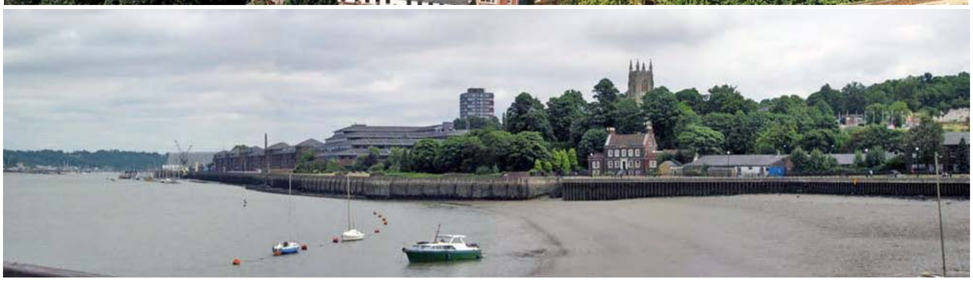
In Association with

&

Renewable Energy Capacity Study

May 2010



Prepared for

Medway Council

Revision Schedule

Renewable Energy Capacity Study
May 2010

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Executive Summary

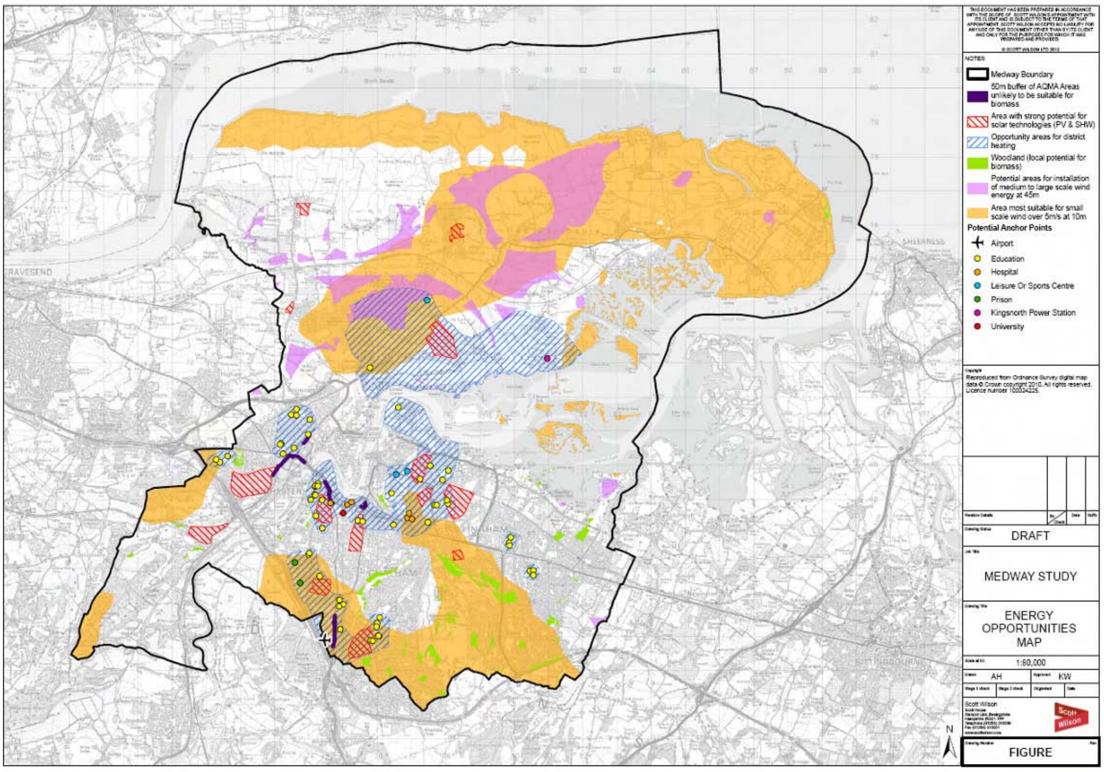
Scott Wilson, in conjunction with its project partners Thameswey Energy and Cyril Sweett, was commissioned by Medway Council to undertake a renewable energy capacity study and to develop an evidence base for policy in the Core Strategy as part of the Local Development Framework process, which is expected to be adopted in 2011.

The provision of decentralised and renewable or low carbon energy generation will be central to sustainable economic growth and development in Medway. It is vital that such development be coordinated through the spatial planning system incorporating technical input from the renewable energy and low carbon sectors. The Climate Change Supplement to Planning Policy Statement 1 (PPS1) is a key driver for this study, along with the need to address ambitious regional targets that are both deliverable and viable in accordance with Medway Council's wider objectives such as affordable housing.

The carbon footprint analysis of Medway UA confirmed 1,233 (0.28%) tonnes of carbon per annum which can be compared to 432,727,000 for the UK. Based on an evaluation of this carbon footprint against the LDF energy policy options presented in the Core Strategy, Issues and Options Consultation, the figures for domestic and commercial emissions projections identify there is only a limited level of impact on overall building stock emissions that new-build policy can make. If the overall goal of policy design and implementation is to reduce global carbon emissions, then this analysis strongly points towards the need for policy measures that target the emissions of existing buildings as well as new construction.

Further analysis was undertaken to determine the overall capacity for the installation of Low and Zero Carbon technologies, which was estimated as 641 MW. The results from this section were used to feed into the Strategic Sites analysis, which presents different scenarios for meeting the respective targets for domestic and non-domestic buildings at different phases across each site. If a strategic view is taken to addressing energy requirements throughout the lifetime of the development, district heating should be considered at an early stage, as it appears to be the most cost-effective option either through gas-fired (in Rochester Riverside and Chatham Centre and Waterfront) or biomass (on all three sites) Combined Heat and Power.

Further low and zero carbon technologies should be considered on a development site basis. It should be noted that wind resources are only viable in Lodge Hill. Microgeneration options have been identified in the Energy Opportunities Map for Medway developed using GIS, as illustrated overleaf, which identifies areas favourable for specific technologies in Medway.



In terms of development viability, the 'elemental approach' (one of the two assessment methods used by Scott Wilson and Cyril Sweett) illustrates that whilst many factors affect viability, nearly all of these pale in comparison with wider market fluctuations. This means that whilst in the current depressed market some of the increase in costs implicit in higher environmental standards would appear to burden developers in areas where there is already very little or no margin available, in uplifted market conditions the same measures would arguably only have a minor impact on land value. Policy should be sufficiently flexible to address changing market conditions and hence, to allow for a more favourable market for development, any policy demands should be accompanied by the onus of evidence of non-viability being provided by developers (above a certain threshold of development).

On an Authority-wide basis, the thresholds adopted in the South East Plan are reasonable for Medway. Nevertheless, it should also be considered that the vast majority of applications are for small developments, i.e., for less than 10 dwellings or 1,000 m2 of non-residential floorspace. Consideration should, therefore, be given to policy specific to minor applications, i.e., less than 10 dwellings. In terms of the recommended policy orientation for the Strategic Sites, this study strongly suggests the following points:

- Lodge Hill: There is a distinct opportunity for large wind and there are potentially District Heating opportunities through Kingsnorth power station, which may be supported by a leisure centre to the north-west of the development site. Please refer to Section 4.3 for details on the current limitations to linking Kingsnorth to Lodge Hill.
- Rochester Riverside: There is significant opportunity on Rochester Riverside for District Heating through the University of Creative Arts on Interface Land and a number of schools, which could provide the necessary anchor loads.

- Chatham Centre and Waterfront: This site benefits from having a hospital in close proximity and a number of schools and two leisure centres. The proposed development site at Gillingham Waterfront is also in close proximity to Chatham Centre and Waterfront and potential synergies may exist for a heat network.

Finally, outline analysis of a Merton-style rule has shown that a target of 20% or more would have some impact on carbon emissions in the Unitary Authority in the years prior to the introduction of zero-carbon standards. However, as viability outside the High Value Medway areas is demonstrated to be eroded by the imposition of CSH Levels 3 and 4 alone, the additional burden of further requirements is not considered appropriate within the wider Unitary Authority. Additional contribution to emissions savings could be made through a Merton-style rule of 20%. It should be noted that the imposition of a rule of this nature could lead to the undesirable reduction of energy efficiency measures in favour of renewable technologies. Therefore Medway may want to consider including a carbon reduction target from energy efficiency measures to support the deployment of such a Merton-style rule.

1 Introduction & Policy Context

1.1 Background

Scott Wilson, in conjunction with its project partners Thameswey Energy and Cyril Sweett, was commissioned by Medway Council to undertake a renewable energy capacity study and to develop an evidence base for policy in the Core Strategy as part of the Local Development Framework process, which is expected to be adopted in 2011.

The provision of decentralised and renewable or low carbon energy generation will be central to sustainable economic growth and development in Medway. It is vital that such development be coordinated through the spatial planning system incorporating technical input from the renewable energy and low carbon sectors. The Climate Change Supplement to Planning Policy Statement 1 (PPS1) is a key driver for this study, along with the need to address ambitious regional targets that are both deliverable and viable in accordance with Medway Council's wider objectives such as affordable housing.

1.1.1 Key drivers of the study

- Response to PPS 1 Supplement, PPS 22 & Climate Change Act 2008.
- UK renewable energy strategy target of 15%/
- Achieving national and regional targets for renewable energy.
- Improving existing stock.
- Need to ensure viable local policies and targets, taking into account housing costs, affordable housing shortages, ecological and landscape characteristics.
- Corporate targets, including National Indicator 186.

1.1.2 Key objectives of the study

- Carry out a high level analysis of Medway's potential for renewable energy generation across the board of renewable technologies and quoted in MW.
- Using all information available on the existing housing stock condition consider the general feasibility for retrofitting initiatives to improve energy performance.
- Consider the feasibility of applying on-site targets for renewable or low carbon technologies in new developments across the area.

1.1.3 Structure of this report

Chapter 1 provides an overview of Medway and reviews international, European, national, regional and local energy and sustainability policy relevant to this study.

Chapter 2 reviews UK government standards and targets on energy use and development, including the Code for Sustainable Homes and BREEAM and explains the financial implications of meeting the above standards and providing a step change to zero carbon.

Chapter 3 presents the findings of an evaluation of the baseline district energy demand and a district-wide emissions projection.

Chapter 4 reviews the constraints and opportunities for low carbon and renewable energy in Medway and summarises potential capacity for the region in MW as outlined in the DECC methodology.

Chapter 5 considers the technical feasibility and capacity of low and zero technologies on strategic sites within Medway for meeting different levels of the Code for Sustainable Homes and BREEAM for non-residential development.

Chapter 6 presents two approaches to Development Viability; the energy extra over-costs and the elemental approach.

Chapter 7 draws key points and links them to policy.

Chapter 8 provides conclusions, presents the main findings of this study and makes recommendations, including an outline of the implications for the Council and its strategic partners.

1.2 Overview of Medway

Medway is a coastal borough located in Thames Gateway in North Kent, a national growth area extending from East London along both sides of the Thames Estuary as far as Southend and the Isle of Sheppey. Medway contains one of the largest urban conurbations in the South East and it has an extensive rural area and natural assets of considerable national and international significance.

Medway Council has been a unitary council since 1998, responsible for providing services, including education and social services, in Rochester (population 27,000), Strood (population 33,000), Chatham (population 71,500), Gillingham (population 99,800), Rainham (population 6,400), the nearby rural areas and the Hoo Peninsula. It covers an area of just over 190 km^2 and has a population of around 253,000, expected to grow to 280,000 by 2026.

There are currently 13,000 businesses with 85,400 jobs, predominantly in public administration, retail and distribution, but also a significant financial service sector and high levels of specialist manufacturing and engineering.

In a regional, national and international context Medway is important for many reasons, including the following:

- It generates more than 10% of the country's energy needs, the largest contribution within the greater South East.
- It has the largest natural gas importation and storage point in the country and one of the largest in the world.
- The Medway and Thames Marshes are a crucial part of the Natura 2000 network, making them internationally significant wetlands.
- Medway has one of the largest surviving areas of high grade agricultural land in the region with the Hoo Peninsula and north and east Rainham being of particular significance.
- The former Chatham naval dockyard and its associated defences is a candidate World Heritage Site.

The South East Plan identifies Medway as a 'regional hub' and Chatham as one of twelve centres for 'significant change in the region' and has set a requirement for Medway to make provision for an additional 16,300 dwellings over the period 2006 to 2026. It identifies the main locations for this development to be within the Medway urban area at riverside sites and on Ministry of Defence land at Chattenden (Lodge Hill).

Description	Number of Units
Units completed 2006 to 2008	1,352
Units with planning permission 2009 to 2026	7,850
Allocations not yet started	574
Regeneration Sites*	**Estimated Capacity**
Chatham Centre and Waterfront	2,000
Lodge Hill, Chattenden	5,000
Rochester Riverside	2,000

** Identified for evaluation in this study.*

1.3 Physical Context

The area benefits from 11 km of riverside with a strong naval heritage, centred on the old dockyard at Chatham Maritime. Rochester has a castle and cathedral, while Medway as a whole has over 800 listed buildings and 26 conservation areas. The countryside surrounding the Medway area includes Sites of Special Scientific Interest (SSSI) and Ramsar sites on the Hoo Peninsula. See GIS image below illustrating landscape designations and other constraints overleaf.

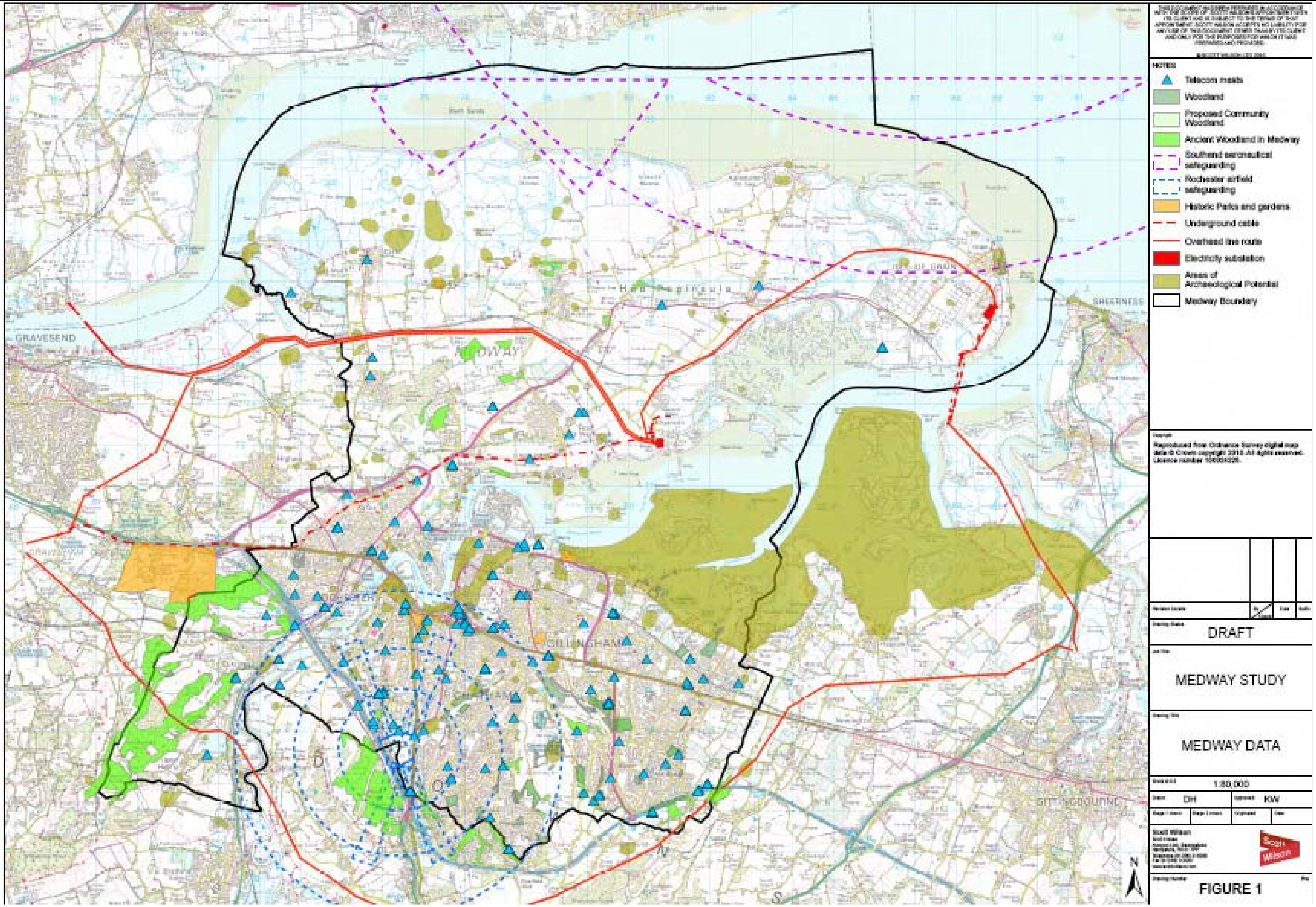


Figure 1.1: Landscape designations and other constraints in Medway.

