year.	South or west facing roof required. Roof needs to be structurally sound to support installation. New larger water tank required which includes a solar coil.	Free unlimited resource. Low maintenance. Can provide 40-60% of a dwellings annual hot water requirements. If maintained, can have lifespan of 20+ years.	Renewable Heat Incentive (RHI) – available to businesses at present but will be available to householders later in 2013 Renewable Heat Premium Payment (RHPP) available to householders until RHI comes in later in 2013 for householders

Solar PV

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
(PV) systems 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. 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: Connected directly to the grid; Connected to battery system for stand-alone power; or Combination of the above. **Crystalline PV panels** **Thin film panels**   **Solar roof tiles** 	Technically viable on any building with south to south west facing roof, optimally tilted at 30° and 40° from horizontal. A tilt of between 10° and 50° still gives 90% of optimal. South facing vertical facades generates approx 70% of optimal. Avoid shading from trees, chimneys etc. Crystalline solar panels are the most common form and are most efficient. 'Thin film' types are less efficient and require a larger surface area for the same power output, but look more like coloured glass panes so can be architecturally 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 or on the ground.	Average of £12,000 for a typical 2 kW system (average domestic installation). Typical payback period could be 20 years.	Typical system will take up around 14 sq.m and produce around 50% of annual electricity demand of an energy conscious family. On average, a system will produce 850 kWhpa per installed kW.	PV panels are heavy, so the structure of the building should be checked to ensure it can support the weight. Where the PV structure needs to penetrate the existing roof, care should be taken to ensure water tightness. Accessible space is required for the electronic inverter and other electrical components.	Free unlimited resource. Low maintenance. Easy form of renewable generation to integrate into existing buildings.	Feed in Tariff (FiT) – available to householders / businesses

Wind turbines - small scale (less than 2 kW)

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
Wind turbines convert power from the wind into electricity. Small scale turbines vary in size from 100 watts to 6 kW. Small scale wind turbines can either be stand alone (see below for free standing turbines) or building-mounted and the choice is normally determined by the available, space. Most small wind turbines generate direct current electricity (DC) and require an inverter to convert it to alternating current electricity (AC). They can either use a battery to store the energy generated or be connected to the national grid, which means any excess electricity can be sold to the national grid. Building mounted wind turbines may be either mast mounted or roof mounted. They can either be of the horizontal or vertical axis type. The horizontal axis type is similar to most large scale wind turbines, but smaller. The vertical axis type can be less visually obtrusive and some are hidden in a box. Vertical axis types are less efficient, but cope better with turbulent conditions. Building mounted turbines are best located on gable ends, negating the need for extra 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. **Horizontal axis wind turbine**  **Vertical axis wind turbine** 	Building mounted wind turbines require a wind speed of 5 metres per second or more. Need to ensure that wind is not obstructed by obstacles such as buildings, trees or pylons (these increase turbulence and are likely to reduce wind speed). Building mounted turbines are usually secured to gable end walls. These are suitable for homeowners or small businesses subject to other planning considerations (e.g. conservation area / listed building statues)	Up to 2 kW £1,500-£4,000/kW installed capacity. Typical payback period 8 years.	Output highly site dependent, maximum of 2,000-5,000 kWh per annum for a 2 kW 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. Potential impacts of noise, vibration and flicker.	Free unlimited resource. Relatively Low maintenance. Regular service checks required. Can operate in lower wind speeds than larger wind turbines. Potential to last up to 20 years.	Feed in Tariff (FiT) - available to householders and businesses

Wind turbines - small less than 100 kW Medium and large 100 kW – 2 MW

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
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. Large scale wind farms of 2 MW 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.). 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). 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. **Small Scale (5 kW) wind turbine** **100 kW wind turbine**  	Smaller turbines in this range are usually sited on small masts and as a result they suffer from turbulence, and low wind speeds in urban areas. The effect is that the turbine is likely to struggle to repay costs over its lifetime. Position in sites that are unobstructed. Typically projects will be community scale and could be connected to local centres. For medium/large turbines the installation is more involved, but the returns are far better. Although they only have a small footprint, health and safety considerations in a built up area can make siting difficult. The greatest potential is in non residential areas where schemes of one or two turbines could be achieved. Given the scale of these turbines they are not suitable for homeowners.	Small - Up to £1,500-£4,000 per kW installed capacity Medium / Large – £1,500-£2,500 per kW installed capacity	Small - Output is highly site dependent, maximum 20 – 50 MWh per annum for 20 Kw turbine. Medium / Large Large turbine (750 kW) could produce 1,200 – 1,800 MWh per annum.	These could be retrofitted to existing areas, but need to ensure clear access to wind resource and that there is suitable access for maintenance. Distance from turbine to point of use is also a consideration as long cable runs increase cost. For larger schemes installation issues will include landscape impacts and airport safeguarding areas.	Free and unlimited resource. Relatively low maintenance. Smaller turbines can operate in lower wind speeds than larger ones. Large turbines are an economically attractive option for larger scale renewable generation.	Feed in Tariff (FiT) - available to householders and businesses

Ground source heat pumps (GSHPs)

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
GSHPs work by 'pumping' heat from one medium to another using a fluid called a refrigerant. 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. A heat pump uses a heat collector which can draw heat from a number of sources, including the ground. GSHPs use a condenser (which is a length of copper tubing). The refrigerant is pressurized by the compressor. When the pressure on a liquid is increased, it rises in temperature. As the fluid flows through the condenser, the extra heat leaks out of the tubing either into the ground or into the house. At the end of the condenser is a small valve which sprays the refrigerant into an evaporator. The evaporator is a low-pressure section of piping. As the refrigerant expands in the evaporator, it cools rapidly. Heat flows into the evaporator through the tubing, either from the house or the ground. GSHPs are capable of heating and cooling, effectively by changing the direction of the heat flow. **Ground source heat pump** 	The space available for the external sub soil heat exchanger will determine the system or (borehole or shallow horizontal system) used. Where there is adequate free space, horizontal systems can be used, in built up areas where land is at a premium, more expensive borehole systems are common. Vertical systems or systems with coiled loops require less space. A single dwelling requires approx 200m of pipework. Higher efficiencies are achieved with the system delivering 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 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 the required heights and associated heat loss. Consideration also needs to be given to how residents are charged for the heat they use. This type of system supplying several homes is only likely to be feasible where the 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.	Typical single dwelling systems range from 6-12 kW. Prices range from £8,000 - £12,000 excluding heat distribution system (under floor heating) Typical payback period 6-8years (assuming RHI)	A correctly sized system can supply 100% of 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 systems for a single house to large systems for whole housing estates.	Sufficient space is required to install the sub soil heat exchangers. Boreholes require at least 9 metres between them with the depth and number required dependent on location. 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 the heat pump is located in the dwelling so as not to disturb residents. GSHP is suitable for new build.	GSHPs provide 3 to 4 units of heat for every unit of electricity used in operation. Utilising the heat in the ground (which is renewable). Provide a reliable heat source with fairly constant efficiencies due to relatively stable ground temperatures. Can be run in-off peak electricity periods and still deliver required heat with substantially reduced running costs.	Renewable Heat Incentive (RHI) – available to businesses at present but will be available to householders later in 2013 Renewable Heat Premium Payment (RHPP) available to householders until RHI comes in later in 2013 for householders

Air source heat pumps (ASHPs) and heat recovery based on exhaust air systems

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
ASHPs are a device that uses a small amount of energy to move heat from one location (the air) to a heat sink (the home or building). Heat pumps use similar technology to that employed in domestic refrigerators or freezers, but in reverse. ASHP works by extracting low-grade heat from the air outside but where a refrigerator rejects heat from the contents to keep it cool, a heat pump will use it to heat water and provide heating. The technology works by using fans to pull air from outside over refrigerant filled coils, the liquid in the coils absorb the heat and expand, the vapour then passes through a compressor which increases the pressure and passes the vapour over coils inside the building, the heat is then pumped into air ducts in the building. Heat pumps can also be used in reverse for space cooling. **Air source heat pump** 	ASHPs work well in moderate climates. ASHPs are suitable for installation in single or multiple dwellings. There are two main categories: Air to Water and Air to Air. Air to Water heat pumps are similar to GSHPs in that they operate most efficiently in well insulated buildings with under floor heating. The major advantage of these systems is that they require little space for installation, unlike GSHPs. 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 domestic hot water temperature (if required). In general the efficiency of ASHPs are less than GSHPs but this is offset by the lower capital investment. In addition, heat recovery mechanical ventilation systems incorporating heat pumps are also available that can be considered for some dwelling types.	Domestic ASHP is approx £3,000 - £5,000. Typical payback period 5 – 13 years	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 systems for a single house to large systems for whole housing estates. Supplying domestic hot water to in excess of 60°C will reduce efficiency of the system.	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. ASHP is suitable for new build.	ASHPs provide 2 to 4 units of heat for every unit of electricity used in operation. Utilising the heat in the air (which is renewable). Relatively straight forward to install.	Renewable Heat Premium Payment (RHPP) available to householders until RHI comes in later in 2013 for householders

Biomass boilers

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
Biomass boilers use a biomass feedstock. 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. The most common biomass boiler fuels in the UK are the wood biomass fuels including wood chips and wood pellets. Both can be considered environmentally friendly fuels. 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. Wood chips are made from trees, branch-wood or coppice products which are mechanically shredded by a chipping machine and then air dried. 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 20mm long.	Availability of space for the system and fuel storage, along with ability to deliver the fuel, are all key considerations. Pellet boilers with automatic feeds are now available for individual domestic properties. Fuel hoppers still need filling by hand, which may not be suitable for the elderly or disabled. In addition ash (typically 2-3% of fuel volume) needs to be emptied and disposed of. 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. Pellets are smaller than wood chips and 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.	Pellet fuel boilers costs range from £5,000 - £14,000 depending on size and distribution system size. Wood fuel space heaters (stoves) £2000 - £5,000. Typical payback period 8 years (assuming RHI)	Pellet boilers can provide 100% of the space and domestic hot water requirement for a property. Wood burning stoves can also be used as a top up. Communal systems serving multiple dwellings can bring economies of scale and allow for centralised storage of systems and allow for easier management.	Pellet boilers require internal or external space for the boiler and storage. The connection to the existing heating system will need to be considered to ensure a balanced system. Retrofitting wood burning stoves work well where there is an existing chimney that can be lined. 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 source is renewable. Reliable when a fuel source can be guaranteed.	

Combined heat and power system

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
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. Small scale gas CHP systems incorporate either a gas turbine or reciprocating engine. 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 2 MW power output. It becomes more economical and efficient to use a gas turbine above 2 MW. 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.	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 heat. CHP can also be used for cooling in addition to heating (combined cooling heating and power CCHP) 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.	£1,200 - £1,800 / kW The smaller the differential between electricity and gas prices, the less economically attractive a CHP system will be.	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 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 where retrofitting. CHP is suitable for new build.	Low carbon technology, Reliable and proven technology. Integrates well with the existing energy infrastructure. Can be highly efficient across the full year.	Mirco-CHP - Feed in Tariffs (FiTs) - available to householders and businesses

Biomass combined heat and power system

Technology	Technology Description	Technical Considerations	Typical Installed System Cost	Typical output	Retrofit / installation Issues	Primary Advantages
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. 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. 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.	Performance and installation considerations similar to conventional CHP systems, but in addition the on-site storage of fuel requires considerable space. 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.	£4,000 - £7,000 / kW The smaller the differential between electricity and biomass prices, the less economically attractive a CHP system will be.	Depending on size, CHP can provide all or most of the electricity and heat for anything up to an entire district.	Same issues as conventional CHP but also large space required for wood storage. Biomass CHP is suitable for new development as well as retrofit.	Low carbon technology. Can be highly efficient if year round heat load exists at or near to the site.	Renewable Heat Incentive (RHI) – available to businesses at present but will be available to householders later in 2013 Renewable Heat Premium Payment (RHPP) available to householders until RHI comes in later in 2013 for householders

Appendix B. Glasshouses and industrial areas

B.1. Introduction

B1.1 This appendix sets out information on the glasshouse industry some of the Districts large industrial areas (those that are located in areas of high heat demand as shown in chapter 3). This information has been used to inform our assessment of the likely power and heating needs of these areas, in order to explore the potential for CHP (as set out in chapter 4) and other renewables (see Appendix c)

B.2. Glasshouse sector

B2.1 There are four existing clusters of glasshouses:

- Lower Nazeing
- Roydon
- North of Waltham Abbey
- South of Waltham Abbey

B2.2 The plan below gives some indication of where these are located. There are approximately 77 glasshouse businesses in the district[74]. The average size is 2.11 ha.