Regeneration across Medway is well underway. Key sites include mixed-use development at Rochester Riverside, a retail-led expansion of Chatham Town Centre and Waterfront and a several major mixed-use riverside sites (see Figure 1.2 for details). The key waterfront regeneration sites are:

- Chatham Waterfront;
- Rochester Riverside;
- Strood Riverside;
- Temple Waterfront; and
- Gillingham Waterfront.

Of these, Chatham Centre and Waterfront and Rochester Riverside will be explored in more detail, along with the Lodge Hill land allocation in Chattenden on the Hoo Peninsula. These sites have been selected in agreement with Medway Council, in order to reflect the characteristics and typology of development within the Council and offer the greatest scope for new policy to have an impact, due to the mix of development and their planning status.

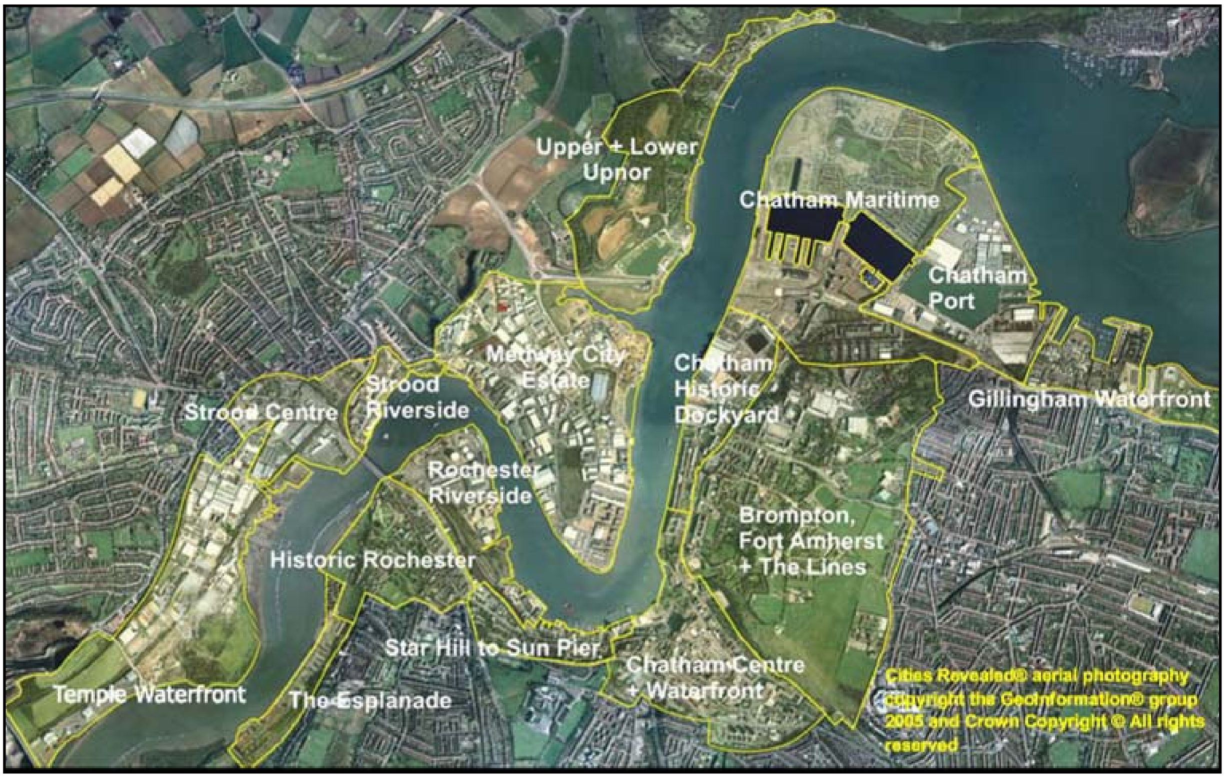
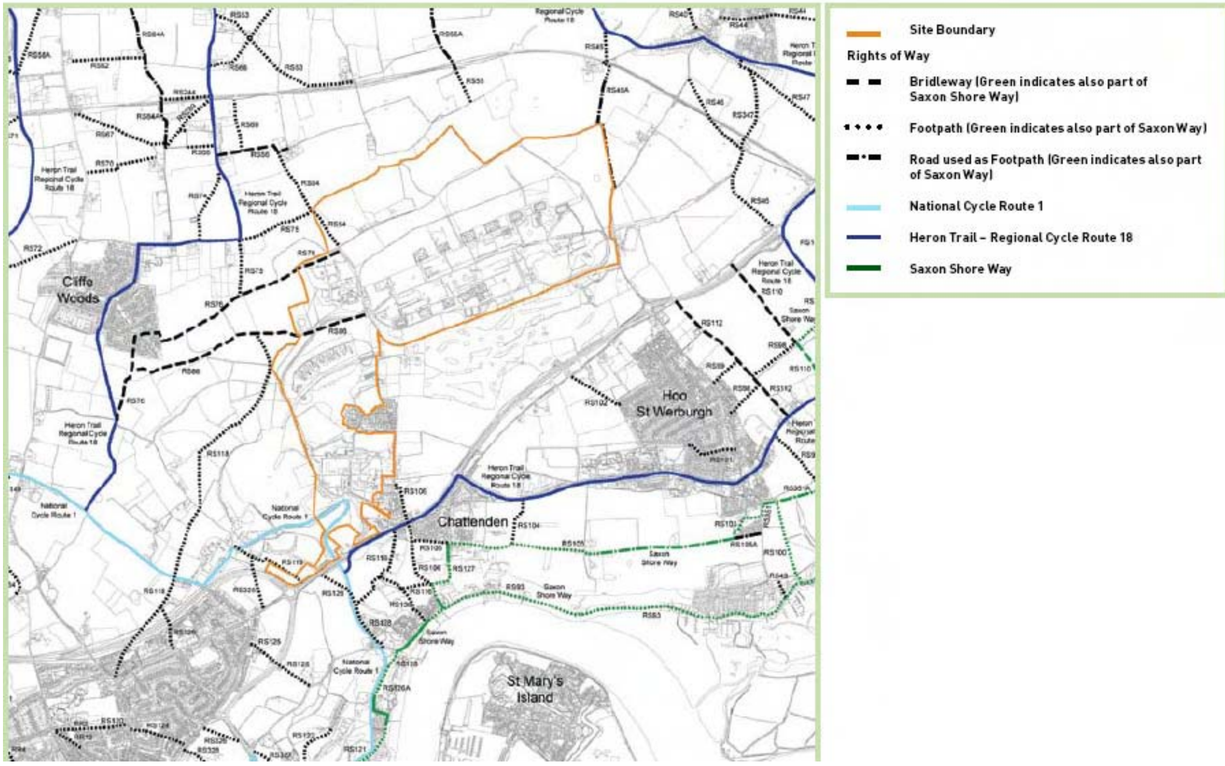


Figure 1.2: Waterfront development sites in Medway under the Medway Renaissance programme.



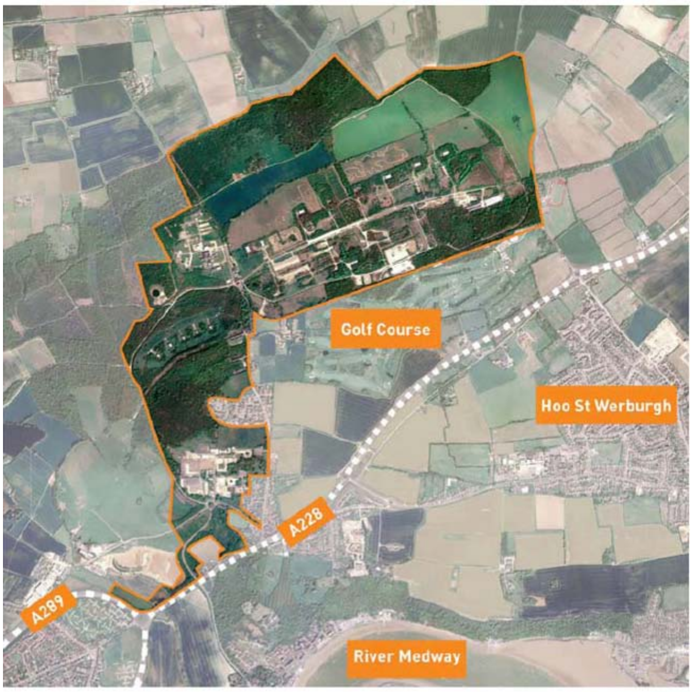


Figure 1.3: Lodge Hill; location and development site

Further areas of interest identified by Medway are the Interface Land, Rochester Airfield, Kingsnorth and the Isle of Grain. These areas have been considered throughout the study although have not been specifically evaluated as strategic sites within this study.

1.4 International & European Policy

The following is a review of national, regional and local policies relevant to Medway Council's 'Renewable Energy and Low Carbon Development Study'.

1.4.1 Kyoto Protocol Agreement

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European Community for reducing greenhouse gas (GHG) emissions. These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

The Kyoto Agreement is currently being updated using the 'Bali Roadmap'. Following the Copenhagen summit in December 2009, no agreement was reached in terms of committing the UK to further carbon reductions, technology development and investment. Therefore, UK planning policy currently reflects ambitious internal targets that the Government has set.

1.4.2 EU Energy Performance of Buildings Directive (EPBD)[1]

The principal objective of the Energy Performance of Buildings Directive (EPBD) is to promote the improvement of the energy performance of buildings within the EU through cost-effective measures. Key requirements include:

- A calculation methodology, which must be implemented to ascertain the energy performance of buildings, taking account of all factors that influence energy use;
- Minimum energy performance standards to be set for buildings; and
- An energy performance certificate (EPC) to be produced for new buildings.

1.4.3 Renewable Energy (RE) Directive[2]

The RE Directive sets out how the EU will increase the use of renewable energy sources in order to meet the overall target of **20% renewables by 2020**. Under this Directive, the UK will be required to ensure that at least 15% of its final energy consumption comes from renewables by 2020. The Directive sets the UK's interim targets at 4% for 2011/2012, 5.4% for 2013/2014, 7.5% for 2015/2016 and 10.2% for 2017/2018.

1.4.4 Energy Performance Certificates

The Energy Performance Certificate (EPC) is a measure introduced across Europe to reflect legislation under the EU Performance of Buildings Directive (EPBD) which aims to reduce buildings' carbon emissions. An Energy Performance Certificate is required for all homes

[1] http://ec.europa.eu/energy
[2] http://www.r-e-a.net/document-library/thirdparty/rea-and-fqd-documents/REDDoc_090605_Directive_200928EC_OJ.pdf

whenever built, rented or sold. The certificate records how energy efficient a property is as a building and provides ratings on a scale of A-G, with 'A' being the most energy efficient and 'G' being the least.

1.4.5 European Air Quality Framework Directive (96/62/EC)[3]

The **Air Quality Framework Directive (96/62/EC)** on ambient air quality assessment and management defines the policy framework for 12 air pollutants known to have a harmful effect on human health and the environment. The limit values for the specific pollutants are set through a series of Daughter Directives:

- **Directive 1999/30/EC** sets limit values (values not to be exceeded) for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (dust) and lead in ambient air.
- **Directive 2000/69/EC** establishes limit values for concentrations of benzene and carbon monoxide in ambient air.
- **Directive 2002/3/EC** establishes long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.
- **Directive 2004/107/EC** establishes a target value for the concentration of arsenic, cadmium, nickel and benzo pyrene in ambient air so as to avoid, prevent or reduce harmful effects of arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons on human health and the environment as a whole.
- **Directive 2008/50/EC**, which incorporates the Daughter Directives, came into force in June 2008, and will be transposed into UK national legislation by June 2010.

1.5 National Policy

The following sets out the overarching policies of the UK national Government.

1.5.1 Securing the Future

Securing the Future is the UK's Sustainable Development Strategy (March 2005) which sets out the principles for sustainable development with a focus on environmental limits. Four priority areas were identified; consumption and production, climate change, natural resource protection and sustainable communities.

1.5.2 UK Strategy for Sustainable Construction

In June 2008, the Government released a Strategy for Sustainable Construction. The Strategy, developed in collaboration with the Strategic Forum for Construction, is aimed at "*providing clarity around the existing policy framework and signalling the future direction of Government policy*".

The Strategy for Sustainable Construction is a joint industry and Government initiative intended to promote leadership and behavioural change, as well as delivering benefits to both the

[3] EU (1996) *Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management* [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31996L0062:EN:HTML

construction industry and the wider economy. Developed by BERR in conjunction with the Strategic Forum for Construction, the strategy is intended to fulfill the following functions:

- Providing clarity to business on the Government's position by bringing together diverse regulations and initiatives relating to sustainability;
- Setting and committing to higher standards to help achieve sustainability in specific areas; and
- Setting specific commitments by industry and the Government to take the sustainable construction agenda forward.

To deliver the Strategy, Government and industry have devised a set of overarching targets related to the goals and the initiatives required to achieve the goals. The goals relate directly to sustainability issues, such as climate change and biodiversity; the initiatives describe processes to help achieve the goals. The final Strategy was released on 11th June 2008.

1.5.3 Planning Policy Statement 1: Delivering Sustainable Development4

PPS1 sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system. It includes the key principle that local planning authorities should ensure that development plans promote the development of renewable energy resources. It also sets out that development plan policies should seek to promote and encourage, rather than restrict, the use of renewable resources, and that local authorities should promote small scale renewable and low carbon energy schemes in developments.

1.5.4 Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate Supplement to PPS1

In March 2010 the Government published for consultation Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate. This consultation document brings together the Planning and Climate Change supplement to PPS 1 with the 2004 PPS 22 on Renewable Energy into a new draft PPS on Planning for a Low Carbon Future in a Changing Climate. This new PPS will replace the 2007 and 2004 PPSs and it is proposed that it will become a consolidated supplement to PPS 1. This will support and provide an overarching framework for PPS 25 on Development and Flood Risk and emerging planning policies on green infrastructure.

According to this draft publication, climate change is the greatest long-term challenge facing the world today. Addressing climate change is, therefore, the Government's principal concern for sustainable development. The Government expects planning to continue to provide for the development needs of all in the community, contribute to housing supply and economic growth and support social justice. Planning should also continue to sustain biodiversity and protect natural and historic environments. All planning strategies, and the decisions taken in support of them, must however reflect the Government's ambition to help business and communities build a low carbon future and prepare for the impacts of climate change.

Plan-making and development management should fully support the transition to a low carbon future in a changing climate. This means planning should:

[4] http://www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement1

- Shape places so as to help secure radical cuts in greenhouse gas emissions. This requires the location and layout of new development to be planned to deliver the highest viable energy efficiency, including through the use of decentralised energy, reducing the need to travel, and the fullest possible use of sustainable transport.
- Actively support and help drive the delivery of renewable and low carbon energy.
- Shape places and secure new development so as to minimise vulnerability and provide resilience to impacts arising from climate change, and do so in ways consistent with cutting greenhouse gas emissions.
- Ensure local communities are given real opportunities to take positive action on climate change; in particular by encouraging community-led initiatives to reduce energy use and secure more renewable and low-carbon energy.

1.5.5 Planning Policy Statement: Planning and Climate Change Supplement to PPS1[5]

In December 2007, the Government published Planning Policy Statement – Planning and Climate Change, a supplement to PPS1. This document gives an indication of the issues to be taken into account in attempting to achieve sustainable development as a contribution to addressing climate change.

Key planning objectives include:

- Enabling new development, securing the highest viable standards of resource and energy efficiency and reduction in carbon emissions;
- Delivering patterns of urban growth that secure sustainable transport movements;
- Securing new development resilient to the effects of climate change; and
- Sustaining biodiversity.

PPS1 supplement on Planning and Climate Change requires Local Authorities to mitigate and adapt to climate change through appropriate location and patterns of development. It states that spatial strategies should abide by the principle that *“new development should be planned to make good use of opportunities for decentralised and renewable or low carbon energy”*. The Supplement, therefore, strengthens the requirement for planners to acknowledge a national need for renewable and low carbon technologies. Planning Authorities should provide a framework that promotes and encourages renewable and low-carbon energy and supporting infrastructure and develop positive policies towards that end. The Supplement sets out several other measures intended to increase uptake of renewable energy that encourage renewable energy in new development, promote consistency with PPS22, encourage the identification of suitable areas for renewables and supporting infrastructure, and expect a proportion of energy supply from new development to be from decentralised and renewable or low-carbon energy sources. Further measures are set out through Local Development Orders (LDOs), selecting land for development, local requirements for energy to supply new development and for

[5] Communities and Local Government (2007*) Planning Policy Statement: Planning and Climate Change* [online] available at: http://www.communities.gov.uk/documents/planningandbuilding/pdf/ppsclimatechange.pdf

sustainable buildings and the design of proposed developments and impact of proposed development on renewable energy supplies.

Web-based Practice Guidance[6] has been developed to assist with the implementation of the PPS on Climate Change and to secure good practice. It draws upon the principles in PPS 22: Renewable Energy.

1.5.6 Planning Policy Statement 22: Renewable Energy[7]

PPS 22 on Renewable Energy sets out UK National Policy on renewable energy. It includes a requirement for local authorities to allocate specific sites for renewable energy and to encourage developers to provide on-site renewable energy generation as appropriate.

It requires Local Planning Authorities and developers to consider opportunities for the incorporation of renewable energy into all new developments. Accordingly, Local Authorities should encourage renewable energy schemes through their inclusion in Local Development Documents.

1.5.7 Planning Policy Statement 3 (PPS3): Housing[8]

PPS3 states that "*Local Planning Authorities should encourage applicants to bring forward sustainable and environmentally friendly new housing developments, including affordable housing developments, and in doing so should reflect the approach set out in the forthcoming PPS on climate change, including the Code for Sustainable Homes*".

In addition to considerations at the regional level, it adds that Local Development Documents should set out a strategy for the planned location of new housing which contributes to the achievement of sustainable development, including identifying locations that take into account: *"The contribution to be made to cutting carbon emissions from focusing new development in locations … where it can readily and viably draw its energy supply from decentralised energy supply systems based on renewable and low-carbon forms of energy supply, or where there is clear potential for this to be realised"*.

1.5.8 Planning Policy Statement: Eco-towns - A supplement to PPS1[9]

This PPS sets out a range of minimum standards that go beyond what is normally required for new development. Although they are aimed at eco-towns, the standards *"could potentially be adopted by other developers as a way of meeting the wider objectives of the Planning Policy Statement on Climate Change planning policy"*. The Supplement includes a standard for zero carbon so that, over a year, the net CO_2 emissions from all energy use within the buildings on the eco-town development as a whole are zero or below.

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[6] http://www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/ppsclimatechange/practiceguidance/

[7] ODPM (2004) *Planning Policy Statement 22: Renewable Energy* [online] available at: http://www.communities.gov.uk/publications/planningandbuilding/pps22

[8] http://www.communities.gov.uk/publications/planningandbuilding/pps3housing

[9] http://www.communities.gov.uk/publications/planningandbuilding/pps-ecotowns

1.5.9 Climate Change Act[10]

The Climate Change Act 2008 sets targets for green house gas emission reductions through action in the UK and abroad of at least 80% over 1992 levels by 2050, and reductions in CO_2 emissions of at least 26% by 2020 against a 1990 baseline. As part of the package of measures to achieve this, Government has set a target to generate 20% of the UK's energy demand from renewable sources by 2020.

The Climate Change Act, passed in November 2008, and PPS 22 set out the Government's policies and targets on carbon emissions and renewable energy. These are primarily:

- to reduce UK greenhouse gas emissions to 12.5% below 1990 levels by 2008-2012;
- to reduce UK carbon dioxide (CO_2) emissions to 26% below 1990 levels by 2020, with a long term target of 80% below 1990 levels by 2050;
- to meet 10% of UK electricity demand from renewable energy by 2010 and 20% by 2020;
- to have at least 10 GW (gigawatts) of combined heat and power (CHP) capacity in the UK by 2010; and
- to comply with the system of binding five year "carbon budgets", with requirements set out for the Government to report every 5 years on their progress against these and on other climate change impacts and policies.

The April 2009 Budget included a proposal to amend the Climate Change Act to include an interim target for the period covering 2018 – 2022 and increase the 26% reduction in CO_2 emissions to 34%.

1.5.10 UK Renewable Energy Strategy[11]

Published in July 2009, the UK Renewable Energy Strategy aims to tackle Climate Change by reducing carbon dioxide emissions and setting guidelines and targets to increase the renewable energy supply in the UK. It sets out the path for the UK to meet its legally-binding target to ensure 15% of its energy comes from renewable sources by 2020: almost a seven-fold increase in the share of renewables in scarcely more than a decade. The document provides strategies for meeting the following targets for energy:

- More than 30% of electricity generated from renewables, 12% of heat generated from renewables.
- 10% of transport energy from renewables.
- Drive delivery and clear away barriers.
- Increase investment in emerging technologies and pursue new sources of supply.
- Create new opportunities for individuals, communities and business to harness renewable energy.

[10] The Climate Change Act 2008 is available at: http://www.defra.gov.uk/environment/climatechange/uk/legislation/
[11] www.decc.gov.uk

1.5.11 Planning and Energy White Papers[12]

The UK Fuel Poverty Strategy (2001) set out how the Government proposes to ensure affordable warmth for all households. The subsequent Energy White Paper: Our Energy Future – Creating a Low Carbon Economy (2003) includes the key energy policy goal to "ensure that every home is adequately and affordably heated" and the aim "in England, within reason, for no household to be in fuel poverty by 2016". The Paper outlines national commitments on CO_2 reduction, energy efficiency and energy security, addresses the challenges facing the current energy system and outlines a long term framework for developing policies to ensure that the UK has access to reliable and affordable energy. Furthermore, it sets a priority for strengthening the contributions of energy efficiency and renewable energy, sets out plans for funding and support for innovation in – and deployment of – low carbon technology (such as renewables) and a more supportive approach to planning. It also sets an aspiration by 2020 to double renewables' share of electricity from the 2010 target.

The revised 2007 Energy White Paper includes a strategy to accelerate the deployment of low carbon technologies. It states that "planning is one of the most significant barriers to the deployment of renewables", sets out a 'statement of need' for renewables, sets out plans to improve the renewables grid connection and builds upon three underlying principles:

- Improving the strategic context (i.e., national policy) against which individual planning decisions should be made;
- Introducing more efficient inquiry procedures in the current consent regimes; and
- Exploring options for more timely decision-making.

The 2007 White Paper: Planning for a Sustainable Future sets out detailed proposals for reform of the planning system, stating that planning can *"speed up the shift to renewable and low carbon forms of energy"*. It is intended to assist, amongst other targets, in delivering the Government's ambition of zero carbon development and in delivering greater use of renewable and low carbon sources of electricity through improved infrastructure.[13]

The 2009 Energy White Paper: *The UK Low Carbon Transition Plan* sets out a twelve-year plan for the UK to reduce CO_2 emissions by 18% on 2008 levels. This plan is the first that allocates specific carbon budgets for each of the Government departments and presents a roadmap to decarbonising the grid, including a target for the production of 30% of the electricity through renewable resources.

As part of the Low Carbon Transition Plan, the Government have allocated £3.2 billion to help households become more energy efficient and are piloting "pay as you save" ways to help people make their whole house greener. Furthermore, smart meters are being rolled out in every home by 2020. The Low Carbon Transition Plan also proposes mandating social price support, particularly for the older pensioners and lowest incomes. In order to deliver green homes in low income areas, the Government will also be piloting a community-based approach expected to help around 90,000 homes.

[12] http://www.communities.gov.uk/publications/planningandbuilding/planningsustainablefuture
[13] The Draft Consultation on Zero Carbon (December 2008), has expanded the definition of 'zero carbon' homes to include homes which achieve at least a minimum level of carbon reductions through a combination of energy efficiency, onsite and/or offsite energy supply.

1.5.12 Code for Sustainable Homes and Building Regulations[14]

To strengthen the sustainability requirements of new dwellings, the Government launched the Code for Sustainable Homes (CSH or 'the Code') in 2006 to operate in parallel to the Building Regulations for energy use for new residential development (Approved Document Part L1A). CSH sets out the national standard for sustainable design and construction of new homes. From April 2008, achieving Level 3 of the Code became mandatory for new social housing developments.

The Code includes sections on a number of different sustainability headings that cover, for example, the energy use in a home, the materials used for its construction and its effect on the site's biodiversity. Credits awarded for the Dwelling Emission Rate category within the energy section of the Code are based on percentage improvement of carbon dioxide emissions over Building Regulations.

The Code is currently undergoing consultation in view of Building Regulations requiring higher levels of efficiency; the Building Regulations will be progressively tightened requiring buildings to be 'carbon neutral' from 2016 onwards, which is equivalent to Level 5/6 of the Code. In terms of carbon emissions Level 3 equals a 25% carbon improvement relative to current 2006 standards in the Building Regulations. New housing developments will have to comply with Level 4 by 2013 (44% carbon improvement relative to current 2006 standards in the Building Regulations) and Level 6 by 2016 (zero carbon). Table 1.1 below summarises the proposed relationship between the Code and current and future Building Regulations.

Code Level	Current energy standard (Percentage improvement over 2006 Part L)	When change to regulations takes place	2009 Code consultation proposals (Percentage improvement over 2006 Part L)
1	10%		25%
2	18%		25%
3	25%	2010	25%
4	44%	2013	44%
5	100% regulated emissions		70% onsite + 30% allowable solutions
6	zero carbon onsite – 100% onsite plus appliances (equivalent to approximately 150% in total)	2016	"Zero Carbon Home" – 70% onsite + allowable solutions to reach zero carbon

Table 1.1: The Code for Sustainable Homes Consultation and Building Regulations

[14] CLG (2008) *The Code for Sustainable Homes: setting the standard in sustainability for new homes* [online] available at: http://www.communities.gov.uk/documents/planningandbuilding/pdf/codesustainhomesstandard.pdf

1.5.13 UK Building Regulations [15]

The 2006 Part L Building Regulations aim to reduce CO_2 emissions from buildings. Key additional requirements of Part L are as follows:

- New buildings must produce 20-28% less CO2 than a 2002 Building Regulations compliant building.
- All new buildings must be designed to meet the design CO2 emission target using the Simplified Buildings Energy Model (SBEM) or other approved software.
- Systems should be provided with appropriate controls to enable the achievement of reasonable standards of energy efficiency in use.
- In buildings with floor areas greater than 1,000 m^2, automatic meter reading and data collection facilities should be included.
- An Energy Performance Certificate (EPC) must be provided for buildings over 1,000 m^2.

1.5.14 Climate Change Levy

Renewables are exempt from the CCL, which is designed to encourage the business and public sectors to improve energy efficiency and reduce emissions of greenhouse gases through a price based signal on energy usage.

1.5.15 Carbon Reduction Commitment (CRC)

The CRC, aimed at reducing carbon emissions from large organisations, requires commercial and public sector organisations consuming at least 6,000 MWh per year of electricity on all half-hourly (HH) electricity meters to participate in mandatory emissions trading. The cap-and-trade scheme will begin in January 2010, and the first capped phase will begin in January 2013.

1.5.16 Air Quality Strategy (2000)

Prepared under the Environment Act (1995), the strategy contains plans to improve and protect air quality in the UK and a statutory duty for local air quality management (LAQM) under the Environment Act 1995.

1.5.17 SOGE Targets

The Sustainable Operations on the Government Estate (SOGE) has set the following targets for carbon emissions from offices and for energy efficiency and renewables:

- Reduce carbon emissions by 12.5% by 2010-11, relative to 1999/2000 levels.
- Reduce carbon emissions by 30% by 2020, relative to 1999/2000 levels.
- Departments to increase their energy efficiency per m^2 by 15% by 2010, relative to 1999/2000 levels.

[15] www.communities.gov.uk

- Departments to increase their energy efficiency per m² by 30% by 2020, relative to 1999/2000 levels.
- Departments to source at least 15% of electricity from Combined Heat and Power (2010).

1.6 Regional Policy

1.6.1 The South East Plan

The South East Plan aims to reduce the region's carbon emissions by 20% by 2010 and by at least 25% by 2015. Policy CC2 on Climate Change includes the encouragement of renewable energy development and use. Policy CC4 on Sustainable Design and Construction requires a proportion of the energy supply of new development to be secured from decentralised and renewable or low-carbon sources. The Plan sets out several specific policies for Renewable Energy:

- NRM11: Development Design for Energy Efficiency and Renewable Energy – includes, where applicable, the target (in advance of local targets being set in development plan documents) for new developments of more than 10 dwellings or 1000m^2 of non-residential floorspace to secure at least 10% of their energy from decentralised and renewable or low-carbon sources.
- NRM12: Combined Heat and Power (CHP) – encouraging integration of CHP and district heating in developments, including biomass investigation and promotion.
- NRM13: Regional Renewable Energy Targets – sets minimum regional targets for electricity generation from renewable sources of: 620MW installed capacity and 5.5% electricity generation capacity by 2010, 895MW and 8% by 2016, 1,130MW and 10% by 2020 and 1,750MW and 16% by 2026.
- NRM14: sets out indicative sub-regional targets for Kent and Medway for land-based renewable energy. These are 111 megawatts by 2010 and 154 Megawatts by 2016. To assist, Local Authorities should: collaborate and engage with communities, the renewable energy industry and other stakeholders; undertake detailed assessments of local potential; encourage small scale community-based schemes; encourage development of local supply chain (especially for biomass); and raise awareness, ownership and understanding of renewable energy.
- NRM15: Location of renewable energy development – LDDs should encourage development of renewable energy in order to achieve the above targets. The policy sets out how locations may be prioritised to avoid adverse impacts (e.g. on AONBs and protected landscape) and should be informed by landscape character assessments where available.
- NRM16: Renewable energy development criteria – Local Authorities should support development of renewable energy in principle and develop policies that consider: regional and sub-regional targets; renewables' integration in existing and new development; potential benefits to communities and the environment; the proximity of biomass combustion plants to the fuel source and the adequacy of local transport networks; and availability of connection to the electricity distribution network.