B2.3 There are currently four sites that have CHP:

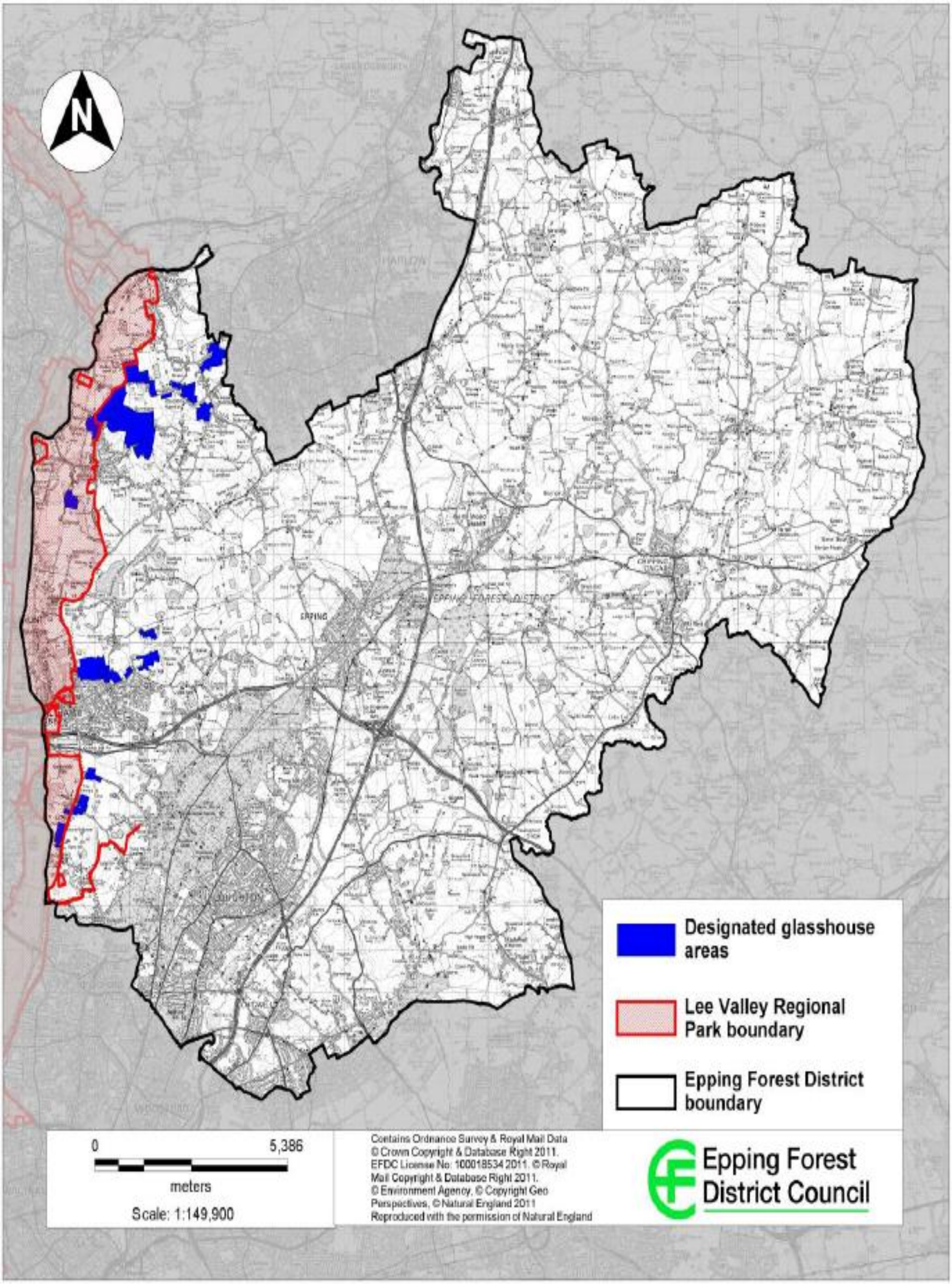
- Coronation Nursery – Nazeing, EN9 2RN with 0.5 MW generating capacity
- Tower Nursery – Roydon, CM19 5JP – with 3.1 MW generating capacity
- Villa Nurseries – Roydon, CM19 5LE with 3.1 MW generating capacity
- Abbey View – Waltham Abbey, EN9 2AG with 3.1 MW generating capacity

B2.4 The Lea Valley Glasshouse Industry Report (2012) identifies some key facts about the glasshouse industry:

- Large percentage of glasshouse businesses in the District are less than 1ha in size.
- Most glasshouses are less than 4m tall.
- The main crop that is grown is cucumbers.
- Most are family operated businesses.
- Energy is one of growers' main concerns and they see CHP, biomass heating and anaerobic digestion as potential solutions.
- 22% of businesses have invested in energy, with 60% of those investing in mains gas supply and 40% renewable energy (100% CHP).

B2.5 There are grower aspirations to increase the size and height of glasshouses. Most consider that the minimum size for a viable business will increase from 2.6 ha to 6.28 ha in the next 20 years.

[74] Lea Valley Glasshouse Industry Report (2012)



Source: The Lea Valley Glasshouse Industry Report (2012)

B.3. Industrial estates

B3.1 Information has been collated from Valuation Office Agency (VOA) data, from the Council's Employment Land Review (ELR) and the Consultant's knowledge of employment sites in the District from their work on the ELR.

Site	Key facts
Sainsbury's Distribution Depot (Waltham Abbey)	**Site Area:** 18 ha **Premises no. / Type:** 1 occupier – storage and distribution for Sainsbury's. Large 2 storey purpose built storage and distribution warehouse. **Ownership:** Single ownership Occupiers: supermarket storage **Floorspace:** Approx 70,000 sq.m of floorspace
Meridian Business Park (Waltham Abbey)	**Site Area:** 2ha **Premises no. / Type:** approx 10 premises, 1 large unit 9 small units, and single / 2 storey modern purpose built light industrial units. **Ownership:** Appears to be under single ownership / management **Occupiers:** storage, air conditioning contractors **Floorspace:** Approx 15,000 sq.m of floorspace.
Abbey Mead Industrial Estate (Brooker Road, Waltham Abbey)	**Site Area:** 9.5 ha **Premises no. / Type:** 51 premises – Generally single storey / 2 storey light industrial units with ancillary office space **Ownership:** Fragmented / various land holdings – not all in one ownership **Occupiers:** Predominantly light industry , occupiers include: printers, building contractors, manufacturers, wholesale, storage and sales of goods, sales and servicing of equipment, vehicle bodywork repairs, there is also a car sales showroom / garage. **Floorspace:** Approx Total 46,000 sq.m – with following split 5,000 sq.m office, 5,000 sq.m retail, 18,000 sq.m factory, 12,000 sq.m warehouse
Oakwood Industrial Estate / Langston Road	**Site Area:** 34.6 ha **Premises no. / Type:** 148 premises – Range of size, age and types of unit. Western side (Oakwood Industrial estate) is generally older, mostly single storey industrial units. On the Langston Road side – the premises include some large modern offices , large car showrooms, mix of new and older light industrial units with ancillary offices, SME seed bed centre (purpose built small industrial units / workspaces), and a large 3 or 4 storey manufacturing unit for Bank of England (BoE). **Occupiers:** Oakwood Industrial Estate - Construction, general storage, building suppliers, glaziers, commercial vehicle repair, engineering, printers, storage and distribution, equipment suppliers. Langston Road – office occupiers, car showrooms, construction (mostly office operations though e.g. Offices for Kier), printers, wholesalers, building and engineering services, publishers, machine engineering, largest occupier is BoE / De La Rue Currency printing money for BoE. **Ownership:** Fragmented / various land holdings – not all in one ownership. One large occupier (Bank of England / De La Rue Currency). **Floorspace:** Approx Total 136,000 sq.m – with the following split 18,000 sq.m office, 14,000 sq.m retail, 63,000 sq.m factory, 37,000 sq.m warehouse

Appendix C. Renewables potential in glasshouses and industrial areas

C.1. Introduction

C1.1 The assessment in chapter 4 of potential carbon savings from the glasshouse industry and the District's larger industrial areas focused on the potential for carbon savings through implementation of CHP schemes. The assessment concluded that there is limited potential for CHP to be implemented in the glasshouse industry and other industrial areas. Therefore, an additional assessment (set out below) was undertaken to explore the potential for other renewable technologies glasshouse industry and other industrial areas.

C.2. Glasshouses

C2.1 The following includes a brief summary of the potential for other types of renewable and low carbon energy that could be used by the glasshouse industry.

Renewable fuelled boilers

C2.2 As the energy for glasshouses is predominantly used for heating it would make good sense to use biomass or liquid Biofuel boilers. Biomass boilers would be incentivised by the Renewable Heat Incentive. Compared to the base case of boilers fired on oil or kerosene, biomass boilers should present a favourable economic case and will reduce the carbon emissions by a considerable amount. Based on the CRC scheme where biomass contributes no CO_2 the saving would be approximately 1,150 te CO_2 per annum per hectare if biomass entirely replace gas (or 1,480 te CO_2 per annum per hectare if replacing kerosene).

C2.3 Unfortunately it is not easy to harness the CO_2 for crop production from biomass or oil boilers as it is from natural gas or kerosene so whilst this is a potential option it will not be ideal for the grower who requires the CO_2. The size of boilers required to make any significant contribution to larger glasshouse sites would only qualify for the RHI at the lowest level making the scheme less financially attractive than smaller biomass installations.

Solar PV and solar thermal

C2.4 Solar thermal, at any scale that would have a significant effect on the carbon emissions, is assumed not to be relevant as any available area that could be devoted to these technologies is presumably better used for further crop production. Using the greenhouse upper surfaces is obviously counterproductive as it will shade the crop.

C2.5 If there are redundant areas of land or roofs of other buildings, packing sheds and the like, then solar PV can be considered. The economics will generally be as for any other user who installs PV. The 24/7 average demand for electricity is around 15 kW per hectare. Meeting this average even during the height of a sunny day would typically require 100 sq.m of panels per hectare. Despite recent reductions on the Feed in Tariff (FiT), PV should be expected to give a simple payback period of 10 years giving typically an 8% return on investment over 20 years. Displacing the total site electrical load would reduce the carbon emissions by about 6%, or 70 te CO_2 per annum per hectare of glass, and would require about 1,000 sq.m of PV panels.

C2.6 Chennells Farm in Lincoln chose to install a 100 kW solar PV system for a new grain store, and used FEC for advice on the best way to go about the installation. They assisted in choosing a supplier, and advised them on how to best install the system to make the greatest returns.

Wind Power

C2.7 Wind power could be applied to glasshouse sites if the average wind speed is sufficiently high and there is sufficient space. As shown in Figure 42 parts of the west of the District where the glasshouse house industry is concentrated have been identified as potential suitable areas for wind turbines, each site would need to be tested to for local wind speeds as the efficiency of wind turbines are highly susceptible to turbulence caused by nearby obstructions. Planning constraints (such as green belt and the need to minimise impact on nearby uses) and electrical connection cost will influence the local viability of a project.

C2.8 The FIT incentivises wind generation and payback periods could be expected to be in the range of 8 – 15 years depending on wind conditions and the size of the plant. Displacing all the electricity used on-site would reduce the carbon emission by about 6%, or 70 te CO_2 per annum per hectare of glass, as for solar PV wind power will only provide electricity, so even if wind power could be used to meet some or all of the growers electricity requirements, growers would still have a need for an additional source energy for heating.

Ground source heat pumps

C2.9 Providing heat from heat pumps would be technically feasible but would not provide any CO_2 for crop promotion so the grower would tend to burn fuel as well solely for this purpose. The other challenge would be using the lower temperature water from the heat pump circa 60°C. Greenhouses operators are typically familiar with using water at 80°C so a change to the heating system within the greenhouse would be required.

C2.10 Assuming the above mentioned technical difficulty can be overcome, the size of the scheme would depend on the heat demand, the capacity of the electrical connection and the ground availability and ground conditions as to how much heat could be extracted.

C2.11 As greenhouses often have large thermal stores these could be utilised to employ cheaper electricity at night time to raise more heat than is required to store for use later in the day

C2.12 With the benefit of RHI on the heat produced, a heat pump could potentially displace a large proportion of the heat required and would give a payback period of typically 4 - 8 years.

C2.13 Water source heat pumps would be equally possible if a reasonably large body of water or river is available.

C2.14 The Victorian Plant Nursery at Powis Castle is an example where the National Trust has installed a ground source heat pump which heats a range of green houses and poly tunnels and also provides heat to the tea room at the castle. The project has been funded by National Trust's Green Energy Fund, which is supported by Npower.

Hydro

C2.15 Hydroelectricity feasibility is very specific to the individual installation and is possible if there is access to and ownership rights over a flowing water course with sufficient head height. None of the rivers in the District are sufficient for installation of Hydro power.

Summary

C2.16 In summary, glasshouses have a large heat load compared to their electricity load and have a requirement for CO_2 to promote crop growth. They account for an approximate carbon emission of around 1,100 te CO_2 per annum per hectare. In the past the energy demand on the larger sites has been met with natural gas fired CHP to provide heat and CO_2 with most of the power being exported to the grid. Currently the relative price of gas and power does not make this an economically attractive investment. Typically it would take an increase export power price to around three to four times the gas price to make CHP at glasshouses economically attractive. This scenario may well re-occur within the next 5 to 10 years, but it is not certain.

C2.17 Various renewable and energy efficiency measures can be taken to cut CO_2 emissions by a considerable amount (circa 500-1,000 te CO_2 per annum per hectare could be achievable). There is not a perfect, indisputable, leading technology and each grower will have specific circumstances determining which technology is most suitable. The investment case should offer a simple payback period of 4 – 10 years. Solar PV, renewable fuelled CHP, biomass boilers and ground/water source heat pumps are all technologies that could be employed.

C.3. Industrial Areas

C3.1 Chapter 4 considered the potential for carbon reductions through CHP this appendix includes additional information to consider the potential for other types of renewable and low carbon energy.

Biomass Boilers

C3.2 Biomass boilers could be used to provide heat to any buildings that require heating. Biomass heat will benefit from the RHI but it is unlikely that the combination of low heat load and alternative fuel price will make a highly persuasive financial case. As it is likely that any space heating is currently using gas, the economic case would be significantly worse than for buildings using fuel oil of LPG which is more expensive than gas.

C3.3 Biomass heat may however be particularly relevant to any businesses processing wood products where there is a significant quantity of wood waste. There may be the case for certain types of manufacturer such as furniture manufacturers.

Ground source heat pumps

C3.4 Heat pumps could provide an economic alternative to gas heating in offices, retail and storage depots. Assuming there is sufficient ground area to lay horizontal coils or that the geology is right for a borehole system then a payback period of around 4 – 8 years might be expected. Typically this would reduce the carbon emissions due to fossil fuel by 40-50%.