1.6.2 Existing Stock

Policies in the South East Plan also encourage energy efficiency when refurbishing existing stock:

- NRM11 & NRM12 (as outlined above); and
- Policy CC4.

1.6.3 Regional Strategy for Energy Efficiency and Renewable Energy[16]

This Energy Efficiency and Renewable Energy Strategy is a regional framework that sets out a vision for the substantial increase in the efficiency of energy use and the proportion of energy supplied by renewable sources in South East England. It includes a target for the region to generate at least 5.5% of its electricity from renewable sources by 2010 and at least 16% by 2026.

1.6.4 Kent Thames Gateway Sub-Regional Policy

The Draft South East Plan includes a sub-regional policy for Kent Thames Gateway that applies to Medway. It strongly emphasises the need for new infrastructure investment and for development to include social and economic regeneration, through maximising the use of urban and previously developed sites as a first priority. In particular, it highlights the need to concentrate new dwellings, employment and services within the Medway urban area at riverside sites and to set high standards for sustainability and the design of new development, reflecting the historic character of the area.

The key issues are the creation of:

- a flourishing local economy;
- effective engagement and participation of local people;
- a safe and healthy environment with well designed public and green space;
- sufficient size and scale and density to support basic amenities;
- good public and other transport, both locally and linking to other centres;
- a well integrated mix of decent homes;
- good quality services including education, training and health;
- a 'sense of place', and
- the right links with the wider regional, national and international community.

Policy KTG1 suggests that of approximately 48,000 new dwellings to be distributed within the Sub-Region between 2006 and 2026, about 15,700 of them will be located in Medway. Of the 15,700 new dwellings, 7,500 of them are expected to be completed by 2016, with the balance of 8,200 dwellings completed by 2026.

[16] http://www.southeast-ra.gov.uk/sustainability_energy_efficiency.html

Policy KTG6 also proposes that major developments should achieve a broad balance between housing and jobs in urban areas.

Policy KTG8 refers to developing Chatham as a major town centre, acting as a regional hub for concentrating new mixed retail, leisure and service uses.

Policy KTG9 requires that strategic flood risk assessments are conducted for major development sites in Medway to ensure development is planned to avoid the risk of flooding.

Policy KTG10 ensures that development is of the highest standards of design and best practice is adopted in the use of sustainability.

1.7 Local Policy

1.7.1 Local Plan

The Local Plan (2003) will be replaced by the Local Development Framework. The Local Plan is guided by the community's core values and sustainable development principles relating to the promotion of economic, physical and social regeneration and also improving the environment.

It emphasises the creation of an urban renaissance, through the redevelopment of brownfield sites within the urban area. The Local Plan includes the strategic objective to develop Chatham into the thriving city centre of Medway with high quality designed mixed use development comprising a range of housing, retail, leisure and community facilities, and thus becoming a major sub-regional centre able to compete effectively with its neighbours.

- Fostering balanced and timely provision of housing, employment, infrastructure and community services to meet the social needs of the community and to help maintain and develop well functioning settlements;
- Supporting the retention and growth of Kent's employment and investment in a manner that contributes to a sustainable pattern of development, and
- Responding to the implications of long term climate change by: advancing the conservation and prudent use of energy, water and other natural resources; minimising pollution and assisting the control of greenhouse gas emissions; safeguarding areas of potential flood risk from development.

1.7.2 Medway Local Development Framework

The LDF consists of a portfolio of documents instead of a single plan. It includes development plan documents, which will be subject to public examination by an independent inspector; and supplementary planning documents, which will not need to be subject to a public examination.

These documents will be prepared in accordance with a programme that is incorporated into a local development scheme (LDS). Medway's development plan documents (DPDs) will consist of the following:

- Core Strategy: containing the vision and strategic objectives for the area and including strategic land allocations;
- A Supplementary Planning Document (SPD) for the new settlement of Chattenden/ Lodge Hill;
- One further DPD covering all remaining land allocations and any necessary development control policies;
- Proposals Map: illustrating, on an ordinance survey base, all the policies and proposals contained in the other documents, and
- A number of Supplementary planning documents will be prepared alongside these documents, including this Chatham Centre and Waterfront SPD in order to provide more detailed guidance. It is also supported by a Statement of Community Involvement explaining the consultation process that will be followed and Sustainability Appraisal demonstrating the contribution that the DPDs will make to the achievement of sustainable development.

1.7.3 Core Strategy

Medway Council is in the process of preparing a Core Strategy Development Plan Document which is expected to be submitted in March 2011 and adopted in October 2011. It is currently out for Issues and Options Consultation.

1.7.4 Development Contributions Guide SPD

A Development Contributions Guide has been prepared by Medway Council that is a supplementary document to **Policy S6** of the Local Plan. Developers are expected to have had full regard to the guide before submitting planning applications to the council.

The Guide aims to assist developers, speed the decision-making process and ensure consistency, transparency and accountability. Planning Obligations or Agreements and Unilateral Undertakings are normally entered into in accordance with Section 106 of the Town & Country Planning Act 1990 (as amended). New development should be sustainable and this is interpreted as it providing capacity and new facilities to meet the needs of new residents. The council has put in place appropriate systems and arrangements to aid the process to be followed in determining contributions and sets out the technical details for most services for which contributions may be sought.

1.7.5 Local Area Agreement 2008

Medway's new Local Area Agreement (LAA) was drawn up by the council and its partners and sets out how agencies working across Medway will share resources and expertise to improve life for local people.

Partners including the council, Kent Police, NHS Medway, Kent Fire and Rescue Service, CVS Medway, Jobcentre Plus, the South East England Development Agency, colleges, businesses and the voluntary sector have signed up to 50 targets that must be met by the end of March 2011.

The LAA is focused around five main priority issues:

- Children, young people and families;
- Safer, stronger Medway;
- Health, well-being and older people;
- Economic development, transport and skills;
- Regeneration, environment, culture and housing.

As part of their LAA, Medway have signed up to monitor and improve upon National Indicator 186 - Per capita CO_2 emissions in the local authority area. The target is to reduce the overall CO_2 emissions by 13.9% by 2011, which equates to a reduction of 4.3 tonnes CO_2 per capita.

1.7.6 Supplementary Planning Guidance and Development Briefs

1.7.6.1 Rochester Riverside Development Brief

Rochester Riverside is a flagship regeneration site, one of the largest and most challenging brownfield opportunities in the Thames Gateway and is also one of several major regeneration schemes in the heart of Medway.

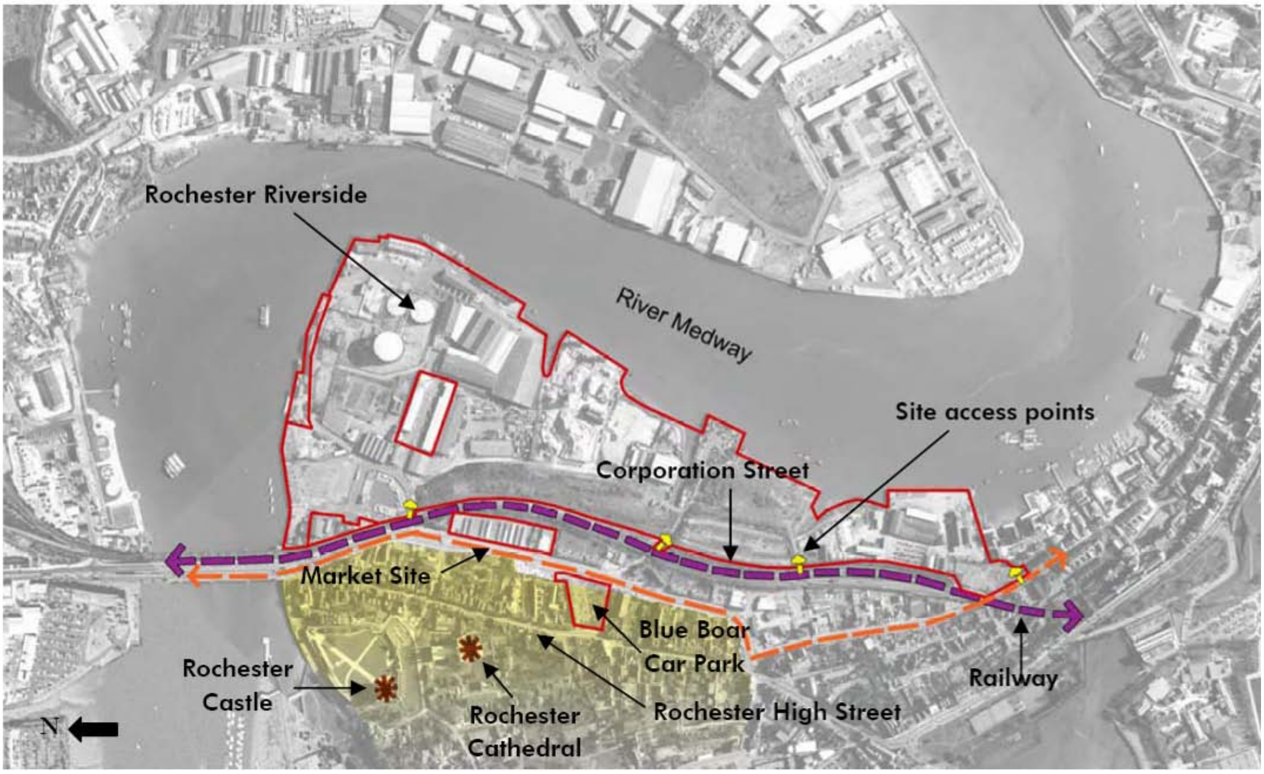


Figure 1.4: Rochester Riverside within context

The principal aims of the Rochester Riverside Development Brief are to:

- Promote a new and exciting sustainable urban quarter;

- Stimulate regeneration of the waterfront through a vibrant mixed use development integrating with the existing character and environmental context of Rochester;
- Ensure long term benefits for Rochester's existing and future residents and visitors;
- Deliver a 'prosperity plan' for Rochester and its surrounding Medway area;
- Realised inspirational and high quality urban design, architecture and public realm;
- Recognise the site's role in securing and enhancing the area's ecological potential;
- Create a sense of local distinctiveness and enhance Rochester's tourist appeal; and
- Provide clear guidance on delivery mechanisms for the development of the site.

1.7.6.2 Chatham Centre and Waterfront SPD

Exciting and visionary plans have been created for Chatham. Along with celebrating the natural splendour of the River Medway and undulating Kent landscape, there are opportunities to improve local transport connections, leisure amenities and shops, create a wide range of new homes and enhance everyone's quality of life with fantastic public spaces and parks.

While plenty of energy and investment will be focused on the future, the town's history is certainly not forgotten. Since ancient times, Chatham has had strong connections with London. It has a rich maritime and naval history dating back more than 400 years (its importance could be recognised with World Heritage status), there are literary connections with such great writers as Charles Dickens, and an impressive collection of historic buildings. Chatham and its waterfront are poised for transformation. Medway Council and Medway Renaissance Partnership are fully committed to the successful regeneration of Chatham and its waterfront.

The River Medway is one of the area's greatest assets providing the backdrop to many of the most exciting development opportunities in the South-East of England and the Thames Gateway.

The Medway Waterfront Renaissance Strategy (2004) sets out development guidance for the next twenty years. The aspiration is to transform Medway into a new city of learning, culture, tourism and enterprise.

A major step in creating this modern, exciting waterfront city is to develop key regeneration areas along the River Medway with Chatham at its heart. Chatham Centre and Waterfront will be the centre of strategic commercial, cultural and civic activity for well over a quarter of a million people in Medway.

To achieve the ambitious goals, new development should be well designed and energy efficient using natural resources as carefully as possible. Parks, streets and squares should be constructed with high-quality materials. Significant investment is to be made in Medway's transport infrastructure and new housing development should incorporate a mixture of types and tenures.

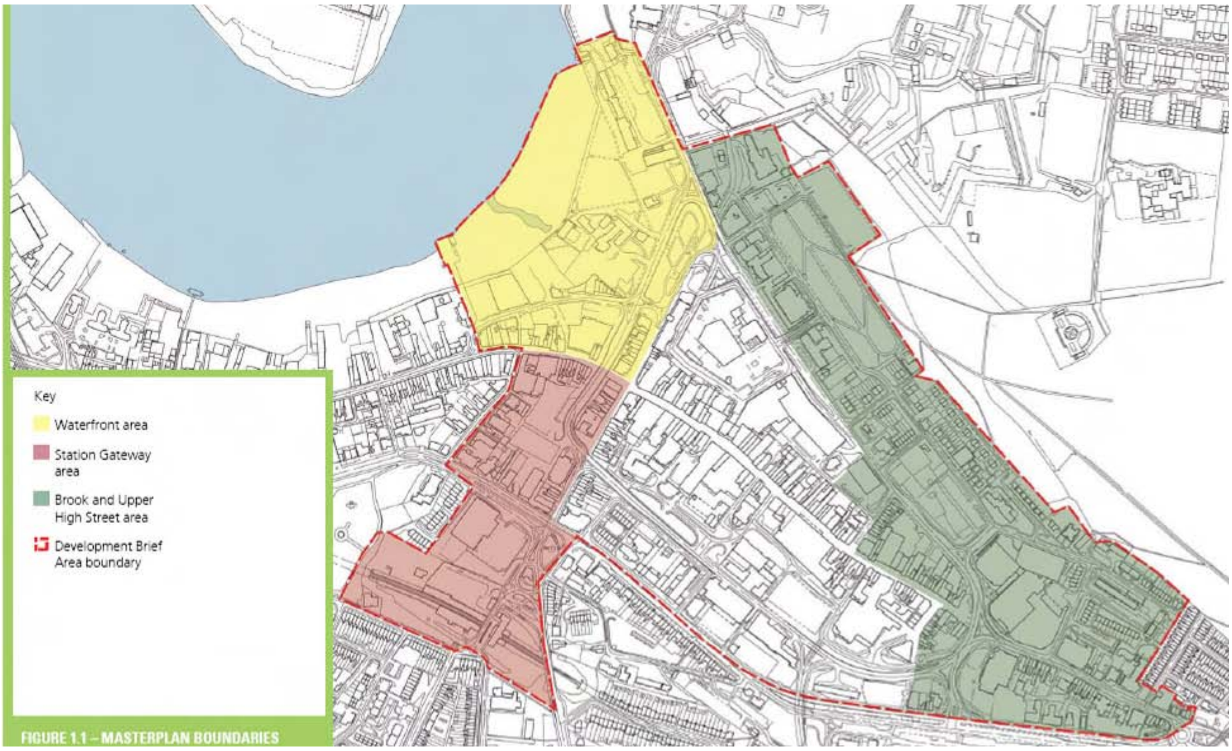


Figure 1.5: Chatham Centre and Waterfront and the three main sub-areas; the Waterfront area, Station Gateway, and Brook and Upper High Street area.

The development brief seeks to ensure that development takes place in a balanced and co-ordinated manner by setting out a comprehensive framework to guide the delivery of cultural facilities, retail, housing, employment, leisure and associated community facilities, infrastructure, transport initiatives and environmental protection and enhancement.

The purpose of this development brief is to provide guidance for developers and landowners and to inform planning decisions on new development within the masterplan areas. It is also intended to set out the regeneration aspirations for Chatham and as such, the development proposals contained in the brief are intended to illustrate the likely form and amount of development that could be achieved. The document contains a number of illustrations and diagrams which indicate the overall design principles that should be applied but are not intended to indicate specific building layouts which would be determined at the detailed design stage.

The area covered by this document is shown outlined by a red dashed line on Figure 1.5. It incorporates the core retail area and waterfront allocation as defined on the Adopted Local Plan (2003) Proposals Map. Since 2004, the development opportunities for realising Medway's vision for Chatham and its waterfront have been identified as extending beyond the core area. The site boundary has therefore been expanded to take account of these changes and overlaps with the proposed World Heritage Site. In addition, detailed masterplanning guidance is provided for three areas within the study – The Brook, the Waterfront and Station Gateway, also shown on Figure 1.5.

1.8 UKCIP09 Projections

1.8.1 Introduction

The UK Climate Projection[17] (UKCIP09) provides projections of climate change for the UK, giving greater spatial and temporal detail than previously released UK climate scenarios. The work of the UK Climate Projections programme gives perspective to the targets and aims of the environmental policy measures that Medway Council is developing in its Core Strategy. Understanding of human impact on climate change is continually improving, and this section provides a brief overview of the latest set of climate predictions for the UK (UKCP09), and the probability of different levels of climate outcomes occurring locally in Medway.

The UKCIP does not attempt to predict the degree to which economic and social change will affect emissions levels, but rather takes as its starting point three different emissions scenarios (A1FI or 'high', A1B or 'medium' and B1 or 'low'), and then calculates the probability of different climate scenarios resulting from these emissions level changes. The level of ambition of different policy scenarios under examination in this study are effectively contributing to the shift towards a lower emissions scenario, and thereby reducing the probability of more severe climate change impacts occurring, as calculated, to the best of their ability, by Climate Change experts.

The levels of annual global emissions adopted under different scenarios are illustrated in Figure 1.6 below:

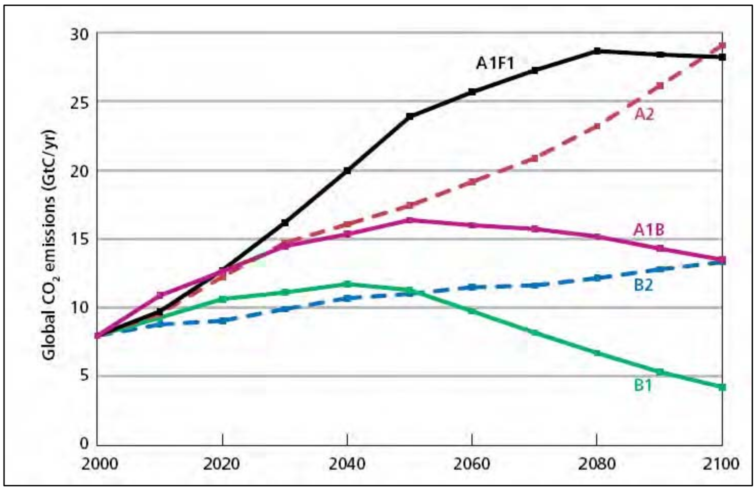


Figure 1.6: Global annual CO_2 emissions under the three IPCC scenarios in UKCP09.

NB: The dotted lines in Figure 1.6 show UKCIP02 scenarios.

[17] UK Climate Impacts Programme, DEFRA, DECC, DOE, The Scottish Government, the Welsh Assembly Government, the Met Office Hadley Centre, July 2009.

Regarding the level of confidence which we should attribute to the results of modelling, UKCP09 states 'Models will never be able to exactly reproduce the real climate system; nevertheless there is enough similarity between current climate models and the real world to give us confidence that they provide plausible projections of future changes in climate'[18].

The figure below[19] illustrates projections in global temperature from 21 global models (mean series shown in black dots) under the A1B ('medium') emissions scenario.

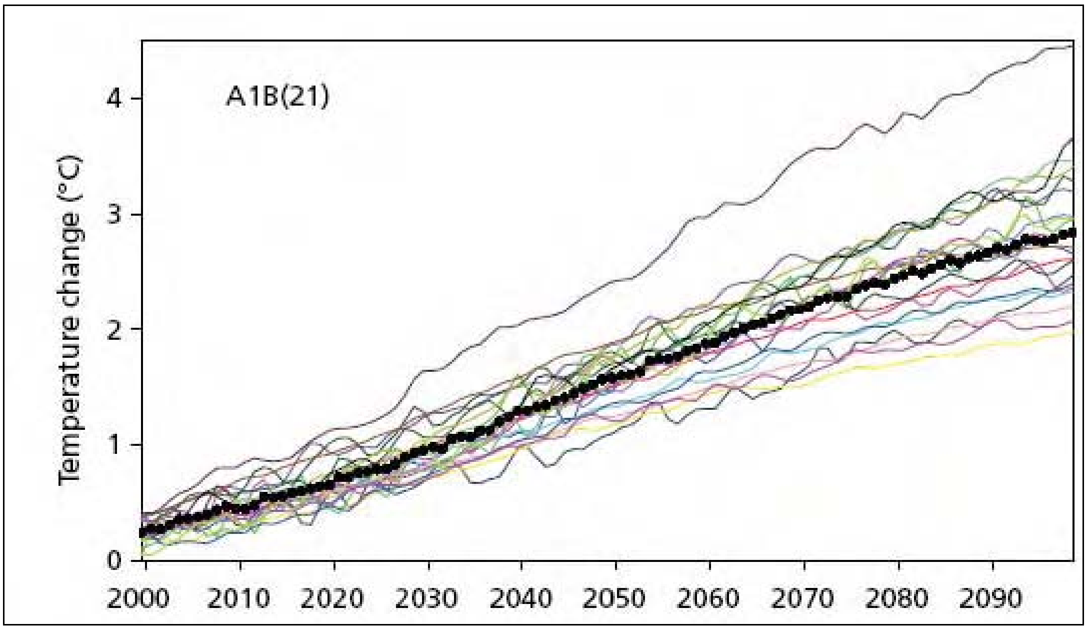


Figure 1.7: Temperature changes under A1B emissions

Whilst global weather changes are critical to the sustainability of human existence, local climate changes also bring home the relevance of intervention at a local level. The latest projections of UKCP09 show changes for the administrative regions:

[18] Ibid, page 8.
[19] Ibid, page 29

Figure 1.8: Administrative regions over which changes are averaged in the UKCP09 regional key findings

For the South East of England, under a medium emissions scenario, the following statements are made by UKCP09[20] for 2080:

- Under medium emissions, the central estimate of increase in winter mean temperature is 3ºC; it is very unlikely to be less than 1.6ºC and is very unlikely to be more than 4.7ºC.
- Under medium emissions, the central estimate of increase in summer mean temperature is 3.9ºC; it is very unlikely to be less than 2ºC and is very unlikely to be more than 6.5ºC.
- Under medium emissions, the central estimate of change in winter mean precipitation is 22%; it is very unlikely to be less than 4% and is very unlikely to be more than 51%.
- Under medium emissions, the central estimate of change in summer mean precipitation is –23%; it is very unlikely to be less than –48% and is very unlikely to be more than 7%.

The 50% probability levels (e.g. as likely to happen as not to happen) for annual mean temperature, summer precipitation and winter precipitation in the South East of England are displayed in the Appendices to this document[21]:

[20] http://ukcp09.defra.gov.uk/content/view/38/6/, accessed 02 November 2009
[21] http://ukclimateprojections.defra.gov.uk/content/view/1480/543/#50, accessed 02 November 2009

2 Energy Standards and Cost Implications

2.1 The Code for Sustainable Homes

The Code for Sustainable Homes (CSH) was introduced in April 2007 as a voluntary measure to provide a comprehensive assessment of the sustainability of a new home and replaces the EcoHomes methodology. It is developed by the BREEAM centre at the Building Research Establishment under contract to Communities and Local Government and can be used by developers to differentiate the performance of their homes and to give the consumer the necessary information to help make a more sustainable choice of dwelling. The Code Level is awarded on the basis of achieving both a set of mandatory minimum standards for waste, material, surface water run-off, energy and potable water consumption and also a minimum overall score.

Ratings under the Code are attributed to each dwelling type within a development and specific mandatory energy targets are set for each level of the Code as outlined in Table 2.1 below.

CSH Level and Star rating	Energy Requirements (Improvement over TER)
Level 1 (*)	10%
Level 2(**)	18%
Level 3 (***)	25%
Level 4 (****)	44%
Level 5 (*****)	100%
Level 6 (******)	Zero Carbon

Table 2.1: CSH Level and Performance Improvement

The targets above are based on improvements to Part L of the Building Regulations. Currently Level 6 of the Code (zero carbon) is obtained through offsetting all of the CO_2 from both Part L regulated energy uses and non-regulated energy sources such as household appliances and cooking (not assessed under Part L). Unregulated energy accounts for approximately 30-40% of a household's energy consumption and will require a reduction on the Target Emission Rate (TER) of approximately 150% to attain Code 6. See Figure 2.1, which illustrates regulated and unregulated emissions overleaf:

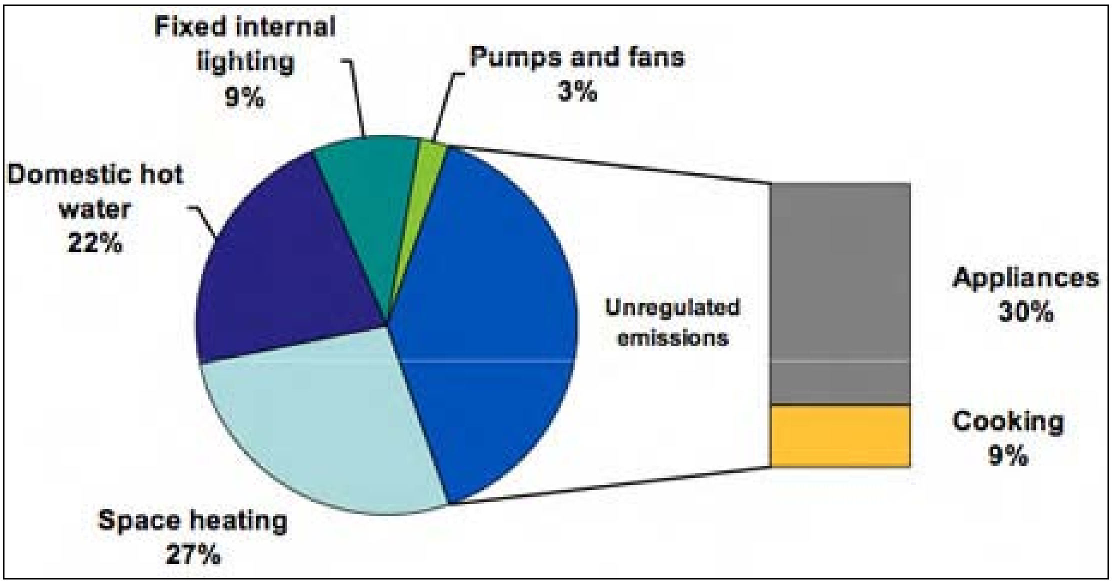


Figure 2.1: Regulated and unregulated emissions as defined by Part L

'Zero carbon' homes as defined by the Code are required to have a maximum heat loss parameter (HLP) from the building fabric of 0.8 Wm^2K. Additionally, low and zero carbon energy generation are required to be either located on the development site or be physically connected to a dwelling via private wire or a District Heat (DH) network. The Code is currently undergoing consultation, which is likely to replace the HLP measure with an energy demand measure in kWh/m^2. Furthermore, Building Regulations will be requiring higher energy efficiency levels as part of the Roadmap to zero carbon homes (refer to Section 1.5.11 in this report for further details).

There is still ambiguity over the definition of zero carbon and how this is defined by part L of the Building Regulations, however the consultation paper released by the Department of Communities and Local Government sets out the following:

- A minimum standard of energy efficiency will be required.
- A minimum carbon reduction should be achieved through a combination of energy efficiency, onsite low and zero carbon (LZC) technologies, and directly connected heat. This is referred to as achieving carbon compliance.
- Any remaining emissions should be dealt with using allowable solutions, including offsite energy.

Developers will need to employ some combination of the following '**allowable solutions**' in order to deal with the residual emissions after taking account of the minimum carbon compliance standard, expected to be somewhere between 44% and 100%. Allowable solutions are proposed to be as follows:

- carbon compliance beyond the minimum standard (towards or fully mitigating 100 per cent of regulated emissions plus emissions from cooking and appliances);

- a credit for any energy efficient appliances or advanced forms of building control system installed by the house builder that reduce the anticipated energy demand from appliances or reduce regulated emissions below the level assumed by the Government's Standard Assessment Procedure (SAP);
- where, as a result of the development, low carbon or renewable heat (or cooling) is exported from the development itself, or from an installation that is connected to the development, to existing properties that were previously heated (or cooled) by fossil fuels, then credit will be given for the resulting carbon savings;
- a credit for S106 Planning Obligations paid by the developer towards local LZC energy infrastructure;
- retrofitting works undertaken by the developer to transform the energy efficiency of existing buildings in the vicinity of the development;
- any investment by the developer in LZC energy infrastructure (limited to the UK and UK waters) where the benefits of ownership of that investment are passed on to the purchaser of the home;
- where offsite renewable electricity is connected to the development by a direct physical connection (and without prejudice to any regulatory restrictions on private wire), a credit for any carbon savings relative to grid electricity; and
- any other measures that Government might in future announce as being eligible.

Box 1: What does a zero carbon home mean?

Building A Greener Future (July 2007) set out that all new homes are to be built from 2016 in such a way that, after taking account of:

- emissions from space heating, ventilation, hot water and fixed lighting
- expected energy use from appliances
- exports and imports of energy from the development (and directly connected energy installations) to and from centralised energy networks,

the building will have net zero carbon emissions over the course of a year.

The present consultation retains the approach of looking at net emissions (including from appliances) over the course of a year. It proposes that, to meet the zero carbon homes standard, homes should:

- be built with high levels of energy efficiency
- achieve at least a minimum level of carbon reductions through a combination of energy efficiency, onsite energy supply and/or (where relevant) directly connected low carbon or renewable heat; and
- choose from a range of (mainly offsite) solutions for tackling the remaining emissions.

Box 2.1: Extracted from the "Definition of Zero Carbon Homes and Non-domestic Buildings: Consultation"[22]

Often overlooked and fundamental in terms of policy is that the energy targets are only part of the Code. The Code for Sustainable Homes also addresses other environmental issues:

- Water

22 www.communities.gov.uk/publications/planningandbuilding/building-a-greener

- Materials
- Surface Water runoff
- Waste
- Pollution
- Health and Wellbeing
- Management
- Ecology

Mandatory credits are included for energy reduction, water use, construction materials, surface water runoff and construction Site Waste Management.[23] Although the significant proportion of the cost of delivering Code levels is attributed to energy, the other categories will also require some due consideration throughout the development planning process. Nevertheless, for the purpose of this study we focus on the energy targets only and, therefore, do not evaluate in detail the wider sustainability requirements.

2.2 BREEAM

BREEAM (Building Research Establishment Environmental Assessment Method) is a tool used to review of the sustainability performance of non-domestic buildings throughout the life cycle of the project; from planning through to detailed design, construction and finally building handover. In the UK, BREEAM has been accepted as representing best practice for building appraisal and is now being used extensively by property professionals to provide a benchmark for the environmental performance of buildings that they are designing, refurbishing or operating. BREEAM is flexible and can be applied to provide a benchmark of environmental performance at any stage of the building's life cycle.

2.2.1 Core Component

The issues assessed as part of the core component provide a comparative assessment of a building's environmental impact during operation. Core issues are addressed during both Design and Procurement and cover essential elements of key environmental topic areas: Health and Wellbeing, Energy, Transport, Water, Materials and Pollution. They can be applied at any stage of the building's lifecycle, providing a consistent tool for the property market.

2.2.2 Design and Procurement

This usually takes place during the detailed design stage of all new build and refurbishments. It includes an assessment of issues under key topic areas that are of relevance during the design process such as construction project commissioning and cooling tower design, thermal comfort, predicted noise, building materials selection, re-use of façades and specification of thermal insulation materials. It also includes an assessment of sub-elements to additional key topic areas of Land Use (contaminated land, remediation, etc.) and Ecology (habitat diversity, habitat enhancement etc.).