Solar PV

C3.5 Solar PV is an option for industrial and commercial premises as it is easy to integrate into the building and the economics are not highly dependent on the building loads. It does depend on an appropriate area (roof or ground) where PV panels can be orientated to within about 50° of due south. There are many examples of solar PV being mounted on commercial properties. A good example of solar PV on a distribution warehouse is given below:

C3.6 Gazeley UK Ltd installed a total of 36 solar rooftop generators on the 48 acre site of the Gazeley 'Blade' warehouse in Sheffield, each rated at 1 kWp, to form the system without any structural upgrade costs.

C3.7 Generating over 28,000 kWh each year, the system is likely to save the CO_2 emissions equivalent of eight three-bedroom houses and provide 75% of the offices' electricity needs. The majority of the system is built off-site and can be installed in as little as four man hours per 1 kWp generator. This is a critical factor for success, with the turnaround of modern commercial buildings as fast as ten weeks.

C3.8 The example of Gazeley illustrates the sharp cuts in carbon emissions that can be achieved through the application of solar PV, which combined with other environmentally friendly technologies can make a significant positive impact on the environment.

Wind power

C3.9 The returns available from wind power improve as the size of the turbines increases. This is particularly true in areas where there are many low buildings as to get into 'clean wind' (i.e. not turbulent) height is required. In this general location an annual average wind speed of 6 m/s at about 25 m above ground level whilst at 45 m above ground it is 6.4 m/s. This is generally considered the lowest speed compatible with a favourable wind power project. On this scale it would probably be best to consider one large turbine at each location (subject to the necessary planning constraints) as has been done at the Green Park near the M4 at Reading.

C3.10 Here, Ecotricity have installed an Enercon E-70 wind turbine, billed as the UK's most visible turbine. The blades are 33 m long, with a tower height of 85 m. With a wind speed of 14 m/s the machine generates 2.05 MW of electricity, which is enough to power around 1,500 homes. It is owned and operated by Ecotricity and was completed in November 2005. Between 2005 and 2010, it worked at 17% of its capacity, and it received £600,000 in public subsidies. In 2010, the subsidies received were thought to be worth more than the total amount of electricity that the turbine generated. Typically the average wind speed in Epping Forest is slightly higher than in the Reading site.

C3.11 In the context of the Epping Forest sites the output of the Reading turbine equates to approximately 3 million kWh per annum or roughly the whole electricity consumption estimated for the Abbey Mead site or 40% of the electricity use for the Oakwood industrial estate.

Summary

C3.12 In summary, the industrial and commercial areas have a carbon emission due to electricity and fossil fuel use totalling in the order of 11,000 te CO_2 per annum. It is unlikely that the type of area with relatively similar heat profiles common to all users would justify the installation of a retrofit district heating or cooling scheme.

C3.13 Various other renewable energy technologies could be installed at individual sites. There is not a single leading technology and each business will have specific circumstances determining which technology is most suitable. The investment case should offer a simple payback period of 4 – 10 years and could displace typically between 10 – 40% of the carbon emissions. Solar PV, renewable fuelled CHP, biomass boilers and ground or water source heat pumps are all technologies that could be employed.

C3.14 One large (2 MW) wind project at each business area could reduce the carbon emission by around 30 - 50% of estimated current levels.

Appendix D. Feed in Tariff rates

D.1. Introduction

D1.1 The tables below set out: the FIT rates for an accredited FIT installation of the description specified; a Tariff Date specified ; and the applicable rate.

D1.2 All FIT tariff rates in Tables below are pence per kilowatt hour at 2012/13 values. Only technologies that are likely to be applicable in Epping Forest District are included.

D.2. Anaerobic digestion

Description	Period in which Tariff Date Falls	Tariff (p/KWh)
Anaerobic digestion with total installed capacity of 250 w or less	1 April 2010 to 29 September 2011	12.70
	30 September 2011 to 31 March 2013	14.70
Anaerobic digestion with total installed capacity greater than 250 w but not exceeding 500 kW	1 April 2010 to 29 September 2011	12.70
	30 September 2011 to 31 March 2013	13.60
Anaerobic digestion with total installed capacity of 250 w or less	1 April 2010 to 29 September 2011	9.90
	30 September 2011 to 31 March 2013	8.96

D.3. Wind

Description	Period in which Tariff Date Falls	Tariff (p/KWh)
Wind with total installed capacity of 1.5 kW or less	1 April 2010 to 31 March 2011	37.90
	1 April 2011 to 30 November 2012	35.80
	1 December 2012 to 31 march 2013	21.00
Wind with total installed capacity greater than 1.5 kW but not exceeding 15 kW	1 April 2010 to 31 March 2011	29.30
	1 April 2011 to 30 November 2012	28.00
	1 December 2012 to 31 march 2013	21.00
Wind with total installed capacity greater than 15 kW but not exceeding 100 kW	1 April 2010 to 31 March 2011	26.50
	1 April 2011 to 30 November 2012	25.40
	1 December 2012 to 31 march 2013	21.00
Wind with total installed capacity greater than 100 kW but not exceeding 500 kW	1 April 2010 to 31 November 2012	20.60
	1 December 2012 to 31 march 2013	17.50
Wind with total installed capacity greater than 500 kW but not exceeding 1.5 MW	1 April 2010 to 31 November 2012	10.40
	1 December 2012 to 31 march 2013	9.50
Wind with total installed capacity greater than 1.5 MW	1 April 2010 to 31 November 2012	4.90
	1 December 2012 to 31 march 2013	4.48

D.4. Combined heat and power (CHP)

Description	Period in which Tariff Date Falls	Tariff (p/KWh)
Combined Heat and Power with total installed electrical capacity of 2 kW or less (tariff only available for 30,000 units)	Before the conditional date	11.00
	On or after the conditional date	12.50

D.5. Export tariff

Description	Period in which Tariff Date Falls	Tariff (p/KWh)
All Eligible Installations	1 April 2010 to 30 November 2012	3.20
	On or after 1 December 2012	4.50

D.6. Photovoltaic eligible installations (2012/13)

Description	FIT Year 3 2012 / 13					
	For Eligible Installations with an Eligibility Date on or after 1 April 2012 and before 1 August 2012 (p/kWh)		For Eligible Installations with an Eligibility Date on or after 1 August 2012 and before 1 November 2012 (p/kWh)		For Eligible Installations with an Eligibility Date on or after 1 November 2012 and before 1 February 2012 (p/kWh)	
Solar photovoltaic with Total Installed Capacity of 4kW or less, where attached to or wired to provide electricity to a new building before first occupation	Higher Rate	21.00	Higher Rate	16.00	Higher Rate	15.44
	Middle Rate	16.80	Middle Rate	14.40	Middle Rate	13.90
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic with Total Installed Capacity of 4 kW or less, where attached to or wired to provide electricity to a building which is already occupied	Higher Rate	21.00	Higher Rate	16.00	Higher Rate	15.44
	Middle Rate	16.80	Middle Rate	14.40	Middle Rate	13.90
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic (other than stand-alone) with Total Installed Capacity greater than 4 kW but not exceeding 10 kW	Higher Rate	16.80	Higher Rate	14.50	Higher Rate	13.99
	Middle Rate	13.40	Middle Rate	13.05	Middle Rate	12.59
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic (other than stand-alone) with Total Installed Capacity greater than 10 kW but not exceeding 50 kW	Higher Rate	15.20	Higher Rate	13.50	Higher Rate	13.03
	Middle Rate	12.20	Middle Rate	12.15	Middle Rate	11.73
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic (other than stand-alone) with Total Installed Capacity greater than 50 kW but not exceeding 100 kW	Higher Rate	12.90	Higher Rate	11.50	Higher Rate	11.50
	Middle Rate	10.30	Middle Rate	10.35	Middle Rate	10.35
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic (other than stand-alone) with Total Installed Capacity greater than 100 kW but not exceeding 150 kW	Higher Rate	12.90	Higher Rate	11.00	Higher Rate	11.00
	Middle Rate	10.30	Middle Rate	9.90	Middle Rate	9.90
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic (other than stand-alone) with Total Installed Capacity greater than 150 kW but not exceeding 250 kW	Higher Rate	12.90	Higher Rate	11.00	Higher Rate	11.00
	Middle Rate	10.30	Middle Rate	9.90	Middle Rate	9.90
	Lower Rate	9.00	Lower Rate	7.10	Lower Rate	7.10
Solar photovoltaic (other than stand-alone) with Total Installed Capacity greater than 250 kW		8.90		7.10		7.10
Stand-alone (autonomous) solar photovoltaic (not attached to a building and not wired to provide electricity to an occupied building)		8.90		7.10		7.10
Export Tariff		3.20		4.50		4.50

D6.1 The FIT Payment rates above have been determined by the Gas and Electricity Markets Authority (Ofgem) under article 13 of the Feed-in Tariffs (Specified Maximum Capacity and Functions) Order for solar photovoltaic installations with eligibility dates between 1 November 2012 and 31 January 2013, in accordance with Annex 3 to Schedule A to Standard Licence Condition 33.

Appendix E. Biomass heating of buildings

E.1. Typical annual heating and system size requirements

E1.1 The following data has been extracted from the Biomass Energy Centre website http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163211&_dad=portal&_schema=PORTAL in November 2012

E1.2 Based on specific examples in the UK and elsewhere. These figures are a guide only.

Building	Annual energy demand (MWh_{th})	System size (kW_{th})	Wood chips required p.a.		Wood pellets required p.a.		Land area required		
			Weight @ 30% MC (tonnes) See note 1	Volume @ 30% MC (m^3) See note 2	Weight @ 10% MC (tonnes) See note 3	Volume @ 10% MC (m^3) See note 4	Forest residues (ha) See note 5	SRC (ha) See note 6	Miscanthus (ha) See note 7
Domestic house	20	20	5.7	23	4.2	6.3	2	0.5	0.3
Small industrial unit	140	100	40	160	29	44	14	3	2.3
Large farm with outbuildings	400	150	114	460	83	125	40	9	6.5
Hotel	660	250	190	760	138	205	66	15	11
Municipal complex	360	300	100	400	75	115	36	8	6
District heating scheme	600	500	170	700	125	190	60	13	10
Municipal buildings	1,000	700	290	1,150	210	315	100	22	16
Greenhouse	4,200	1,200	1,200	4,800	875	1300	420	93	70
CHP (ORC)	14,800 (thermal)	1,850 (400 kW_e)	6,600	26,400	4,800	7,200	2,300	500	380
CHP/Power station	16,000 (electrical)	2,000 kW_e	20,000	80,000	14,600	21,800	6,900	1,550	1,160

Notes:

1. *3.5 MWh/tonne (12.6 GJ/t) mixed hard and soft wood*
2. *250 kg/m3 = 0.9 MWh/m^3 (3.2 GJ/m^3)*
3. *4.8 MWh/tonne (17 GJ/tonne)*
4. *670 kg/m3 = 3.2 MWh/m^3 (11.4 GJ/m^3)*
5. *2 odt/ha = 2.9 tonnes @ 30% MC*
6. *9 odt/ha = 12.9 tonne/ha.a @ 30% MC*
7. *13 odt/ha = 17.3 tonne/ha.a @ 25% MC*

Appendix F. Viability assessment assumptions

F.1. Code for Sustainable Homes compliance standards

F1.1 The CfSH compliance standards described in Table F-1 the basic assumptions for demand assessment and target compliance achieved for CfSH Level 3, Level 4 and Level 5 used to in the viability model. This included Dwelling Regulated energy considers the demand (electricity and heat) for a house and apartment and subsequent target reduction in demand with CfSH Level 3, Level 4, and Level 5.

F1.2 The CO_2 emissions (kg CO_2) displays the benchmark standards adopted in 2006 and the subsequent 25% reduction in emissions in 2010, 44% reduction in 2013 and the subsequent achievement of zero carbon in achievement in 2016. This includes the improvements through fabric energy consideration and does not take into account the impact from renewal energy adoption. As an exercise, the impact of unregulated energy requirements (as required by the original CfSH Level 6) has been included.

Table F 1 Dwellings emission and energy assumptions

Dwelling Emission and Energy Summary Table - Output

Dwelling Floor Area / sq.m		
House (Average between 3 Mid Terrace 3 storey dwelling & Original house standard)	108	Note: Dwelling based on rough approximation of dwelling dimensions
Flat (Based on 1 bed)	52	

Dwelling Regulated Energy Use / kWh YR

Standard	House Elec	House Heat	House Total	Apartment Elec	Apartment Heat	Apartment Total
Code Level 3/ Part L 2010 (base year)	578.24	5,044.63	5,622.87	548.79	3,210.58	3,759
Achieving the Fabric Energy Efficiency Standard* Potential 2013	649.02	5,768.66	6,417.68	577.96	2,511.97	3,090
Code Level 5 - As above	649.02	5,768.66	6,417.68	577.96	2,511.97	3,090
Code Level 6**	N/A	N/A	N/A	N/A	N/A	N/A

* Potential Building Regulations 2013

** No energy demands have been modelled for a CfSH 6 Home as un-regulated energy (applicable for CfSH 6) are to be excluded from Building Regulations and outside the Governments definition of Zero Carbon Homes

Dwelling Regulated Energy CO_2 Emissions / kg CO_2 /ANNUM

Standard	House Elec	House Heat	House Total	Apartment Elec	Apartment Gas	Apartment Total
Code Level 3/ Part L 2010 (base year)			1699			1059.2
Achieving the Fabric Energy Efficiency Standard* Potential 2013						900.1
Code Level 4 (Calculation simply based on SAP output "DER Target for CfSH 4" cell multiplied by floor area			1388			809.8
On-site Carbon Compliance Target 2016****			1188			724.5
Resultant amount of carbon to be saved to achieve CfSH5 (Potentially through allowable solutions)			1188			724.5
Code Level 6**						

The CO_2 figures have been calculated by multiplying the SAP output DER figure for each stage

**** The 2016, Zero Carbon, emissions are based on the predicted emissions allowed for the dwelling type, using the Zero Carbon Hub's proposed Carbon Compliance limit for a Low Rise Apartment and an Attached House. This limit will need to be achieved through, fabric energy efficiency and/or on-site low or zero carbon energy systems or connected heat. The emission figure itself will then need to be achieved through allowable solutions and/or further fabric improvement or on-site LZC contribution.

CO_2 Emissions Factor (Source: Defra 2012 GHG Conversion factors)

Electricity	0.517	
Gas	0.198	SAP 2009 Guidelines

CO_2 Emissions - Carbon Compliance Limit / kg CO_2 /sq.m/year

Detached Homes	10	This figure is the limit of CO_2 emissions that are allowed for the dwelling type, without using allowable solutions. This limit has to be achieved via the fabric energy efficiency standard and on-site LZC/connected heat
Attached Houses	11	
Low Rise Apartments	14	

CO_2 Emissions - Carbon Compliance Target / kg CO_2 /year	
Attached Houses	200.1
Low Rise Apartments	85.3

These are the emission reductions that will need to be achieved on-site through LZC systems to achieve Zero Carbon - effectively the difference between the emissions expected from a F.E.E.S dwelling and the Carbon Compliance Limit

Dwelling Regulated and Un- Regulated Energy CO_2 Emissions / kg CO_2		
Standard	House Total	Apartment Total
Un-Regulated Emissions	1852	1057
2006 dwelling	0.0	0.0
Code Level 3/ Part L 2010 (base year)***	0.0	0.0
Code Level 4 (Fabric Energy Efficiency Standard*) 2013***	0.0	0.0
Code Level 5 - Zero Carbon 2016****	0.0	0.0
Code Level 6*****	3267.3	1956.9

***** The CfSH 6 Emissions are a sum of the estimated un-regulated emissions for the dwelling type and the emissions from a Code Level 4 (Fabric Energy Efficiency Standard*) 2013 dwelling.

F.2. Combined heat and power assumptions:

F2.1 CHP has been evaluated for scheme-wide an on-site provisions based on the scale of the project. Table F-2 introduces the assumptions for the calculating the costs for adoption of CHP and its reduction in carbon (kg CO_2) targets:

- The variation in scheme-wide and On-site CHP adoption.
- The cost per unit (in green), cost per square meter (in Orange) and the reduction carbon impact per square meter in kg CO_2 /sq.m (in blue) for each type of CHP approach mentioned above.
- The costs for area-wide CHP and scheme-wide schemes was appraised for all case studies, however this should be differ from location and physical constraints of each site.

Table F 2: CHP Technology Connection costs

	Scheme-wide £/install	£/sq.m	Kg CO_2 red. sq.m	On-site £/install	£/sq.m	Kg CO_2 red. sq.m
House	8,217	76	1.5	5,019	46.47	1.5
Apt.	5,300	102	10.2	3,800	73.43	10.2

F2.2 The costs for each type of CHP technology have been broken down by type of development i.e. House and Apartment as seen in Table F-3. Furthermore, the assumptions of costs District Heating (DH) infrastructure costs have been introduced in Table F-4, which determined the infrastructure costs per unit for City-wide CHP adoption. Table F-5 is a summary of energy consumption and carbon reduction assumptions adopted for the purpose of the carbon target calculations.

Table F 3 Generic CHP Costs for each type of development

	Total generic Connection cost £		
	Low rise flat*	Terrace*	Semi-detached (dense)
On-site CHP + District Heating			
DH Scheme wide CHP	4,400	7,500	8,300

Indicative costs from http://www.idea.gov.uk/idk/core/page.do?pageId=23210852

Table F 4: Generic CHP Costs for type of development

District Heating infrastructure costs break-down £				
	District Heating infrastructure cost	District Heating branch cost	Hydraulic Interface Unit +heat meter	**Total**
House	2,719	3,198	2,300	8,217
Apt.	1,500	1,500	2,300	5,300
Indicative costs from http://ecolateral.org/Economics/bankofsustainibilty/distributedheatpoyyre0409.pdf				

Table F 5: Carbon reduction by each CHP technology

Gas engine CHP specifications	Scheme-wide	On-site
Elec efficiency %	28	28
Thermal efficiency	52	52
Cap. Cost £/kWe	1100	1250

F2.3 In order to determine emissions from electricity and heat for the CHP the following calculations was adopted:

CO_2 factors	
Natural gas	0.1836
Grid elec.	0.541

$$\text{Emissions (in kg } CO_2e\text{) per kWh electricity} = \frac{\text{2 x total emissions (in kg}CO_2e\text{)}}{\text{2 x total electricity produced + total heat produced (in kWh)}}$$

$$\text{Emissions (in kg } CO_2e\text{) per kWh heat} = \frac{\text{total emissions (in kg}CO_2e\text{)}}{\text{2 x total electricity produced + total heat produced (in kWh)}}$$

F2.4 **Area-wide and site-wide calculations for CHP:** The two tables below describe the carbon reduction impact calculated for area-wide CHP and site-wide CHP based on the methodology described above.

Table F 6: Area wide CHP assumptions

CHP heat efficiency	42%
CHP electrical efficiency	38%
Total CHP efficiency	80%
Distribution heat loss	10%

For 1000 kWh of gas input to CHP:		
Total emissions	198	$kgCO_2e$
Total electricity produced	380	kWh
Total heat produced	420	kWh
Electricity emission factor	0.33559322	$kgCO_2e$
Heat emission factor	0.16779661	$kgCO_2e$

	House		Apt.	
Building area	108	m²	52	m²
Annual electricity kWh	649	kWh	578	kWh
Annual heat kWh	5,769	kWh	2,512	kWh
Annual electricity emissions	218	$kgCO_2e$	194	$kgCO_2e$
Annual heat emissions	1076	$kgCO_2e$	468	$kgCO_2e$
Default design elect emissions	389	$kgCO_2e$	409	$kgCO_2e$
Default design heat emissions	1259	$kgCO_2e$	872	$kgCO_2e$
Annual electricity savings	172	$kgCO_2e$	215	$kgCO_2e$
Annual heat savings	183	$kgCO_2e$	404	$kgCO_2e$
Total annual emission reduction	355	$kgCO_2e$	619	$kgCO_2e$
Annual emission reduction per m²	3.29	$kgCO_2e$	11.96	$kgCO_2e$

Table F 7: Site wide CHP assumptions (assuming no backup boilers or grid imports required)

CHP heat efficiency	52%
CHP electrical efficiency	28%
Total CHP efficiency	80%
Annual Avg. Distribution heat loss	15%

For 1000 kWh of gas input to CHP:		
Total emissions	198	$kgCO_2e$
Total electricity produced	280	kWh
Total heat produced	520	kWh
Electricity emission factor	0.366666667	$kgCO_2e$
Heat emission factor	0.183333333	$kgCO_2e$

	House		Apt.	
Building area	108	m²	52	m²
Annual electricity kWh	649	kWh	578	kWh
Annual heat kWh	5769	kWh	2,512	kWh
Annual electricity emissions	238	$kgCO_2e$	212	$kgCO_2e$
Annual heat emissions	1244	$kgCO_2e$	542	$kgCO_2e$
Default design elect emissions	389	$kgCO_2e$	409	$kgCO_2e$
Default design heat emissions	1259	$kgCO_2e$	872	$kgCO_2e$
Annual electricity savings	151	$kgCO_2e$	197	$kgCO_2e$
Annual heat savings	14	$kgCO_2e$	330	$kgCO_2e$
Total annual emission reduction	166	$kgCO_2e$	527	$kgCO_2e$
Annual emission reduction per m²	1.54	$kgCO_2e$	10.19	$kgCO_2e$

F2.5 **Comparison between 50 units, 150 units and 500 unit threshold:** The two tables below described the carbon reduction to calculate the annual impact of 50 unit project of apartments and 50 unit housing project in comparison to a 150 unit or 500 unit project for apartments or housing. This was used to evaluate the critical threshold for efficiency for CHP.

Table F 8: CHP 50 units scheme (house and apartment)

	House		Apartment	
Number of houses	50		50	
Area of house	98	m²	52	m²
Annual DHW demand	28	kWh per m² per house	29.5	kWh per m² per house
Daily DHW demand	7.5	kWh per house	4.2	kWh per house
Peak DHW demand	3.8	kW	2.1	kW
Total peak demand	188.0	kW	104.5	kW
	Heat	Electricity	Heat	Electricity
CHP output	70 kWth	38 kWe	35 kWth	19 kWe
FIGURES BELOW ON A PER DWELLING BASIS				
CHP capital cost	£ 1,055		£ 603	
DHN Costs	£ 4,109		£ 3,710	
Total cost	£ 5,164		£ 4,313	
Annual CHP running hours	4000		4000	
Annual CHP heat	5,600	kWh	2,800	kWh
Annual CHP electricity	3,015	kWh	1,508	kWh
Annual CHP Heat Delivered	4,760	kWh	2,380	kWh
Annual CHP gas consumption	10,769	kWh	5,508	kWh
Annual electricity exported to the grid	3,015	kWh	1,508	kWh
Annual CHP gas costs @ 3p/kWh	£ 323		£ 165	
Annual export electricity income @ £45/MWh	£ 136		£ 68	
Cost for equivalent gas boiler based heat @ 5p/kWh for gas	£ 267		£ 134	
Cost for equivalent grid electricity @ 12p/kWh	£ -		£ -	
Annual savings	£ 80		£ 36	
Assumed unit cost of installed base case gas boiler	£ 1,500		£ 1,500	
Payback period [1]	45.8		77.4	
Annual CHP emissions per house	2,132	$kgCO_2e$	1,091	$kgCO_2e$
Electricity emission factor	0.30	$kgCO_2e$	0.25	$kgCO_2e$
Heat emission factor	0.15	$kgCO_2e$	0.13	$kgCO_2e$
Emissions for exported electricity	905	$kgCO_2e$	382	$kgCO_2e$
Emissions savings from displacing grid electricity	1,559	$kgCO_2e$	398	$kgCO_2e$
Total net emissions from CHP	573	$kgCO_2e$	693	$kgCO_2e$
Equivalent emissions for gas boiler	1,059	$kgCO_2e$	623	$kgCO_2e$
Net Emissions from Peak load boiler	30	$kgCO_2e$	4	$kgCO_2e$
Equivalent emissions for grid electricity	336	$kgCO_2e$	299	$kgCO_2e$
Total annual emission reduction	456	$kgCO_2e$	229	$kgCO_2e$
Annual emission reduction per m²	4.65	$kgCO_2e$	4.43	$kgCO_2e$

Table F 9: CHP 150 unit scheme (house and apartment)

	House		Apartment	
Number of houses	150		150	
Area of house	98	m²	52	m²
Annual DHW demand	28	kWh per m² per house	29.5	kWh per m² per house
Daily DHW demand	7.5	kWh per house	4.2	kWh per house
Peak DHW demand	3.8	kW	2.1	kW
Total peak demand	564.1	kW	313.4	kW
CHP output	Heat 210 kWth	Electricity 113 kWe	Heat 110 kWth	Electricity 59 kWe
FIGURES BELOW ON A PER DWELLING BASIS				
CHP capital cost	£ 867		£ 494	
DHN Costs	£ 8,217		£ 5,300	
Total cost	£ 9,084		£ 5,794	
Annual CHP running hours	4000		4000	
Annual CHP heat	5,600	kWh	2,933	kWh
Annual CHP electricity	3,015	kWh	1,579	kWh
Annual CHP Heat Delivered	4,760	kWh	2,493	kWh
Annual CHP gas consumption	10,769	kWh	5,770	kWh
Annual electricity exported to the grid	3,015	kWh	1,579	kWh
Annual CHP gas costs @ 3p/kWh	£ 323		£ 173	
Annual export electricity income @ £45/MWh	£ 136		£ 71	
Cost for equivalent gas boiler based heat @ 5p/kWh for gas	£ 267		£ 140	
Cost for equivalent grid electricity @ 12p/kWh	£ -		£ -	
Annual savings	£ 80		£ 38	
Assumed unit cost of installed base case gas boiler	£ 1,500		£ 1,500	
Payback period [1]	94.8		112.8	
Annual CHP emissions per house	2,132	$kgCO_2e$	1,142	$kgCO_2e$
Electricity emission factor	0.30	$kgCO_2e$	0.25	$kgCO_2e$
Heat emission factor	0.15	$kgCO_2e$	0.13	$kgCO_2e$
Emissions for exported electricity	905	$kgCO_2e$	400	$kgCO_2e$
Emissions savings from displacing grid electricity	1,559	$kgCO_2e$	417	$kgCO_2e$
Total net emissions from CHP	573	$kgCO_2e$	726	$kgCO_2e$
Equivalent emissions for gas boiler	1,059	$kgCO_2e$	653	$kgCO_2e$
Net Emissions from Peak load boiler	30	$kgCO_2e$	1	$kgCO_2e$
Equivalent emissions for grid electricity	336	$kgCO_2e$	299	$kgCO_2e$
Total annual emission reduction	456	$kgCO_2e$	226	$kgCO_2e$
Annual emission reduction per m²	4.65	$kgCO_2e$	4.36	$kgCO_2e$

Table F 10: CHP 500 unit scheme (house and apartment)