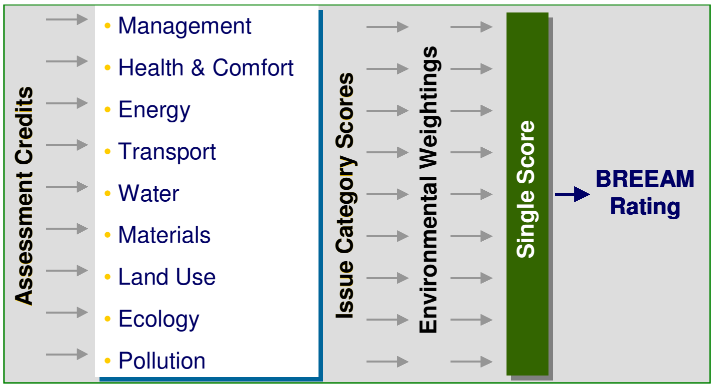
[23] Following the current Code consultation, it is likely that the requirement for a Site Waste Management Plan will be removed, as this is already a mandatory requirement under national policy.

2.2.3 Post-Construction Review

Following the Interim Design Stage assessment a Post-Construction Review (PCR) is carried out by a qualified BREEAM Assessor to verify the building was constructed as per design specifications. Following a formal submission from the BREEAM Assessor to the Building Research Establishment (BRE) and provided the evidence meets all the BRE's requirements and Quality Assurance, a separate PCR certificate would be awarded by the BRE.

Depending on the type of building and the use of the building, it can be assessed under various BREEAM methodologies. For each issue, there are a number of credits available. Where the building attains or exceeds various benchmarks of performance, an appropriate number of credits is awarded. Although a wide range of credits is available for each assessment, each credit does not carry equal importance to the overall score. The findings are weighted based upon their perceived importance as determined by consensus, via detailed research and consultation by BRE with a variety of interest groups.

The weightings obtained as a result of this research are applied to the individual issue categories to provide an overall BREEAM Assessment score.



Depending on the number of credits attained in the various issue categories, the results are translated into a corresponding overall single score which gives consideration to the environmental weightings. This single score translates into the BREEAM rating, in accordance with the thresholds illustrated in Table 2.2.

BREEAM Industrial Rating	Percentage Score
Pass	>30%
Good	>45%
Very Good	>55%
Excellent	>70%
Outstanding	>85%

Table 2.2: BREEAM score and associated rating

2.3 Energy Performance Certificates

The Energy Performance Certificate (EPC) is a measure introduced across Europe to reflect legislation under the EU Performance of Buildings Directive (EPBD) which aims to reduce buildings' carbon emissions. An Energy Performance Certificate is required for all homes whenever built, rented or sold. The certificate records how energy efficient a property is as a building and provides ratings on a scale of A-G, with 'A' being the most energy efficient and 'G' being the least.

Alongside the need for an Energy Performance Certificate to be produced for all new buildings, large public buildings must now also have Display Energy Certificates which illustrate how energy efficient public buildings are, and therefore create an incentive to ensure that buildings incorporate energy efficiency in construction as well as operation.

Specific levels of EPC are mandatory in accordance with different levels of BREEAM. For example, in order to achieve a BREEAM 'Excellent' rating an EPC of 40 is required and for a rating of 'Outstanding' and EPC of 25. There is currently no mandatory EPC requirement for BREEAM Very Good, although an appropriate level in line with the Very Good performance from our experience of projects would be an EPC of 50.

2.4 Future Energy Targets – Non-Domestic

Subsequent policy and standards have also been set in order to create a step change to zero carbon for non-domestic buildings. The UK Sustainable Construction Strategy sets out and anticipates the following step change to zero carbon with new schools, public sector buildings and other non-domestic buildings to be zero carbon from 2016, 2018 and 2019 respectively. See Figure 2.2 below:

Figure 2.2: Anticipated Carbon Reduction Targets all Building Types

2.5 Costs & Delivery Options – Code for Sustainable Homes

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

There will be a variety of development styles within Medway over the plan period, and hence for each of the dwelling types (flats, mid-terrace, semi-detached/ end terrace, detached), the projected uplifts in base build costs are illustrated overleaf[24] (see Figures 2.4 – 2.7):

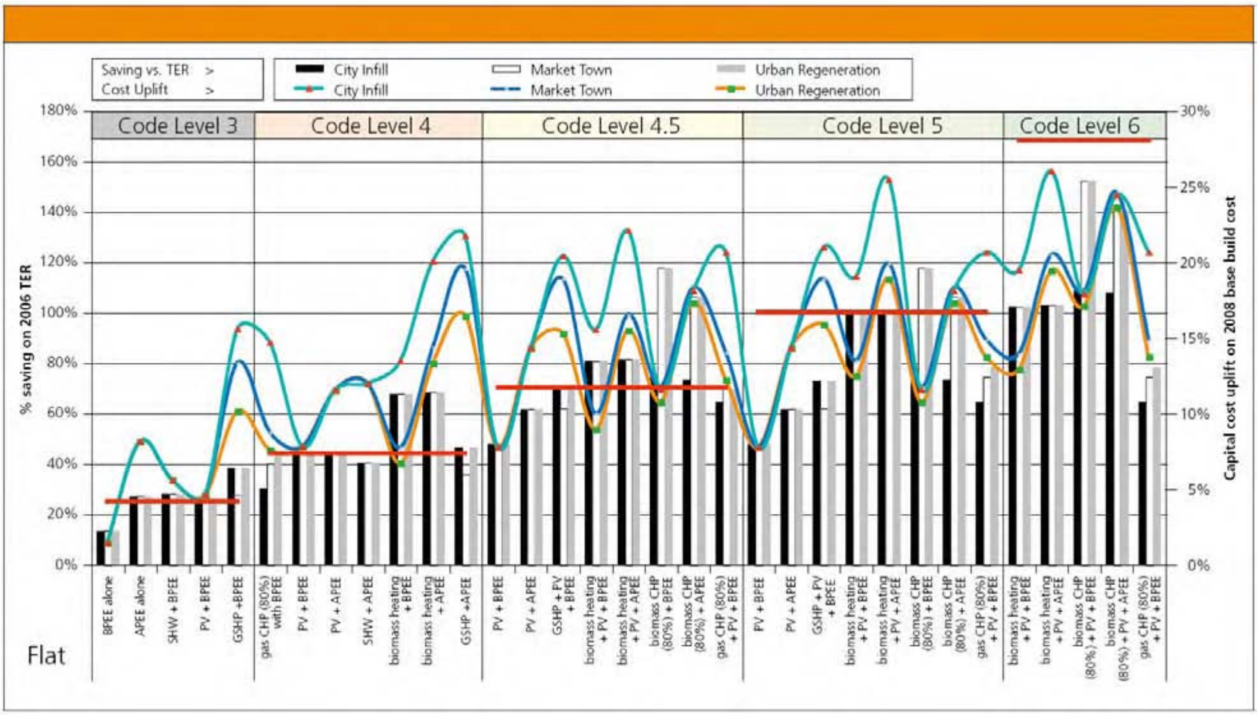


Figure 2.3: DCLG Cost uplift and carbon saving projections (flats)

[24] Costs and Benefits of Alternative Definitions of Zero Carbon Homes, DCLG, February 2009,

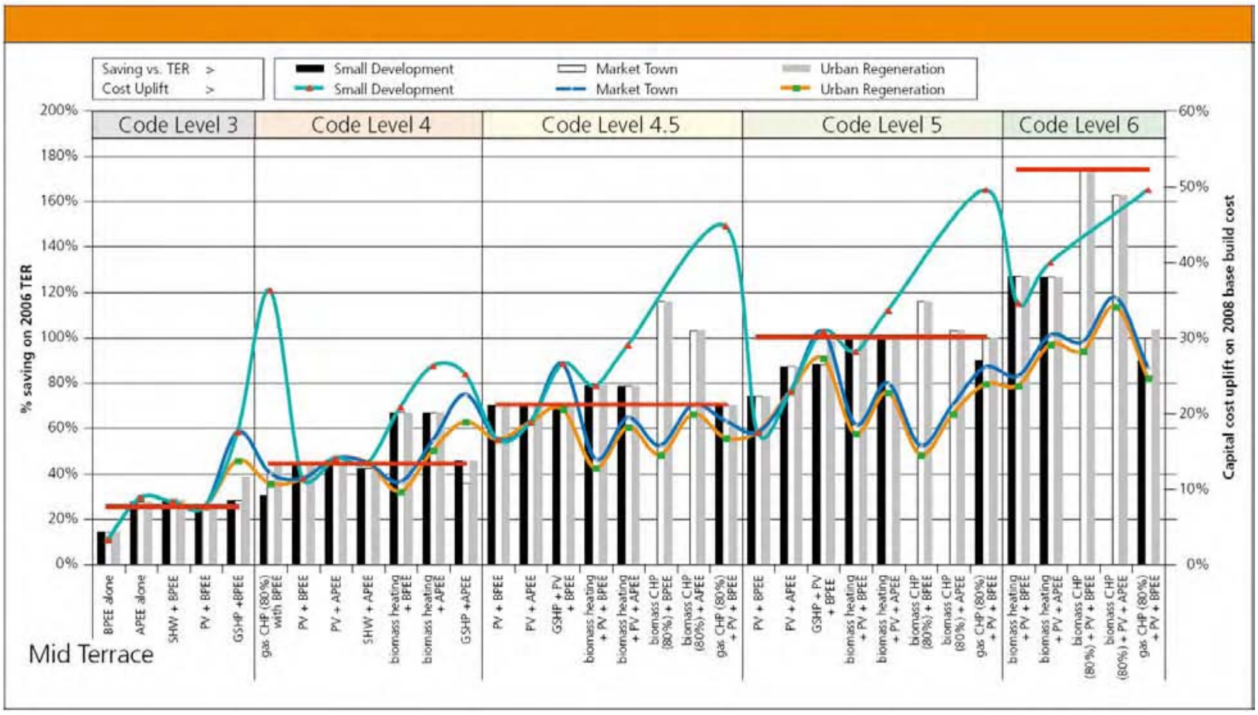


Figure 2.4: DCLG Cost uplift and carbon saving projections (mid-terrace)

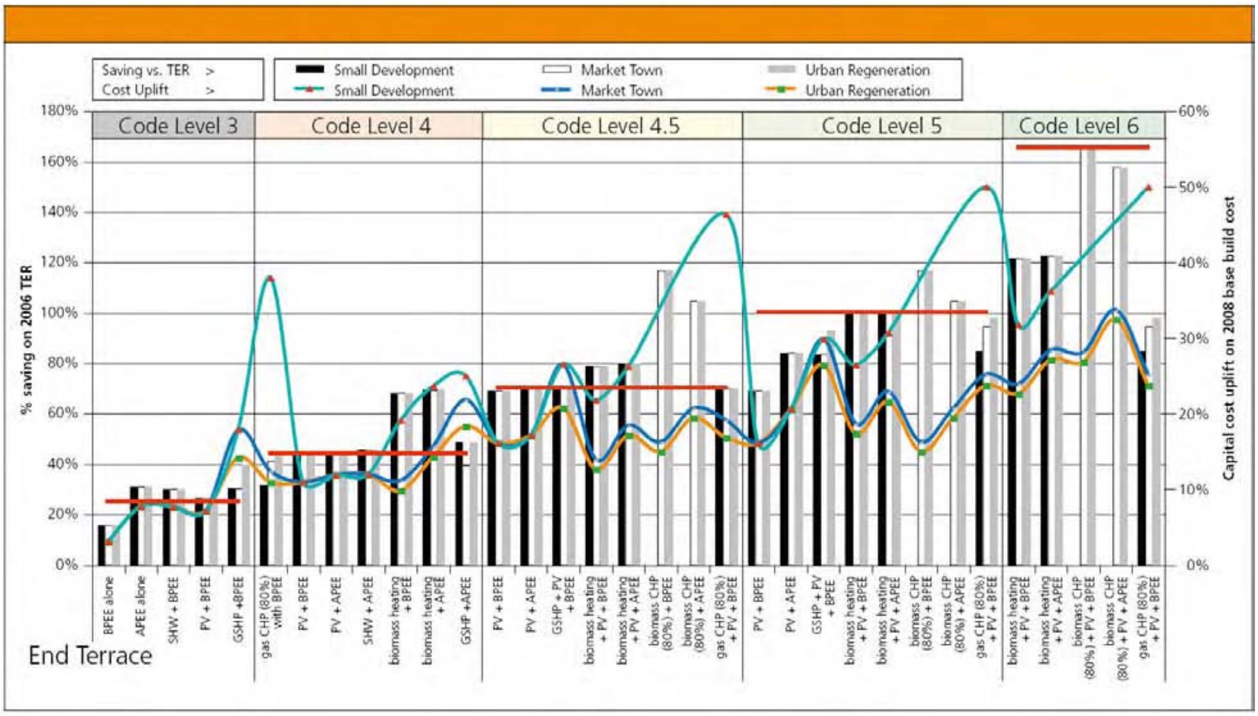


Figure 2.5: DCLG Cost uplift and carbon saving projections (semi-detached/ end-terrace)

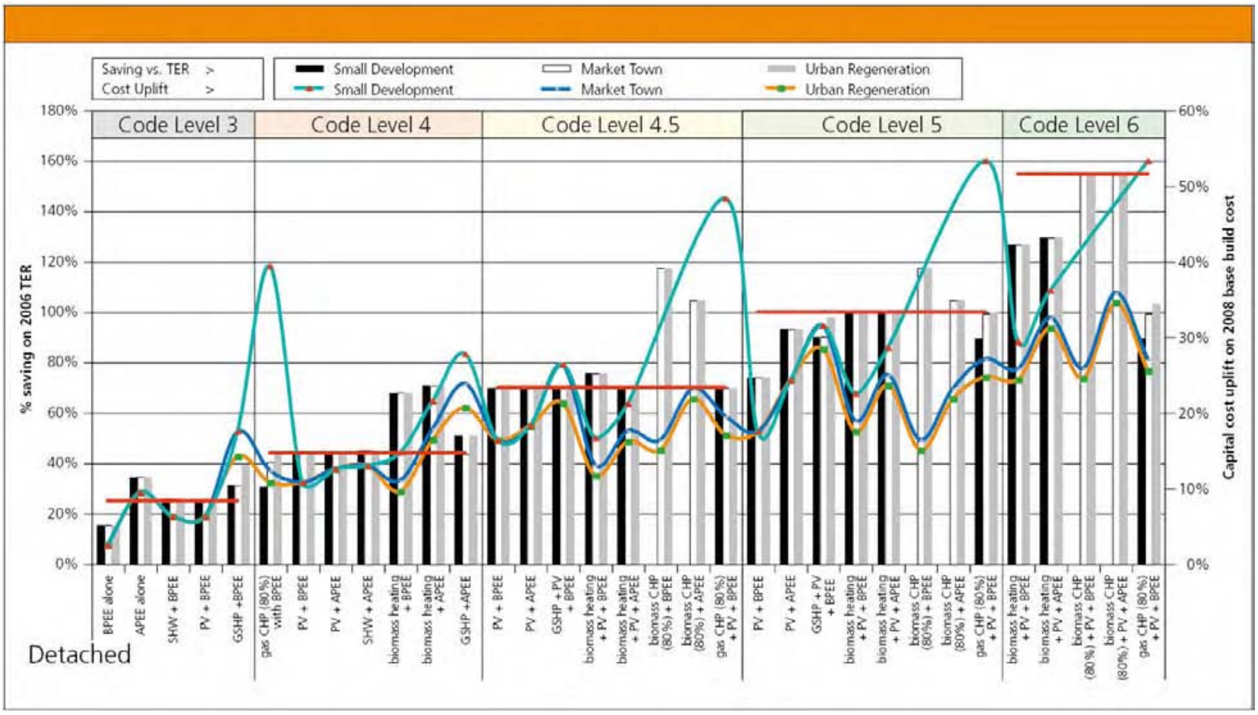


Figure 2.6: DCLG Cost uplift and carbon saving projections (detached)

These graphs provide an indication of the uplift cost for achieving the energy targets for differing Code levels in respect to energy-specific technology which will have wide-ranging implications. However, it must also be emphasised that these are generic figures, and local circumstances may impact the costs illustrated here. Nevertheless, these figures represent a useful starting point upon which to base policy decisions.