	House		Apartment	
Number of houses	500		500	
Area of house	98	m²	52	m²
Annual DHW demand	28	kWh per m² per house	29.5	kWh per m² per house
Daily DHW demand	7.5	kWh per house	4.2	kWh per house
Peak DHW demand	3.8	kW	2.1	kW
Total peak demand	1880.3	kW	1044.6	kW
CHP output	Heat 650 kWth	Electricity 350 kWe	Heat 350 kWth	Electricity 188 kWe
FIGURES BELOW ON A PER DWELLING BASIS				
CHP capital cost	£ 665		£ 396	
DHN Costs	£ 8,217		£ 5,300	
Total cost	£ 8,882		£ 5,696	
Annual CHP running hours	4000		4000	
Annual CHP heat	5,200	kWh	2,800	kWh
Annual CHP electricity	2,800	kWh	1,508	kWh
Annual CHP Heat Delivered	4,420	kWh	2,380	kWh
Annual CHP gas consumption	10,000	kWh	5,508	kWh
Annual electricity exported to the grid	2,800	kWh	1,508	kWh
Annual CHP gas costs @ 3p/kWh	£ 300		£ 165	
Annual export electricity income @ £45/MWh	£ 126		£ 68	
Cost for equivalent gas boiler based heat @ 5p/kWh for gas	£ 248		£ 134	
Cost for equivalent grid electricity @ 12p/kWh	£ -		£ -	
Annual savings	£ 74		£ 36	
Assumed unit cost of installed base case gas boiler	£ 1,500		£ 1,500	
Payback period [1]	99.3		115.5	
Annual CHP emissions per house	1,980	$kgCO_2e$	1,091	$kgCO_2e$
Electricity emission factor	0.30	$kgCO_2e$	0.25	$kgCO_2e$
Heat emission factor	0.15	$kgCO_2e$	0.13	$kgCO_2e$
Emissions for exported electricity	840	$kgCO_2e$	382	$kgCO_2e$
Emissions savings from displacing grid electricity	1,448	$kgCO_2e$	398	$kgCO_2e$
Total net emissions from CHP	532	$kgCO_2e$	693	$kgCO_2e$
Equivalent emissions for gas boiler	983	$kgCO_2e$	623	$kgCO_2e$
Net Emissions from Peak load boiler	40	$kgCO_2e$	4	$kgCO_2e$
Equivalent emissions for grid electricity	336	$kgCO_2e$	299	$kgCO_2e$
Total annual emission reduction	411	$kgCO_2e$	229	$kgCO_2e$
Annual emission reduction per m²	4.19	$kgCO_2e$	4.43	$kgCO_2e$

F2.6 The annual emission reduction per sq.m does not change when the number of houses or apartments increases from 50 to 500 units. This is because the carbon savings are related to the number of hours the CHP plant is run, not the number of buildings attached to them. As the buildings attached are all domestic the heat demand is very low in the summer. Also the electricity and heating demand peaks are in the morning and evening. This does not provide the even heat and power demand required for cost effective CHP operation.

F.3. Solar PV assumptions:

F2.7 Solar PV technology would depend on the available surface area, the angle and direction of the roof or surface and the energy efficiency provided by the choice of PV panel. The assumptions for calculating the costs for solar PV technology and its reduction in carbon (kg CO_2) targets has been summarised in Table F-11 below. The Zero Carbon Hub task group considered that only 0.4 X ground floor area was considered as a suitable adjustment factor for estimating space available for solar PV.

Table F 11: Summary of solar PV technology assumptions

	Gross PV area sq.m	Net PV area sq.m	kWp	kWh/yr	kWh/sq.m/yr	sq.m floorspace PV demand	kg CO_2 e red. Installation	kg CO_2 red. sq.m	Cost £/install	Cost £/sq.m
House	21.6	21.19	3.055	2,507	23	108.00	1,296	1,296	12.0	7,638
x 5 standard apt top floor	103.5	102.69	14.8	12,149	47	258.8	6,281	1,256	24.3	37,013

CO_2 factors	
Natural gas	0.198
Grid elec.	0.517

Source: 2011 Guidelines to DEFRA/DECC's GHG Conversion factors for Company Reporting

http://archive.defra.gov.uk/environment/business/reporting/pdf/110819-guidelines-ghg-conversion-factors.pdf

Zero Carbon Hub Task Group Method		
PV area sizing factor	0.4	x ground floor area

http://www.zerocarbonhub.org/resourcefiles/CC_TG_Report_Feb_2011.pdf

F2.8 The Zero Carbon Hub Task Group considered that a requirement for roof-mounted solar technologies equivalent to 40% of ground floor area is the appropriate reference point for feasibility. If the area required exceeds this amount, other measures may be necessary which are not feasible or desirable in every case.

Figure F 1: Feasibility: how the 40% ground floor Area translates into PV area on typical roofs

From: Carbon Compliance: setting an appropriate level for Zero Carbon Homes: *Zero Carbon Hub* (Feb. 2011 p.14)

F2.9 The following tables introduce the assumptions for individual case studies for the distribution of residential units per floor, with particular reference to the top floor. This was used to determine the floor area and hence the applicable area for solar PV.

F2.10 The following tables describe the assumptions adopted for the solar PV considerations. For apartments an angle of 30 degrees and for houses an angle of 45 degrees was assumed. Solar PV was assumed to be facing due south for maximum performance. The Romag SMT 6(60)P PV Modules were used as a benchmark.

Table F 12: Solar PV reference assumptions

SAP insulation calcs	Orientation: all values kWh per year per kWp				
Collector tilt (degrees)	**South**	**SE/SW**	**E/W**	**NE/NW**	**North**
Horizontal			961		
30	1,073	1,027	913	785	730
45	1,054	997	854	686	640
60	989	927	776	597	500
Vertical	746	705	582	440	371

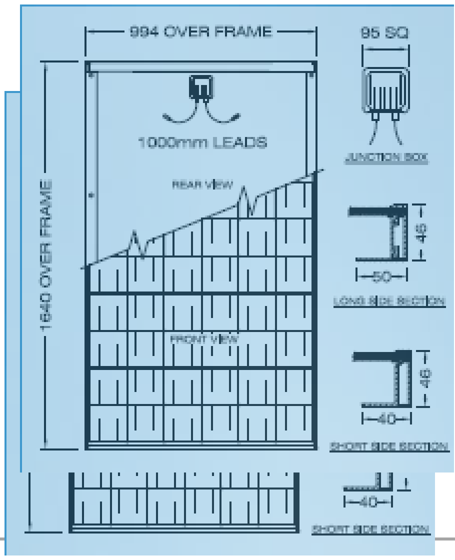
SAP PV output method
0.8 x 1kWp x kWh radiation/sq.m/yr x panel efficiency x over shading factor

ROMAG SMT 6(60)P PV Modules				
Area	1.63	1	6.94	sq.m
Capacity	235	144.17	1,000.00	Wp
Efficiency	14.4%			Percent
Cost £	2,500			kWp

Romag SMT 6(60)P Electrical Characteristics					
Pmpp	235	230	225	220	WP
Vmpp	29.47	29.18	29.03	28.70	V
Impp	7.96	7.88	7.76	7.67	A
Voc	37.32	37.07	36.98	36.74	V
Isc	8.45	8.37	8.24	8.18	A
FF	74.41	74.11	73.84	73.18	%
Efficiency	14.4	14.1	13.8	13.5	%

Temperature Characteristics
Coeficients: Power -0.45%/^{0}C Voltage -0.35%/^{0}C Current 0.05%/^{0}C
Module Weight: 21 Kg

Temperature Characteristics
Coeficients: Power -0.45%/^{0}C Voltage -0.35%/^{0}C Current 0.05%/^{0}C
Module Weight: 21 Kg



F.4. Solar thermal hot water assumptions:

F4.1 Solar thermal technology is used to cater to the thermal requirements of residential units. Solar thermal technology shares assumptions with solar PV for roof surface area and angle, to optimise use of natural sunlight. The assumptions for calculating the costs for solar thermal using the Evacuated tube technology and its reduction in carbon (kg CO_2) targets has been summarised in Table F-13 below. The STHW reference tables consider the basic assumptions for calculating the installation costs per unit and CO2e saved over gas requirements.

Table F 13: Summary of solar thermal hot water technology assumptions

	Collector area per dwelling unit sq.m	Total collector area	kWh/yr	kWh/sq.m/yr	sq.m floorspace DHW demand	kg CO_2 e reduction: total installation	kg CO_2 red./sq.m	Cost £ installation	Cost £/sq.m installation
House	4	4	1800	16.7	108	356	3.3	4,000	37.04
x 4 standard apt top floor	2	10	4500	17	259	891	3.4	14,000	54.11

CO_2 factors	
Natural gas	0.1836
Grid elec.	0.541

Source: 2011 Guidelines to DEFRA/DECC's GHG Conversion factors for Company Reporting
http://archive.defra.gov.uk/environment/business/reporting/pdf/110819-guidelines-ghg-conversion-factors.pdf

STHW reference tables

	Collector type	kWh/sq.m/yr	Collector area sq.m	kWh energy yield/yr	Install cost	CO_2e saved (over gas)
House	Evacuated tube	450	4	1800	3,500.00	330.48
Apartment	Evacuated tube	450	3	1350	3,345.00	247.86
Apartment block	Evacuated tube	450	12	5400	13,380.00	991.44

Technology information leaflet ECA 770 *Solar thermal technology*
http://etl.decc.gov.uk/NR/rdonlyres/BEC48F29-FF6C-49B0-BBC3-3263006A26A/0/ECA770_TILSolarThermal.pdf

F.5. Viability case studies

F5.1 The following section introduces the case study findings from the development appraisal model. The viability testing introduces the details of the case study which includes the number of unites by type and size. The figures in each column denote the appraisal values in 2012 and subsequent projections in 2013 and 2016 based on 4.18% CAGR on construction costs and 4.9% CAGR on sales. The CfSH compliance targets set out below, show that the ones in green satisfy the target for the respective CfSH level while the ones in red do not achieve the target and has to be compensated by allowable solutions. All the case studies displayed below are representative of Moderate markets.

F.6. Case Study 1 (CS1) 2 housing units

Case Study	CS1		
Market Condition	MODERATE		
	Code 3		
Number of Residential Units	2		
	Units		
Apartment 1 bed	units		
Apartment 2 bed	units		
Terraced House 2&3 bed	units		
SemiDetHouse 3&4 bed	2 units		
DetHouse 4 & 4+ bed	units		
Total	**2 units**		
	Floorspace		
Apartment 1 bed	0 sq.m		
Apartment 2 bed	0 sq.m		
Terraced House 2&3 bed	0 sq.m		
SemiDetHouse 3&4 bed	202 sq.m		
DetHouse 4 & 4+ bed	0 sq.m		
Total	**202 sq.m**		
Affordable Housing Component (%)	40%		
Social Rent	70%		
Equity Share	30%		
	2012	**2013**	**2016**
Increase In Sales Assumed	0%		
Gross Development Value	£494,843	£519,090	£599,197
Construction Costs	£174,987	£182,296	£206,106
Reduction in Cost Assumed	0%		
Planning obligations Costs	£8,754	£8,754	£8,754
Fabric Cost of Development	£3,933	£4,098	£4,633
Cost of Code for Sustainable Housing	£1,356	£1,413	£1,597
Commercial Construction	£0	£0	£0
Admin & Prof Fees	£59,154	£61,625	£69,674
Construction Contingency	£9,207	£9,592	£10,845
Land Acquisition	£150,000	£150,000	£150,000
Costs of the Scheme	£407,391	£417,777	£451,609
Residual Value	£87,452	£101,314	£147,588
Developer's Return	21.5%	24.3%	32.7%

Renewable & Low Carbon Technologies

	Compliance with Code 3 (base)	Compliance with 2013 Code 4	Compliance with 2016 Code 5	Compliance with 2016 Code 5 ZERO CARBON	Compliance with Code 6 (Hypothetical)
CHP: Scheme	0 kg/ CO_2 E	-621 kg/ CO_2 E	-1,021 kg/ CO_2 E	-2,376 kg/ CO_2 E	-6,535 kg/ CO_2 E
Developer's Return	£0				
	21.5%	24.3%	32.7%	32.7%	32.7%
PV	2,592 kg/ CO_2 E	1,971 kg/ CO_2 E	1,571 kg/ CO_2 E	216 kg/ CO_2 E	-3,942 kg/ CO_2 E
Developer's Return	£14,250				
	18.0%	20.8%	29.5%	29.5%	29.5%
Solar Thermal	713 kg/ CO_2 E	92 kg/ CO_2 E	-308 kg/ CO_2 E	-1,663 kg/ CO_2 E	-5,822 kg/ CO_2 E
	£7,463				
	19.6%	22.5%	31.0%	31.0%	31.0%

Compliance with 2016 Code 5 ZERO CARBON			
Allowable solutions (to reach Zero Carbon)			
CHP: Neighbourhood Wide Connection	£2,571		
CHP: Scheme	£3,564		
Solar PV	£0		
Solar Thermal	£2,495		
Viability - CfSH + Renewable Tech + Allowable Solution			
CHP: Scheme	20.6%	23.4%	31.9%
Solar PV	18.0%	20.8%	29.5%
Solar Thermal	19.0%	21.9%	30.5%

F.7. Case Study 2 (CS2) 15 housing units

Case Study	CS2		
Market Condition	MODERATE		
	Code 3		
Number of Residential Units	15		
	Units		
Apartment 1 bed	units		
Apartment 2 bed	units		
Terraced House 2&3 bed	5 units		
SemiDetHouse 3&4 bed	6 units		
DetHouse 4 & 4+ bed	4 units		
Total	15 units		
	Floorspace		
Apartment 1 bed	0 sq.m		
Apartment 2 bed	0 sq.m		
Terraced House 2&3 bed	393 sq.m		
SemiDetHouse 3&4 bed	605 sq.m		
DetHouse 4 & 4+ bed	463 sq.m		
Total	1,460 sq.m		
Affordable Housing Component (%)	40%		
Social Rent	70%		
Equity Share	30%		
	2012	**2013**	**2016**
Increase In Sales Assumed	0%		
Gross Development Value	£3,896,953	£4,087,904	£4,718,752
Construction Costs	£1,362,945	£1,419,875	£1,605,331
Reduction in Cost Assumed	0%		
Planning obligations Costs	£188,348	£188,348	£188,348
Fabric Cost of Development	£29,500	£30,732	£34,746
Cost of Code for Sustainable Housing	£13,660	£14,231	£16,089
Commercial Construction	£0	£0	£0
Admin & Prof Fees	£462,375	£481,688	£544,603
Construction Contingency	£71,424	£74,408	£84,126
Land Acquisition	£1,000,000	£1,000,000	£1,000,000
Costs of the Scheme	£3,128,253	£3,209,281	£3,473,244
Residual Value	£768,700	£878,623	£1,245,507
Developer's Return	24.6%	27.4%	35.9%