Figure 2.7 below provides an indication of the likely build cost (residential buildings) for achieving both energy and sustainability targets up to Code level 6 which have been used to inform the development viability analysis specific to Medway, detailed in Chapter 6.

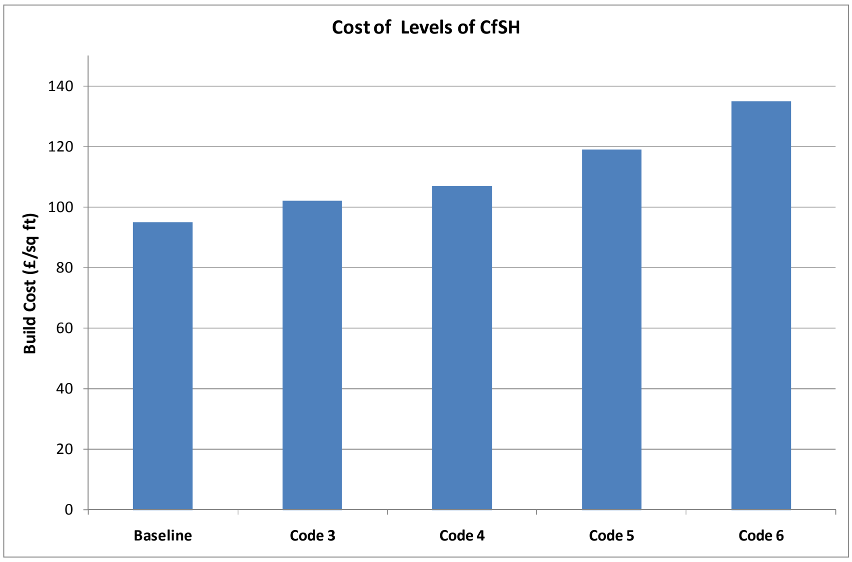
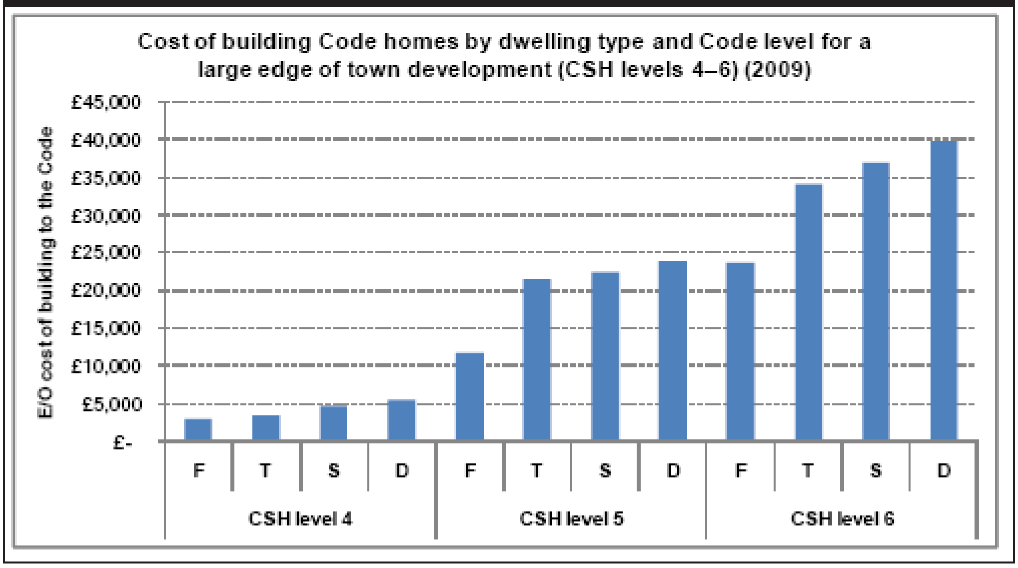


Figure 2.7: Cost Uplift for Code Levels

The above illustrates the general trend for uplift in build costs associate with the Code for Sustainable Homes with Code 3 at just over £100/sqft rising to over £130/sqft for Code 6. This scope of this study relates only to the energy element of the Code illustrated via energy over costs E/O in the following graph below.

Figure 7: Cost of building to the Code for different dwelling types (flat, terraced house, semi-detached and detached house), Code levels 4-6



Cost ranges from approximately £2,500 to £40,000 from Code 4 to Code 6 and differ subject to dwelling type. It should be noted that the steep increase in costs of attaining Code levels 5 and 6 relative to Code level 4 is a result of the increasingly stringent CO_2 emission reductions required.

2.6 Costs of Delivering BREEAM Targets

This section presents cost findings from three studies relating to delivering BREEAM targets in non-residential buildings; offices and schools. For offices, the BRE carried out research in conjunction with Cyril Sweet[25]. For schools, the BRE carried out research in conjunction with Faithful and Gould[26] and a more recent study was undertaken by Corus and the British Constructional Steelwork Association[27]. The key findings are summarised below.

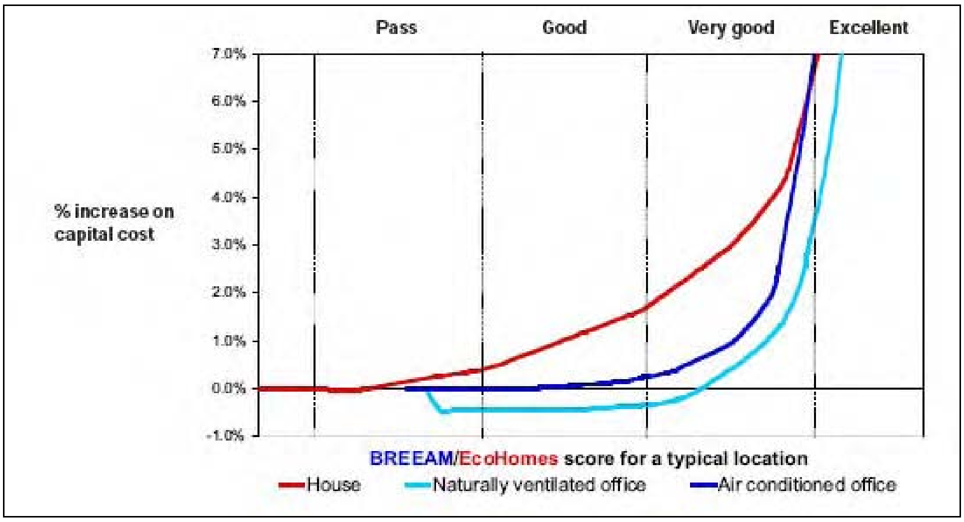


Figure 2.8: Cost for Achieving BREEAM Targets, Offices compared to Housing

In summary, Figure 2.8 identifies the base build cost to deliver Good, Very Good and Excellent ratings under BREEAM Offices 2004 and BREEAM Schools 2006 in Figure 2.9:

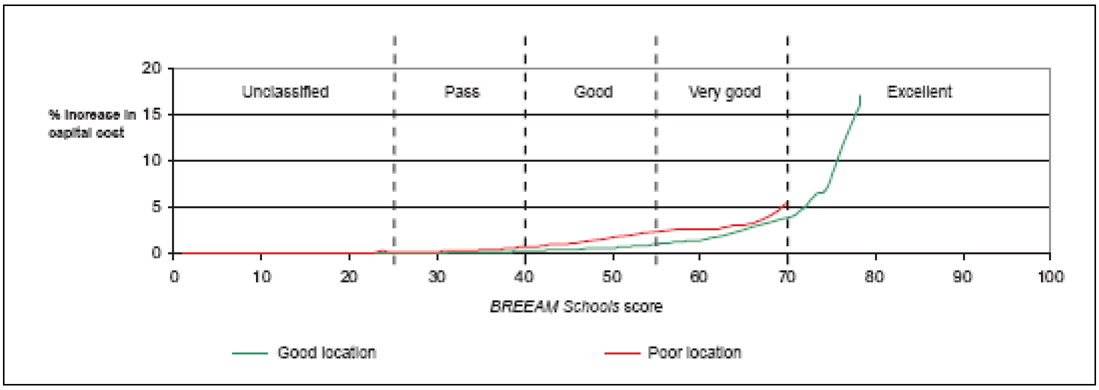


Figure 2.9: Cost for Achieving BREEAM Schools

[25] *Putting a price on Sustainability – BRE, 2005*
[26] *Putting a price on sustainable Schools – BRE 2008*
[27] *Target Zero School: http://www.targetzero.info/ (February 2010)*

Figure 2.9 from the BRE report, *Pricing Sustainability in Schools* suggests an uplift of between 3-15% to deliver BREEAM 'Excellent' based on a secondary school block (3,116m2).

There is very limited published information on the costs to deliver energy targets for non-domestic buildings and no published cost data based on meeting BREEAM Offices targets since 2004, therefore cost data currently available for the new 2008 methodology which has mandatory targets for energy (based on the EPC rating – see Section 2.3 in this report for further details on EPCs) is limited to a study undertaken by Corus and the British Constructional Steelwork Association on the cost of sustainable schools.

This is an independent guide that has been published providing detailed cost analyses and route maps for achieving low or zero carbon schools and BREEAM Outstanding ratings. Commissioned by Corus and the BCSA, Target Zero undertakes a detailed comparison of different energy efficiency measures, low or zero carbon (LZC) technologies and allowable solutions in order to identify the most cost effective means of achieving different levels of carbon reduction. The following section presents their results.

Operational Carbon

According to this study, for schools the likely 2010 Part L compliance target of reducing operational carbon emissions by 25% can be achieved by using a series of energy efficiency measures such as improved airtightness and improved insulation.

This package of measures increases the capital cost of the school building by £31,000 against a construction cost of £22.5m. In use these measures save over 100,000 kgCO_2/year and give a net cost saving over a 25 year period of nearly £600,000.

The least cost route to achieving true zero carbon performance requires the integration of off-site low or zero carbon technologies such as tapping into a district Combined Heat and Power plant as well as on-site energy efficiency measures.

It should be noted that the influence of the frame on the amount of CO_2 emitted during the life of the school was found to be negligible.

BREEAM Cost Uplift for Schools

In terms of BREEAM, the estimated capital cost uplift of the base case study school building was:

- 0.2% to achieve BREEAM Very Good;
- 0.7% to achieve BREEAM Excellent;
- 5.8% to achieve BREEAM Outstanding

2.7 Government Incentives

2.7.1 Clean Energy Cash-back – Feed-In Tariffs (FiTs)

The Energy Act 2008 provides broad enabling powers for the introduction of feed-in tariffs (FiTs) for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts

(MW) capacity - 50 kilowatts (kW) in the case of fossil fuelled CHP. It has been proposed that the FiTs be introduced through changes to electricity distribution and supply licences intended to encourage the uptake of small-scale low-carbon energy technologies. FiTs will guarantee a price for a fixed period for electricity generated using small-scale low carbon technologies, currently estimated to be 38p/kWh, thus encouraging the installation of small scale low carbon technologies. The Government is committed to introducing FiTs by April 2010. Nevertheless, the Renewables Obligation (RO) continues to be the main support mechanism for large scale renewable energy deployment.

The intention from DECC is that the deployment of small-scale low-carbon technologies will:

- Engage communities, businesses and domestic households in the fight against climate change;
- Reduce reliance on centrally generated electricity;
- Increase security of supply; and
- Reduce losses through transmission and distribution networks.

DECC states small-scale low-carbon electricity technologies include:

- Wind;
- Solar photovoltaics (PV);
- Hydro;
- Anaerobic digestion;
- Biomass and biomass combined heat and power (CHP); and
- Non-renewable micro-CHP.

Further information on the implication of FITS in development viability is provided in Section 5.5

2.7.2 Renewable Heat Incentive (RHIs)

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

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

Powers in the Energy Act 2008 allow the setting up of a Renewable Heat Incentive (RHI). The Act allows the RHI to provide financial assistance to generators of renewable heat, and producers of renewable biogas and biomethane. Details of the scheme have not yet been finalised and consultation was proposed for the end of 2009, although it has not started at the time of this study. However, the following will be key features:

- It is expected that the incentive will apply to generation of renewable heat at all scales, whether it be in households, communities or at industrial scale.
- The incentive should also cover a wide range of technologies including biomass, solar hot water, air- and ground-source heat pumps, biomass CHP, biogas produced from anaerobic digestion, and biomethane injected into the gas grid.
- The incentive will apply across England, Scotland and Wales. (Northern Ireland will be required to develop their own legislation)
- The RHI will be banded for example by size or technology (e.g. larger scale biomass heat may require less support per MWh than others).
- The incentive payments will be funded by a levy on suppliers of fossil fuels for heat. These are mainly licensed gas suppliers but also include suppliers of coal, heating oil and LPG.

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

2.8 Delivery Partners (ESCos)

The draft Practice Guidance to support PPS1 Supplement emphasises the value of ensuring adequate delivery arrangements are in place to secure new low and zero carbon energy infrastructure. This is of particular importance where decentralised energy equipment requires significant investment that is to be funded entirely or in part through revenue generated by energy sales and/ or there will be a requirement for co-ordinated operation and management arrangements to be put in place. The Practice Guidance recognises the value of third party involvement in the investment in, and operation of, heating and power networks and recommends the use of Energy Services Companies ('ESCos') as a partner to delivery.

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

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

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

- As a dedicated entity with the primary purpose of delivery of a Council's climate change and spatial planning low carbon energy infrastructure objectives, an ESCo can operate with a sharper focus and purpose that is not available to existing Council services.
- An ESCo can operate as a commercial entity outside a Council's existing services and business structures. This creates a business-orientated environment in which to progress an ESCo's objectives with the consequence that it may be more entrepreneurial in its activities and less directly affected by shorter term Local Authority service objectives.
- The creation of an ESCo provides a means by which a Council can identify and manage its investment risk, maintaining separation between the ESCo and its core services.

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

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

Additionally, the presence of an ESCo will also incentivise the connection of existing buildings to an energy network, by providing enlargement of the ESCo's customer base. This may take the form of physical connection via a heat main to provide district heating to existing buildings; a distributed cooling network to provide air conditioning and cooling; and/ or electricity supply via a private wire network (PWN). Alongside the pipe and cable infrastructure, some ESCos also supply local buildings with electricity via the existing local District Network Operator's (DNO) network. These 'virtual' private wire networks have enabled ESCos to supply surplus electricity generated through CHP equipment to customers such as schools and civic buildings within a local community when they are located too far from the CHP to justify the cost of providing a dedicated private wire connection.

3 Baseline District Energy Demand & Emissions Projection

3.1 Introduction

The aim of the carbon footprint assessment and carbon mapping undertaken on behalf Medway is twofold: first, to quantify the level of emissions currently generated by the building stock; and, second, to identify those areas with the highest density of carbon emissions. The high density emissions areas represent locations where greatest impact on the overall carbon footprint could be made through suitable policy intervention.

3.2 Methodology and Data Sources

Several sources of data have been explored and adapted in compiling the base data to create a carbon snapshot of Medway. Avenues explored included:

- Census 2001 data
- National Statistics Office data
- National Grid
- Site survey
- DECC published data
- Medway Council supplied data

A number of previous statistical studies have addressed the issues of fuel use at a local level and high quality data, which has achieved the status of National Statistics, is available. Already available figures include the level of carbon emissions arising from buildings at UA level, displayed below. The figures corresponding to the National Indicator 186 methodology have been selected in order to ensure compatibility between this document and the Council's internal monitoring and reporting methodology.