Renewable & Low Carbon Technologies

	Compliance with Code 3 (base)	Compliance with 2013 Code 4	Compliance with 2016 Code 5	Compliance with 2016 Code 5 ZERO CARBON	Compliance with Code 6 (Hypothetical)
CHP: Scheme	0 kg/ CO_2 E	-4,658 kg/ CO_2 E	-7,659 kg/ CO_2 E	-17,820 kg/ CO_2 E	-49,010 kg/ CO_2 E
Developer's Return	£0				
	24.6%	27.4%	35.9%	35.9%	35.9%
PV	19,442 kg/ CO_2 E	14,784 kg/ CO_2 E	11,783 kg/ CO_2 E	1,622 kg/ CO_2 E	-29,568 kg/ CO_2 E
Developer's Return	£103,248				
	21.3%	24.2%	32.9%	32.9%	32.9%
Solar Thermal	5,346 kg/ CO_2 E	688 kg/ CO_2 E	-2,313 kg/ CO_2 E	-12,474 kg/ CO_2 E	-43,664 kg/ CO_2 E
	£60,774				
	22.6%	25.5%	34.1%	34.1%	34.1%

Compliance with 2016 Code 5 ZERO CARBON

Allowable solutions (to reach Zero Carbon)			
CHP: Neighbourhood Wide Connection	£19,536		
CHP: Scheme	£26,730		
Solar PV	£0		
Solar Thermal	£18,711		
Viability - CfSH + Renewable Tech + Allowable Solution			
CHP: Scheme	23.7%	26.5%	35.1%
Solar PV	21.3%	24.2%	32.9%
Solar Thermal	22.0%	24.9%	33.6%

F.8. Case Study 3 (CS3) 50 housing units

Case Study	CS3		
Market Condition	MODERATE		
	Code 3		
Number of Residential Units	50		
	Units		
Apartment 1 bed	units		
Apartment 2 bed	units		
Terraced House 2&3 bed	18 units		
SemiDetHouse 3&4 bed	16 units		
DetHouse 4 & 4+ bed	16 units		
Total	**50 units**		
	Floorspace		
Apartment 1 bed	0 sq.m		
Apartment 2 bed	0 sq.m		
Terraced House 2&3 bed	1,413 sq.m		
SemiDetHouse 3&4 bed	1,612 sq.m		
DetHouse 4 & 4+ bed	1,852 sq.m		
Total	**4,877 sq.m**		
Affordable Housing Component (%)	**40%**		
Social Rent	**70%**		
Equity Share	**30%**		
	2012	**2013**	**2016**
Increase In Sales Assumed	**0%**		
Gross Development Value	**£13,244,614**	**£13,893,600**	£16,037,669
Construction Costs	**£4,577,472**	**£4,768,669**	£5,391,527
Reduction in Cost Assumed	**0%**		
Planning obligations Costs	**£628,635**	**£628,635**	£628,635
Fabric Cost of Development	**£98,333**	**£102,441**	£115,821
Cost of Code for Sustainable Housing	**£70,700**	**£73,653**	£83,273
Commercial Construction	**£0**	**£0**	£0
Admin & Prof Fees	**£1,568,275**	**£1,633,781**	£1,847,177
Construction Contingency	**£241,750**	**£251,847**	£284,742
Land Acquisition	**£3,300,000**	**£3,300,000**	£3,300,000
Costs of the Scheme	**£10,485,165**	**£10,759,026**	**£11,651,175**
Residual Value	**£2,759,449**	**£3,134,574**	**£4,386,494**
Developer's Return	**26.3%**	**29.1%**	**37.6%**

Renewable & Low Carbon Technologies

	Compliance with Code 3 (base)	**Compliance with 2013 Code 4**	**Compliance with 2016 Code 5**	**Compliance with 2016 Code 5 ZERO CARBON**	**Compliance with Code 6 (Hypothetical)**
CHP: Scheme	**7,492 kg/ CO_2 E**	**-8,035 kg/ CO_2 E**	**-18,038 kg/ CO_2 E**	**-51,908 kg/ CO_2 E**	**-155,874 kg/ CO_2 E**
Developer's Return	**£371,058**				
	22.8%	**25.7%**	**34.5%**	**34.5%**	**34.5%**
PV	**64,806 kg/ CO_2 E**	**49,279 kg/ CO_2 E**	**39,276 kg/ CO_2 E**	**5,406 kg/ CO_2 E**	**-98,560 kg/ CO_2 E**
Developer's Return	**£344,890**				
	23.0%	**25.9%**	**34.7%**	**34.7%**	**34.7%**
Solar Thermal	**17,820 kg/ CO_2 E**	**2,293 kg/ CO_2 E**	**-7,710 kg/ CO_2 E**	**-41,580 kg/ CO_2 E**	**-145,546 kg/ CO_2 E**
	£204,748				
	24.4%	**27.2%**	**35.9%**	**35.9%**	**35.9%**

Compliance with 2016 Code 5 ZERO CARBON

Allowable solutions (to reach Zero Carbon)			
CHP: Neighbourhood Wide Connection	**£65,069**		
CHP: Scheme	**£77,862**		
Solar PV	**£0**		
Solar Thermal	**£62,370**		
Viability - CfSH + Renewable Tech + Allowable Solution			
CHP: Scheme	**22.0%**	**25.0%**	**33.8%**
Solar PV	**23.0%**	**25.9%**	**34.7%**
Solar Thermal	**23.8%**	**26.7%**	**35.4%**

F.9. Case Study 4 (CS4) 150 mixed units (apartments & houses)

Case Study Market Condition	CS4 MODERATE Code 3		
Number of Residential Units	150 Units		
Apartment 1 bed	24 units		
Apartment 2 bed	48 units		
Terraced House 2&3 bed	36 units		
SemiDetHouse 3&4 bed	36 units		
DetHouse 4 & 4+ bed	6 units		
Total	**150 units**		
	Floorspace		
Apartment 1 bed	960 sq.m		
Apartment 2 bed	3,048 sq.m		
Terraced House 2&3 bed	2,826 sq.m		
SemiDetHouse 3&4 bed	3,627 sq.m		
DetHouse 4 & 4+ bed	695 sq.m		
Total	**11,156 sq.m**		
Affordable Housing Component (%)	**40%**		
Social Rent	**70%**		
Equity Share	**30%**		
	2012	**2013**	**2016**
Increase In Sales Assumed	**0%**		
Gross Development Value	**£27,408,670**	**£28,751,694**	£33,188,674
Construction Costs	**£11,342,642**	**£11,816,415**	£13,359,811
Reduction in Cost Assumed	**0%**		
Planning obligations Costs	**£1,460,796**	**£1,460,796**	£1,460,796
Fabric Cost of Development	**£153,400**	**£159,807**	£180,681
Cost of Code for Sustainable Housing	**£152,313**	**£158,675**	£179,400
Commercial Construction	**£0**	**£0**	£0
Admin & Prof Fees	**£3,559,720**	**£3,708,407**	£4,192,779
Construction Contingency	**£598,500**	**£623,499**	£704,937
Land Acquisition	**£5,000,000**	**£5,000,000**	£5,000,000
Costs of the Scheme	**£22,267,371**	**£22,927,600**	**£25,078,404**
Residual Value	**£5,141,298**	**£5,824,095**	**£8,110,270**
Developer's Return	**23.1%**	**25.4%**	**32.3%**

Renewable & Low Carbon Technologies

	Compliance with Code 3 (base)	**Compliance with 2013 Code 4**	**Compliance with 2016 Code 5**	**Compliance with 2016 Code 5 ZERO CARBON**	**Compliance with Code 6 (Hypothetical)**
CHP: Scheme	**51,818 kg/ CO_2 E**	**9,633 kg/ CO_2 E**	**-12,111 kg/ CO_2 E**	**-93,010 kg/ CO_2 E**	**-343,927 kg/ CO_2 E**
Developer's Return	**£954,287**				
	18.8%	**21.2%**	**28.5%**	**28.5%**	**28.5%**
PV	**125,421 kg/ CO_2 E**	**83,237 kg/ CO_2 E**	**61,493 kg/ CO_2 E**	**-19,407 kg/ CO_2 E**	**-270,324 kg/ CO_2 E**
Developer's Return	**£1,078,772**				
	18.2%	**20.7%**	**28.0%**	**28.0%**	**28.0%**
Solar Thermal	**31,250 kg/ CO_2 E**	**-10,935 kg/ CO_2 E**	**-32,679 kg/ CO_2 E**	**-113,578 kg/ CO_2 E**	**-364,495 kg/ CO_2 E**
	£529,818				
	20.7%	**23.1%**	**30.2%**	**30.2%**	**30.2%**

Compliance with 2016 Code 5 ZERO CARBON

Allowable solutions (to reach Zero Carbon)			
CHP: Neighbourhood Wide Connection	**£110,145**		
CHP: Scheme	**£139,516**		
Solar PV	**£29,111**		
Solar Thermal	**£170,368**		
Viability - CfSH + Renewable Tech + Allowable Solution			
CHP: Scheme	**18.2%**	**20.6%**	**28.0%**
Solar PV	**18.1%**	**20.6%**	**27.9%**
Solar Thermal	**19.9%**	**22.3%**	**29.5%**

F.10. Case Study 5 (CS5) 150 housing units

Case Study Market Condition	CS5 MODERATE Code 3		
Number of Residential Units	150 Units		
Apartment 1 bed	units		
Apartment 2 bed	units		
Terraced House 2&3 bed	54 units		
SemiDetHouse 3&4 bed	48 units		
DetHouse 4 & 4+ bed	48 units		
Total	**150 units**		
	Floorspace		
Apartment 1 bed	0 sq.m		
Apartment 2 bed	0 sq.m		
Terraced House 2&3 bed	4,239 sq.m		
SemiDetHouse 3&4 bed	4,836 sq.m		
DetHouse 4 & 4+ bed	5,556 sq.m		
Total	**14,631 sq.m**		
Affordable Housing Component (%)	**40%**		
Social Rent	**70%**		
Equity Share	**30%**		
	2012	**2013**	**2016**
Increase In Sales Assumed	**0%**		
Gross Development Value	**£39,733,841**	**£41,680,799**	£48,113,007
Construction Costs	**£13,732,415**	**£14,306,008**	£16,174,581
Reduction in Cost Assumed	**0%**		
Planning obligations Costs	**£1,884,721**	**£1,884,721**	£1,884,721
Fabric Cost of Development	**£295,000**	**£307,322**	£347,463
Cost of Code for Sustainable Housing	**£163,275**	**£170,095**	£192,312
Commercial Construction	**£0**	**£0**	£0
Admin & Prof Fees	**£4,687,609**	**£4,883,407**	£5,521,251
Construction Contingency	**£719,868**	**£749,937**	£847,889
Land Acquisition	**£11,000,000**	**£11,000,000**	£11,000,000
Costs of the Scheme	**£32,482,888**	**£33,301,489**	**£35,968,216**
Residual Value	**£7,250,953**	**£8,379,311**	**£12,144,791**
Developer's Return	**22.3%**	**25.2%**	**33.8%**

Renewable & Low Carbon Technologies

	Compliance with Code 3 (base)	**Compliance with 2013 Code 4**	**Compliance with 2016 Code 5**	**Compliance with 2016 Code 5 ZERO CARBON**	**Compliance with Code 6 (Hypothetical)**
CHP: Scheme	**22,476 kg/ CO_2 E**	**-24,106 kg/ CO_2 E**	**-54,115 kg/ CO_2 E**	**-155,724 kg/ CO_2 E**	**-467,622 kg/ CO_2 E**
Developer's Return	**£1,113,175** **18.9%**	**21.8%**	**30.7%**	**30.7%**	**30.7%**
PV	**194,418 kg/ CO_2 E**	**147,836 kg/ CO_2 E**	**117,827 kg/ CO_2 E**	**16,218 kg/ CO_2 E**	**-295,680 kg/ CO_2 E**
Developer's Return	**£1,034,669** **19.1%**	**22.1%**	**30.9%**	**30.9%**	**30.9%**
Solar Thermal	**53,460 kg/ CO_2 E**	**6,879 kg/ CO_2 E**	**-23,130 kg/ CO_2 E**	**-124,740 kg/ CO_2 E**	**-436,638 kg/ CO_2 E**
	£614,245 **20.4%**	**23.3%**	**32.1%**	**32.1%**	**32.1%**

Compliance with 2016 Code 5 ZERO CARBON

Allowable solutions (to reach Zero Carbon)	
CHP: Neighbourhood Wide Connection	**£195,206**
CHP: Scheme	**£233,587**
Solar PV	**£0**
Solar Thermal	**£187,110**

Viability - CfSH + Renewable Tech + Allowable Solution			
CHP: Scheme	**18.2%**	**21.1%**	**30.0%**
Solar PV	**19.1%**	**22.1%**	**30.9%**
Solar Thermal	**19.9%**	**22.8%**	**31.5%**

F.11. Case Study 6 (CS6) 500 house units

Case Study Market Condition	CS6 MODERATE Code 3		
Number of Residential Units	500		
	Units		
Apartment 1 bed	45 units		
Apartment 2 bed	65 units		
Terraced House 2&3 bed	228 units		
SemiDetHouse 3&4 bed	129 units		
DetHouse 4 & 4+ bed	33 units		
Total	**500 units**		
	Floorspace		
Apartment 1 bed	1,800 sq.m		
Apartment 2 bed	4,128 sq.m		
Terraced House 2&3 bed	17,898 sq.m		
SemiDetHouse 3&4 bed	12,997 sq.m		
DetHouse 4 & 4+ bed	3,820 sq.m		
Total	**40,642 sq.m**		
Affordable Housing Component (%)	40%		
Social Rent	70%		
Equity Share	30%		
	2012	**2013**	**2016**
Increase In Sales Assumed	0%		
Gross Development Value	£119,039,266	£124,872,190	£144,142,547
Construction Costs	£41,064,123	£42,779,339	£48,366,945
Reduction in Cost Assumed	0%		
Planning obligations Costs	£5,698,746	£5,698,746	£5,698,746
Fabric Cost of Development	£767,000	£799,037	£903,403
Cost of Code for Sustainable Housing	£514,290	£535,771	£605,751
Commercial Construction	£10,912,500	£10,912,500	£10,912,500
Admin & Prof Fees	£14,692,982	£15,306,696	£17,305,974
Construction Contingency	£2,154,961	£2,244,972	£2,538,198
Land Acquisition	£23,220,139	£23,220,139	£23,220,139
Costs of the Scheme	£99,024,741	£101,497,201	£109,551,656
Residual Value	£20,014,525	£23,374,988	£34,590,891
Developer's Return	20.2%	23.0%	31.6%

Renewable & Low Carbon Technologies

	Compliance with Code 3 (base)	Compliance with 2013 Code 4	Compliance with 2016 Code 5	Compliance with 2016 Code 5 ZERO CARBON	Compliance with Code 6 (Hypothetical)
CHP: Scheme	113,723 kg/ CO_2 E	-34,830 kg/ CO_2 E	-122,233 kg/ CO_2 E	-429,292 kg/ CO_2 E	-1,375,786 kg/ CO_2 E
Developer's Return	£3,248,263				
	16.9%	19.8%	28.6%	28.6%	28.6%
PV	541,459 kg/ CO_2 E	392,905 kg/ CO_2 E	305,503 kg/ CO_2 E	-1,556 kg/ CO_2 E	-948,050 kg/ CO_2 E
Developer's Return	£3,302,816				
	16.9%	19.8%	28.6%	28.6%	28.6%
Solar Thermal	144,099 kg/ CO_2 E	-4,455 kg/ CO_2 E	-91,857 kg/ CO_2 E	-398,916 kg/ CO_2 E	-1,345,410 kg/ CO_2 E
	£1,911,943				
	18.3%	21.1%	29.8%	29.8%	29.8%

Compliance with 2016 Code 5 ZERO CARBON

Allowable solutions (to reach Zero Carbon)			
CHP: Neighbourhood Wide Connection	£537,165		
CHP: Scheme	£643,938		
Solar PV	£2,335		
Solar Thermal	£598,374		
Viability - CfSH + Renewable Tech + Allowable Solution			
CHP: Scheme	16.3%	19.2%	28.0%
Solar PV	16.9%	19.8%	28.6%
Solar Thermal	17.7%	20.6%	29.3%

Appendix G. Viability assessment and analysis

G.1. Market variation analysis

G1.1 The variation of price between Hot, Moderate and Cold markets was based on the SHMA Viability Assessment (2010). As seen in the Price Estimate figure below, price variation across housing typologies and markets (postcodes). Hence the highest and lowest price points were used to determine the price points for Hot and Cold markets.

Figure G 1: Price estimate across housing types

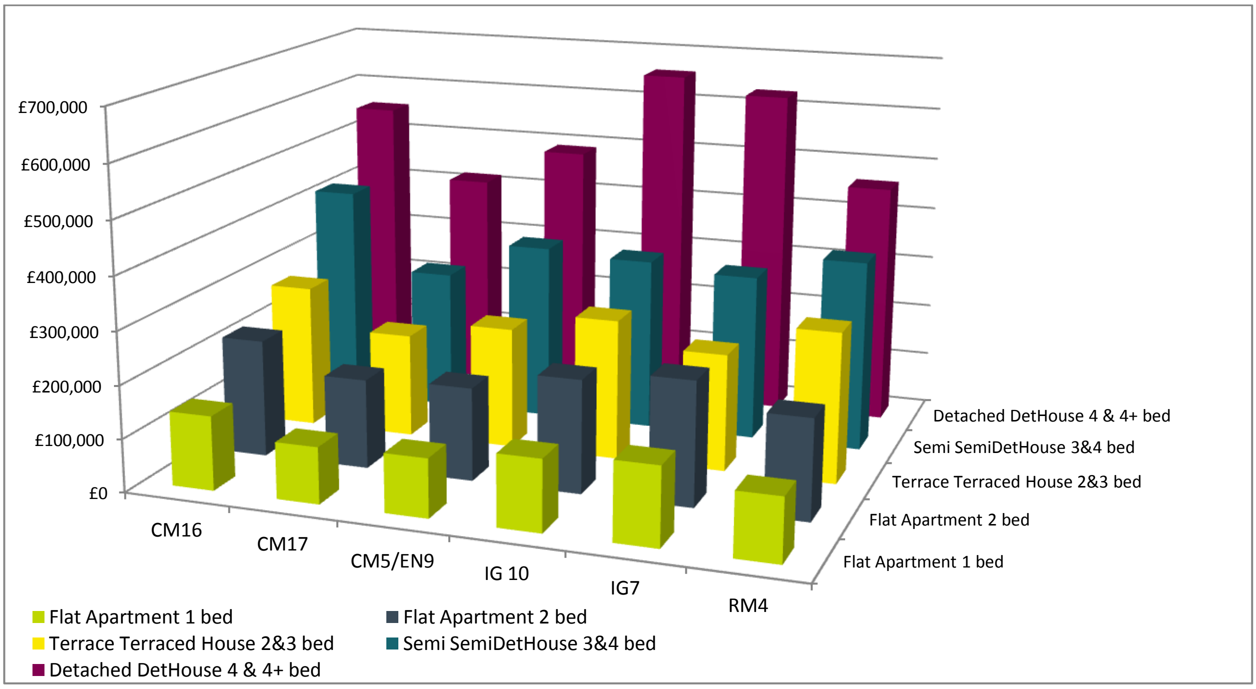


Table G 1: Moderate market

Moderate Market

	CM16	CM17	CM5/EN9	IG 10	IG7	RM4	Moderate (Average)
Apartment 1 bed	11%	-16%	-13%	6%	17%	-6%	£126,320
Apartment 2 bed	11%	-16%	-13%	6%	17%	-6%	£200,533
Terraced House 2&3 bed	11%	-20%	-6%	9%	-9%	16%	£245,653
SemiDetHouse 3&4 bed	23%	-21%	0%	-3%	-7%	7%	£339,528
DetHouse 4 & 4+ bed	4%	-22%	-8%	23%	18%	-14%	£534,630

Source: Atkins Estimates & SHMA Viability Assessment (2010).

G1.2 Moderate market was considered as the average across all markets and housing types and considered the base market benchmark as seen in the Figure above. Based on the above variation from the Moderate / Average Market sales values across postcodes, the postcodes have been further clustered into Hot, Moderate and Cold market locations. Hot markets were identified as CM16, IG10 and IG7 broadly located along the M11 commuter corridor to London and Epping. Moderate market price points matching RM4 closest variation located along the M25 commute corridor. Cold markets were determined by a consistent negative variation from the average which can be seen in CM17, CM5 and EN9 that are north and east of the District. Based on a broad estimates of the SLAA, Hot market constitutes 17% of the land parcels and 26% of the total potential units identified, while Cold market constituted 37% and 35% respectively, with the rest of the SLAA sites undetermined. However, it should be noted that the SLAA constitutes only identified sites, and not actual development. It is anticipated that market forces would determine that Hot market sites are more likely to come forward for development.

G.2. Summary of findings

G2.1 The following represents a summary of viability simulation conducted across all case studies to meet CfSH standards as minimum requirement. The use of renewable and low carbon technologies to reach Zero Carbon Homes standards has been summarised based on the details furnished in below.

G2.2 Table G2 below[75] shows the initial returns of the individual case studies in the varying market conditions, with Part L of the 2010 Building Regulations meeting with CfSH Level 3 compliance and without the added costs of individual LZC technologies. For the purpose of this exercise, it has been assumed that a developer's return must be above 20% for a scheme to be viable.

Table G 2: Initial developer returns in varying market conditions (CfSH Level 3 Compliance)

	HOT		MODERATE		COLD	
Case Study	Scheme Viability	Developer's Return	Scheme Viability	Developer's Return	Scheme Viability	Developer's Return
CS1	YES	44.8%	YES	21.5%	NO	-0.2%
CS2	YES	47.1%	YES	24.6%	NO	2.3%
CS3	YES	49.1%	YES	26.3%	NO	3.7%
CS4	YES	42.3%	YES	23.1%	NO	3.7%
CS5	YES	44.5%	YES	22.3%	NO	0.4%
CS6	YES	36.3%	YES	20.2%	NO	3.4%

G2.3 Table G-2 reveals that all case studies should normally be viable when constructed in accordance with CfSH Level 3 standard and in favourable Hot and Moderate market areas. Exceptions may occur in the Moderate market where there are other abnormal development costs with case studies 1 and 6 which are very close to the viability threshold.

G2.4 In a Cold market, none of the schemes are viable at this initial stage. This is due solely to the significant lower sales values of developments, and the effect of the 40% affordable housing expectation. A revision in the affordable housing percentage should be considered in these markets.

G2.5 Table G3 displays developer returns across market conditions. It can be seen that Hot and Moderate markets are able to achieve CfSH Level 4 minimum standards with the exception of CS6 in Moderate markets which is due to the additional employment land provided in this case study.

Table G 3: Developer returns in varying market conditions (CfSH Level 4 minimum compliance)

	HOT		MODERATE		COLD	
Case Study	Scheme Viability	Developer's Return	Scheme Viability	Developer's Return	Scheme Viability	Developer's Return
CS1	YES	40.0%	YES	20.3%	NO	-1.2%
CS2	YES	45.6%	YES	23.3%	NO	1.3%
CS3	YES	47.4%	YES	24.8%	NO	2.5%
CS4	YES	40.5%	YES	21.5%	NO	2.3%
CS5	YES	43.0%	YES	21.1%	NO	-0.6%
CS6	YES	34.9%	NO	18.9%	NO	2.3%

G2.6 Table G4 details the returns achievable on CfSH Level 5, Hot markets are able to achieve the increased costs of CfSH Level 5 minimum standards. However, in Moderate markets, only CS3 is able to achieve minimum compliance in the current market assessment.

75 Price assumption does not-consider as the price variation caused by the recession between the drop in 2010 to 2012 recovery was marginal would have distorted future viability. This was assessed against housing price index and hence future price projections were only considered after 2012

Table G 4: Developer's returns in varying market conditions (CfSH Level 5 minimum compliance)

	HOT		MODERATE		COLD	
Case Study	Scheme Viability	Developer's Return	Scheme Viability	Developer's Return	Scheme Viability	Developer's Return
CS1	YES	38.5%	NO	16.1%	NO	-1.2%
CS2	YES	41.5%	NO	19.8%	NO	1.3%
CS3	YES	43.5%	YES	21.5%	NO	2.5%
CS4	YES	34.9%	NO	16.6%	NO	2.3%
CS5	YES	39.2%	NO	17.8%	NO	-0.6%
CS6	YES	30.9%	NO	15.4%	NO	2.3%

G.3. CfSH and technology sensitivity analysis

G3.1 The following section examines the viability of the case studies in different market conditions, once additional LZC technologies have been added on to meet higher levels of the CfSH. The viability tabled below is relevant to existing levels of sales and costs. An exercise was conducted to determine the projected viability of the case studies at the stages of when development is expected to meet the subsequent requirements of CfSH Level 4 and CfSH Level 5; in 2013 and 2016, respectively. The effects on case study viability, from adding renewable technologies, were assessed at these future stages to determine whether schemes could be viable in the future as well as reach carbon emission reduction targets. The results discussed below determine the maximum CfSH compliance and technology viable achievable. For the purpose of this exercise, it has been assumed that a developer's return must be above 20% for a scheme to be viable.

Case Study 1

G3.2 The table below shows the effects on the viability of Case Study 1 under varying market conditions, when the scheme includes additional renewable technologies and the construction costs necessary to meet the requirements for the varying CfSH Levels.

Table G 5: Case Study 1: 2012 viability outcomes

Case Study 1	Hot	Moderate	Cold
CfSH3 (Minimum Compliance)	44.8%	21.5%	-0.2%
CfSH4 (Minimum Compliance)	43.4%	20.3%	-1.2%
CfSH4 + Solar PV	40.0%	16.8%	-4.7%
CFSH4 + Solar Thermal	41.7%	18.5%	-3.0%
CfSH5 (Minimum Compliance)	38.5%	16.1%	-4.7%
CfSH5 + Solar PV	35.2%	12.7%	-8.1%
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon	36.2%	13.7%	-7.1%

Source: Atkins estimates of developer's return

G3.3 As seen by the above table the case study is viable in Hot markets across all CfSH levels. Moderate market which is considered the market benchmark, with current market assumptions was only viable up to CfSH Level 4 minimum compliance. Cold markets remained unviable across all CfSH levels.

G3.4 The findings on the projected viability of Case Study 1 are listed below:

- In 2013 based on sales and cost projections Case Study 1 remained viable in Moderate markets up to CfSH Level 4 minimum compliance.
- In 2016, when development is required to meet CfSH Level 5, Case Study 1 in Moderate markets was able to achieve CfSH Level 5 Zero Carbon minimum compliance.
- Cold markets were not viable in 2013 and 2016.

Case Study 2

G3.5 The table below shows the effects on the viability of Case Study 2 in different market conditions, in accordance to additional renewable technologies and construction costs related to the different CfSH levels.

Table G 6: Case Study 2: 2012 viability outcomes

Case Study 2	Hot	Moderate	Cold
CfSH3 (Minimum Compliance)	47.1%	24.6%	2.3%
CfSH4 (Minimum Compliance)	45.6%	23.3%	1.3%
CfSH4 + Solar PV	42.4%	20.0%	-2.1%
CFSH4 + Solar Thermal	43.7%	21.4%	-0.7%
CfSH5 (Minimum Compliance)	41.5%	19.8%	-3.1%
CfSH5 + Solar PV	38.4%	16.6%	-7.2%
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon	39.1%	17.3%	-8.1%

Source: Atkins estimates of developer's return

G3.6 As seen by the above table the case study was viable in Hot markets across all CfSH levels. Moderate market (market benchmark), with current sales and cost assumptions was only viable up to CfSH Level 4 plus renewable solar PV or solar thermal technologies. Cold markets remained unviable across all CfSH levels.

G3.7 The findings on the projected viability of Case Study 2 are listed below:

- In 2013 based on sales and cost projections Case Study 2 remained viable in Moderate markets up to CfSH Level 5 with additional renewable technologies to achieve zero carbon compliance.
- In 2016, when development is required to meet CfSH Level 5, Case Study 2 in Moderate markets was able to achieve CfSH Level 5 Zero Carbon Homes compliance.
- Cold markets were not viable in 2013 and 2016.

Case Study 3

G3.8 The table below shows the effects on the viability for Case Study 3 in different market conditions with additional renewable technologies and construction costs related to the varying CfSH levels.

Table G 7: Case Study 3: 2012 viability outcomes

Case Study 3	Hot	Moderate	Cold
CfSH3(Minimum Compliance)	49.1%	26.3%	3.7%
CfSH3 + connected CHP	45.7%	22.8%	0.1%
CfSH4(Minimum Compliance)	47.4%	24.8%	2.5%
CfSH4 + connected CHP	44.6%	21.4%	-1.0%
CfSH4 + Solar PV	44.2%	21.6%	-0.8%
CfSH4 + Solar Thermal	45.5%	21.6%	-0.6%
CfSH5 (Minimum Compliance)	43.5%	21.5%	-0.3%
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	39.5%	17.4%	-4.5%
CfSH5 + Solar PV	40.4%	18.3%	-3.5%
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon	41.1%	19.0%	-2.2%

Source: Atkins estimates of developer's return

G3.9 As seen by the above case study was viable in Hot markets across all CfSH levels. Moderate market (market benchmark), with current sales and cost assumptions was only viable up to CfSH Level 4 plus renewable solar PV or solar thermal technologies. Cold markets remained unviable across all CfSH levels.

G3.10 The findings on the projected viability of Case Study 2 are listed below:

- In 2013 based on sales and cost projections Case Study 3 is remained viable in Moderate markets up to CfSH Level 5 with additional renewable technologies to achieve zero carbon compliance.
- In 2016, when development is required to meet CfSH Level 5, Case Study 3 in Moderate markets was able to achieve CfSH Level 5 Zero Carbon Homes compliance.
- Cold markets were not viable in 2013 and 2016.

Case Study 4

G3.11 The table below shows the effects that additional LZC technologies and CfSH construction requirements will have on the viability of Case Study 4 in different market conditions.

Table G 8: Case Study 4: 2011 viability outcomes

Case Study 4			
	Hot	Moderate	Cold
CfSH3(Minimum Compliance)	42.3%	23.1%	3.7%
CfSH3 + connected CHP	38.1%	18.8%	-0.6%
CfSH4(Minimum Compliance)	40.5%	21.5%	2.3%
CfSH4 + connected CHP	36.3%	17.3%	-1.9%
CfSH4 + Solar PV	35.8%	16.7%	-2.5%
CfSH4 + Solar Thermal	38.2%	19.1%	0.0%
CfSH5 (Minimum Compliance)	34.9%	16.6%	-1.8%
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	30.3%	11.9%	-6.5%
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon	30.2%	11.9%	-6.6%
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon	32.0%	13.6%	-4.8%

Source: Atkins estimates of developer's return

G3.12 As seen by the above case study was viable in Hot markets across all CfSH levels. However, Moderate market (market benchmark), with current sales and cost assumptions was only viable at minimum compliance for CfSH Level 3 and CfSH Level 4. Cold markets remained unviable across all CfSH levels.

G3.13 The findings on the projected viability of Case Study 4 are listed below:

- In 2013 based on sales and cost projections Case Study 4 remained viable in Moderate markets up to CfSH Level 5 minimum compliance.
- In 2016, when development is required to meet CfSH Level 5, Case Study 4 in Moderate markets was able to achieve CfSH Level 5 Zero Carbon Homes compliance using technologies and allowable solutions.
- Cold markets were not viable in 2013 and 2016.

Case Study 5

G3.14 The table below shows the effects that additional LZC technologies and CfSH construction requirements will have on the viability of Case Study 5 in different market conditions.

Table G 9: Case Study 5: 2011 viability outcomes

Case Study 5	Hot	Moderate	Cold
CfSH3(Minimum Compliance)	44.5%	22.3%	0.4%
CfSH3 + connected CHP	41.1%	18.9%	-3.1%
CfSH4(Minimum Compliance)	43.0%	21.1%	-0.6%
CfSH4 + connected CHP	39.7%	17.7%	-4.1%
CfSH4 + Solar PV	39.9%	17.9%	-3.8%
CfSH4 + Solar Thermal	41.2%	19.2%	-2.5%
CfSH5 (Minimum Compliance)	39.2%	17.8%	-3.3%
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	35.3%	13.8%	-7.4%
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon	36.2%	14.8%	-6.4%
CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon	36.9%	15.4%	-5.7%

G3.15 As seen by the above case study was viable in Hot markets across all CfSH levels. However, Moderate market (market benchmark), similar to Case Study 4, Case Study 5 is viable at minimum compliance for CfSH Level 3 and CfSH Level 4. Cold markets remained unviable across all CfSH levels.

G3.16 The findings on the projected viability of Case Study 5 are listed below:

- In 2013 based on sales and cost projections Case Study 5 is remained viable in Moderate markets up to CfSH Level 5 minimum compliance.
- In 2016, when development is required to meet CfSH Level 5, Case Study 5 in Moderate markets was able to meet CfSH Level 5 Zero Carbon Homes compliance using technologies and allowable solutions.
- Cold markets were not viable in 2013 and 2016.

Case Study 6

G3.17 The table below reveals the developer returns that can be expected from the Case Study 6 scheme in different market conditions, when additional renewable technologies and CfSH construction requirements have been included.

Table G 10: Case Study 6: 2011 viability outcomes

Case Study 6	Hot	Moderate	Cold
CfSH3(Minimum Compliance)	36.3%	20.2%	3.4%
CfSH3 + connected CHP	33.1%	16.9%	0.1%
CfSH4(Minimum Compliance)	34.9%	18.9%	2.3%
CfSH4 + connected CHP	31.7%	15.7%	-1.0%
CfSH4 + Solar PV	31.6%	15.6%	-1.0%
CfSH4 + Solar Thermal	33.0%	17.0%	0.4%
CfSH5 (Minimum Compliance)	30.9%	15.4%	-0.8%
CfSH5 + connected CHP + Allowable Solution to Reach Zero Carbon	27.2%	11.6%	-4.6%
CfSH5 + Solar PV + Allowable Solution to Reach Zero Carbon	27.7%	12.2%	-4.0%

CfSH5 + Solar Thermal + Allowable Solution to Reach Zero Carbon	28.5%	13.0%	-3.2%

Source: Atkins estimates of developer's return

G3.18 As seen by the above case study was viable in Hot markets across all CfSH levels. However, Moderate market (market benchmark), is only viable at minimum compliance for CfSH Level 3. Cold markets remained unviable across all CfSH levels.

G3.19 The findings on the projected viability of Case Study 6 are listed below:

- In 2013 based on sales and cost projections Case Study 6 is remained viable in Moderate markets up to CfSH Level 4 plus all renewable technology options.
- In 2016, when development is required to meet CfSH Level 5, Case Study 6 in Moderate markets was able to meet CfSH Level 5 Zero Carbon Homes compliance using technologies and allowable solutions.
- Cold markets were not viable in 2013 and 2016.

Appendix H. Glossary

Listed below are some of the terms and acronyms used in the document.

A

Absorption chiller
Heat operated refrigeration unit that uses an absorbent (e.g. lithium bromide) as a secondary fluid to absorb the primary fluid (water).

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.

Annual Monitoring Report (AMR)
A document used to assess the performance of a Local Plan policies. This is prepared by local planning authorities once a year.

B

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 Biofuel can be used in conventional vehicles.

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.

Brownfield
Brownfield site or land, refers to a site that has been previously used or developed.

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 Change Levy (CCL)
A levy charged on the industrial and commercial supply of electricity, natural gas, coal and coke for lighting, heating and power.

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 light bulbs and appliances, etc). (See Supplier obligation).

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.

Combined Cycle Gas Turbine
A gas turbine generator that generates electricity. 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.

Community Infrastructure Levy (CIL)
Mechanism for extracting contributions from developers to fund infrastructure. It is payable to local planning authorities (LPA) based on a charging schedule. Once an LPA has adopted a CIL these will replace (in most cases) planning contributions from section 106 agreements.

D

Decentralised energy network
A network of energy generation sources that are connected to homes or other buildings, and are independent of the National Grid.

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 1,000 sq.m.

Distribution network operator (DNO)
Are companies licensed to distribute electricity in the UK.

District heating
Is a system for distributing heat generated in a centralized location for residential and commercial heating requirements such as space heating and water heating.

Diurnal
A pattern that recurs on a daily basis.

E

Electricity production
The total amount of electricity generated by a power plant. It includes own-use electricity and transmission and distribution losses.

Energy Performance Certificate (EPC)
The certificate provides a rating for residential and commercial buildings, showing their 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.

Embedded generators
A local energy generator that distribute energy as part of a decentralised energy network (see above).

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
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 electricity generation, whereby renewable generators obtain a long-term guaranteed price for the output they deliver to the grid.

Feedstock (biomass)
Is a material used to fuel a biomass boiler.

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.

Gas turbine
Also known as a combustion turbine is a type of internal combustion engine.

General Permitted Development Order (GPDO)
Contains provisions relating to permitted development for example certain changes from one use class to another.

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 integrated 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.

Green belt
Is a land use planning policy designation used to protect areas of land from inappropriate development.

Greenfield
Greenfield site or land, refers to a site that has not been previously used or developed.

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 Development Value (GDV)
GDV is the total value possible from the sale of all units within a proposed development.

Gross External Area (GEA)
Is the total area of building (taking each floor into account).

Gross Internal Area (GIA)
Is the total area inside a building (taking each floor into account) when measured to in internal face of the perimeter walls i.e. excluding the thickness of external walls.

GWh (Gigawatt hour)
A measure of energy equal to 1,000 MWh.

H

Heat pumps
This includes 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.

Heat recovery ventilation (HRV)
Is an energy recovery ventilation system using a heat exchanger between inbound and outbound air flow to save energy in heating (or cooling).

Heavy good vehicle (HGV)
A truck over 3.5 tonnes (articulated or rigid).

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

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).

Local Plan
The development plan prepared by the local planning authority setting out planning policies for an area.

Lower Layer Super Output Area (LSOA)
Area of analysis below district and ward level and MSOA for providing small area statistics from Census and other data sources. LSOAs have a minimum population of 1,000 and a maximum population of 3,000 and between 400 – 1200 households.

M

Material Considerations
Factors which have been taken into account when planning decisions are made which may override the development plan.

Megawatt (MW)
Unit of measurement equal to 1 million watts (a watt is a unit of power).

Middle Layer Super Output Area (MSOA)
Area of analysis below district and ward level for providing small area statistics from Census and other data sources. MSOAs have a minimum population of 5,000 and a maximum population of 15,000 and between 2,000 – 6,000 households.

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.

Output areas
An area of statistical output used for providing data from the Census and other data sources. Output areas provide a stable and consistent basis for statistical analysis. Super output areas provide small area statistics (see also Lower Super output Area and Middle Super output area)

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.

Passive solar gain
Is the increase in temperature in a space, object or structure that results from solar radiation.

Permitted development
Some development does not require specific planning permission.

Planning conditions
Planning permission may be granted subject to conditions which must be “precise, necessary, reasonable and relevant to planning.”

Planning obligation
A benefit to the community arising out of the grant of planning permission. These are sometimes made under section 106 of the Town and Country Planning Act.

R

Reciprocating engine
Also known as a piston engine, is a heat engine that uses one or more pistons to convert pressure into a rotating motion.

Renewables
Energy resources, where energy is derived from natural processes that are replenished constantly. They include geothermal, solar, wind, tide, wave, hydropower, biomass and Biofuel.

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)
Provides financial assistance to producers (households and businesses) of renewable heat.

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

Semi-conductor
A material which has electrical conductivity between that of a conductor (e.g. copper) and insulator (e.g. glass).

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 rented (housing)
Social rented refers to social rented housing or the social rented sector. This is housing that is let at lower than open market rents. It is generally provided by local authorities, not-for-profit organisations such as housing associations.

Solar irradiation
Is the process by which an object is exposed to solar radiation.

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 (SAP)
UK Government's recommended method for measuring the energy rating of residential dwellings. The rating is on a scale of 1 to 120.

Supplementary Planning Document (SPD)
Planning guidance document that is prepared by a local planning authority to provide supplementary guidance on Local Plan policies.

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.

Sustainable Development
Development that meets the needs of today without compromising the requirements of the future.

T

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.

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