However, for the purposes of this study, where the effect of policy intervention must be assessed at individual development level, district-wide data only has limited relevance. Hence, one focus of research and efforts in this study has been to break down district-level statistics into more locally specific levels, such that a more detailed picture of carbon impacts can be obtained.

3.3 Medway Carbon Footprint

DECC has published data for Medway in the following form, based on 2007 data:

,000s tonnes CO_2 p.a.	Industrial Commercial Agriculture	Domestic	Road Transport
Medway (NI186, 2007)	410	539	284

Table 3.1: Medway Carbon Emissions Derived from DECC Data

The results above summarise the district-wide carbon emissions that are anticipated from the buildings' sector, forming the focus of this report. A pie chart of emissions by sector for Medway is shown below, illustrating the contribution of the built environment to the wider basket of carbon emissions.

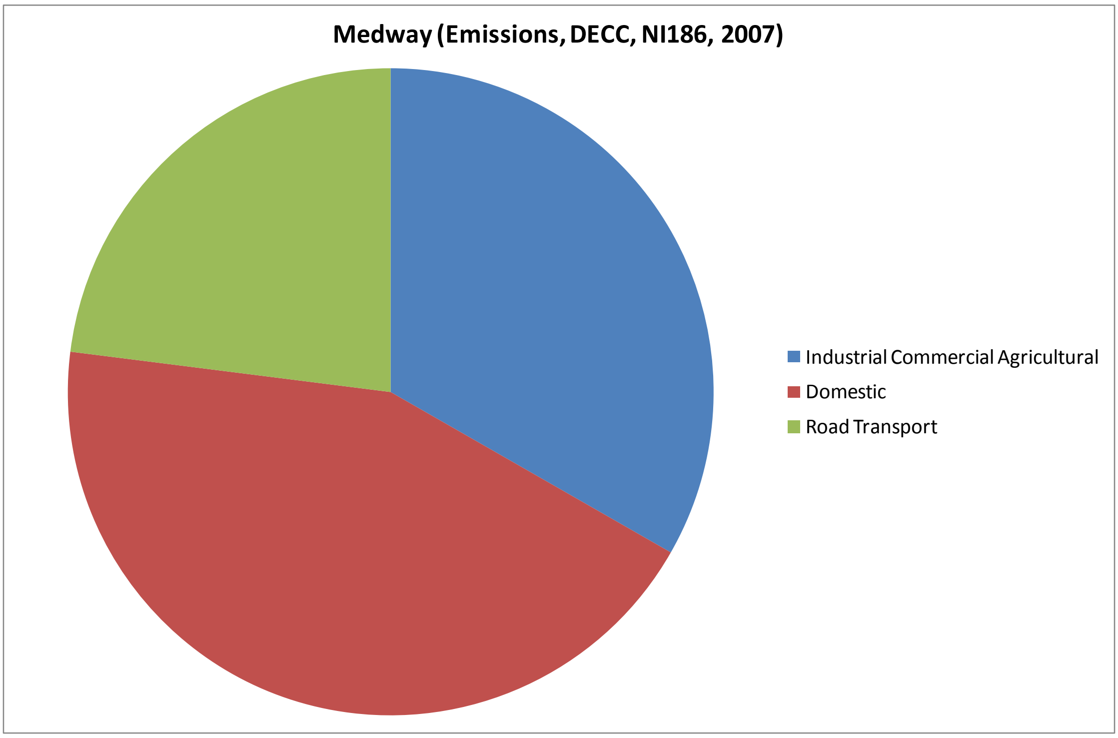


Figure 3.1: Carbon Emissions by Sector in Medway

This chart illustrates that the largest part of the Medway emissions arise from the domestic sector, reflecting the mix of building stock in the borough.

The overall carbon footprint for Medway in comparison to the UK as a whole is summarised in Table 3.2:

NI186 DECC 2007 figures	Total NI186 Carbon Footprint thousands of tonnes carbon dioxide per annum (% of UK total)
Medway UA	1,233 (0.28%)
UK Total	432,727

Table 3.2: Medway Overall Emissions Footprint

In the national context, the figures for electricity consumption on a per dwelling basis can be seen to be fairly low for domestic properties, and low in terms of industrial / commercial consumption levels, as displayed on the following[28] maps:

[28] DECC, Maps showing domestic, industrial and commercial electricity consumption at local authority level, Publication URN 09D/535,

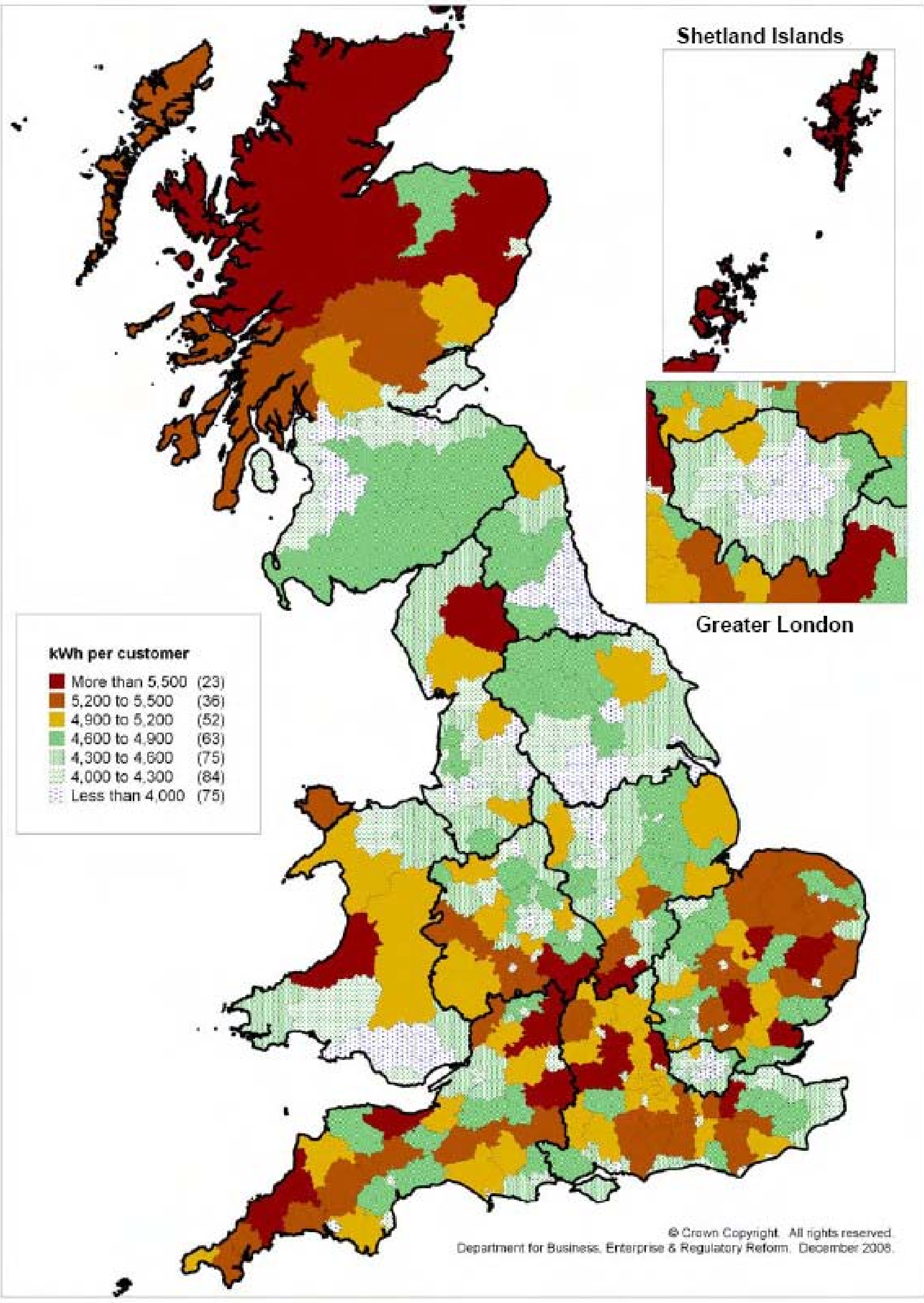


Figure 3.2: Average Domestic Electric Consumption per Meter Point in 2007 (kWh)

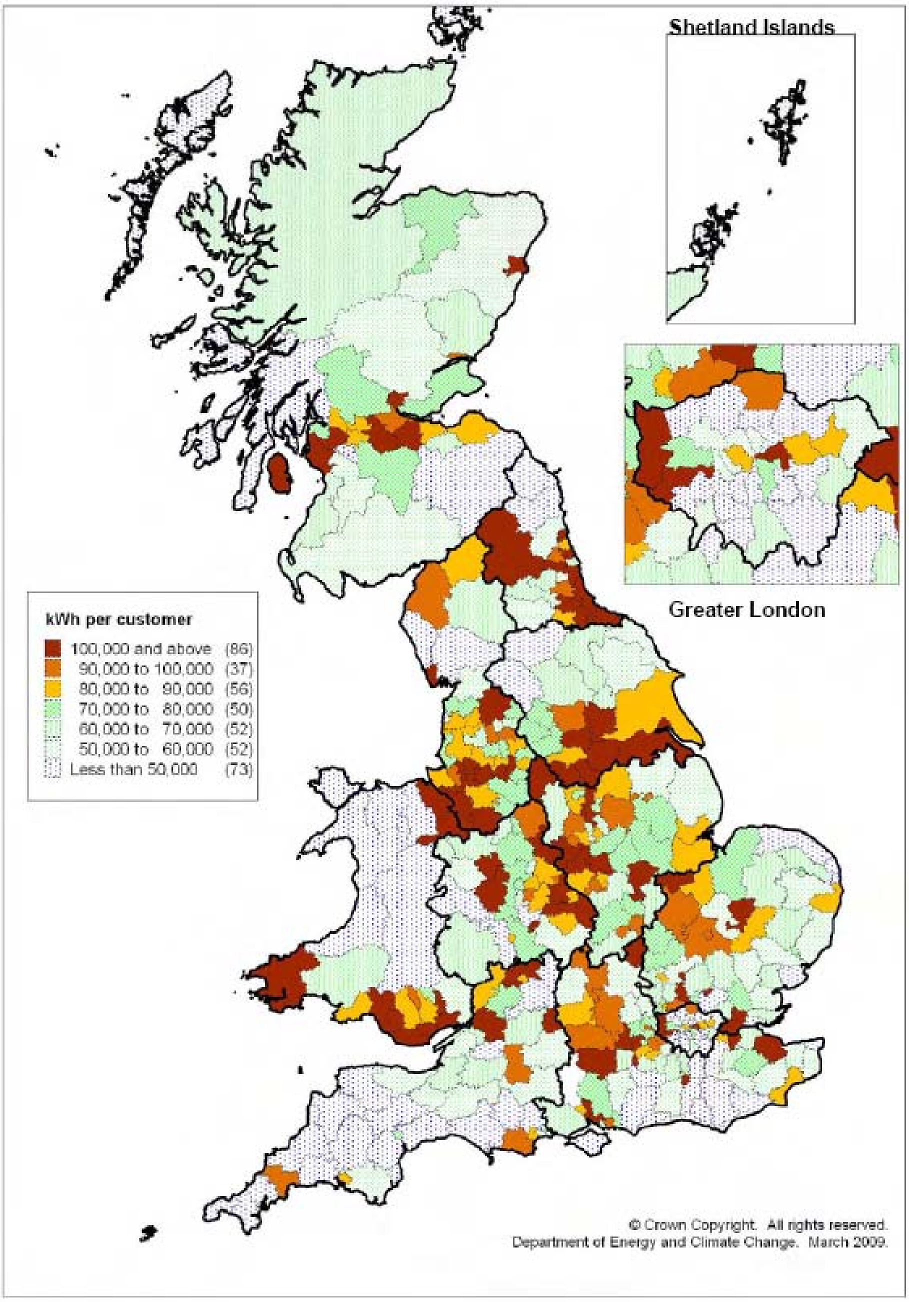


Figure 3.3: Average Industrial / Commercial Electricity Consumption per Meter Point in 2007 (kWh).

On a regional basis, the following charts illustrate the NI186 (DECC 2007) figures for per capita CO_2 emissions in other local authorities in the region.

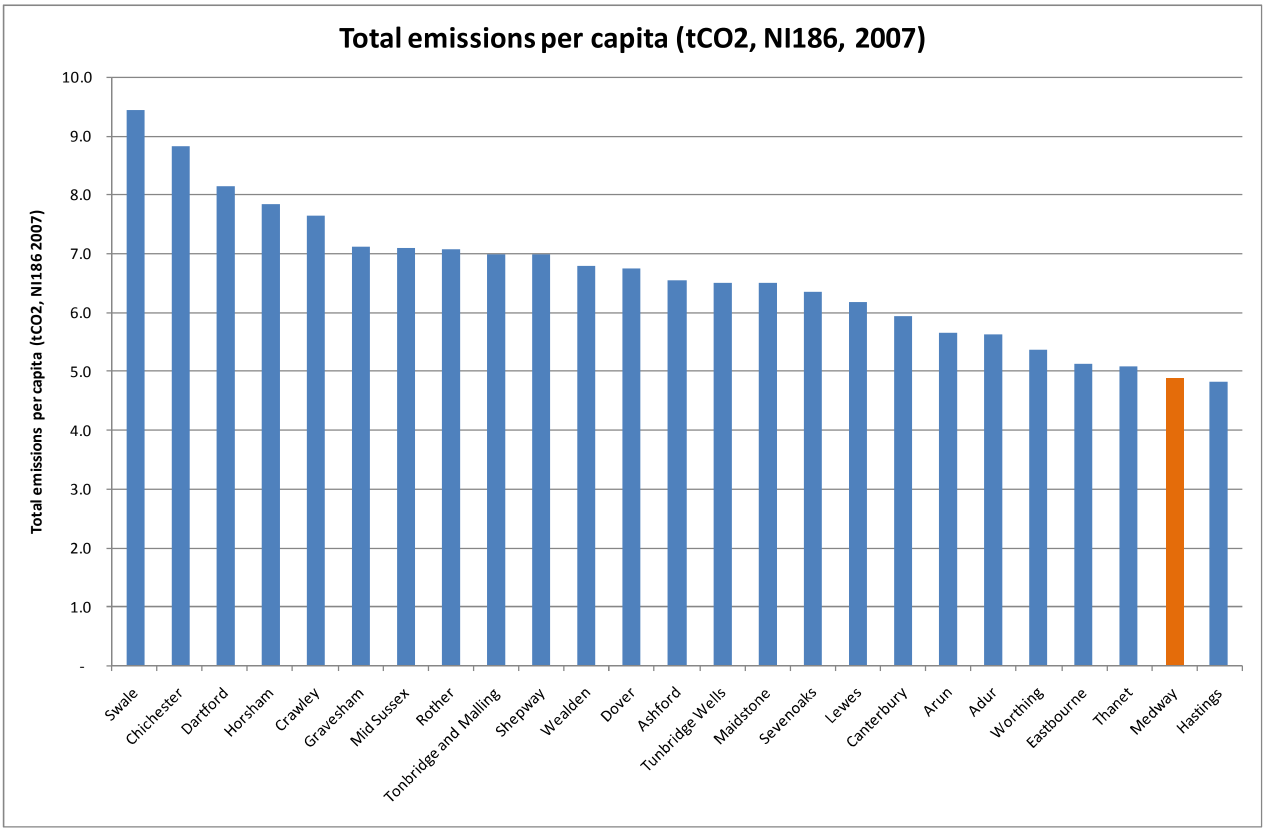


Figure 3.4: Other Local Authority Total Emissions Per Capita (DECC, NI186, 2007)

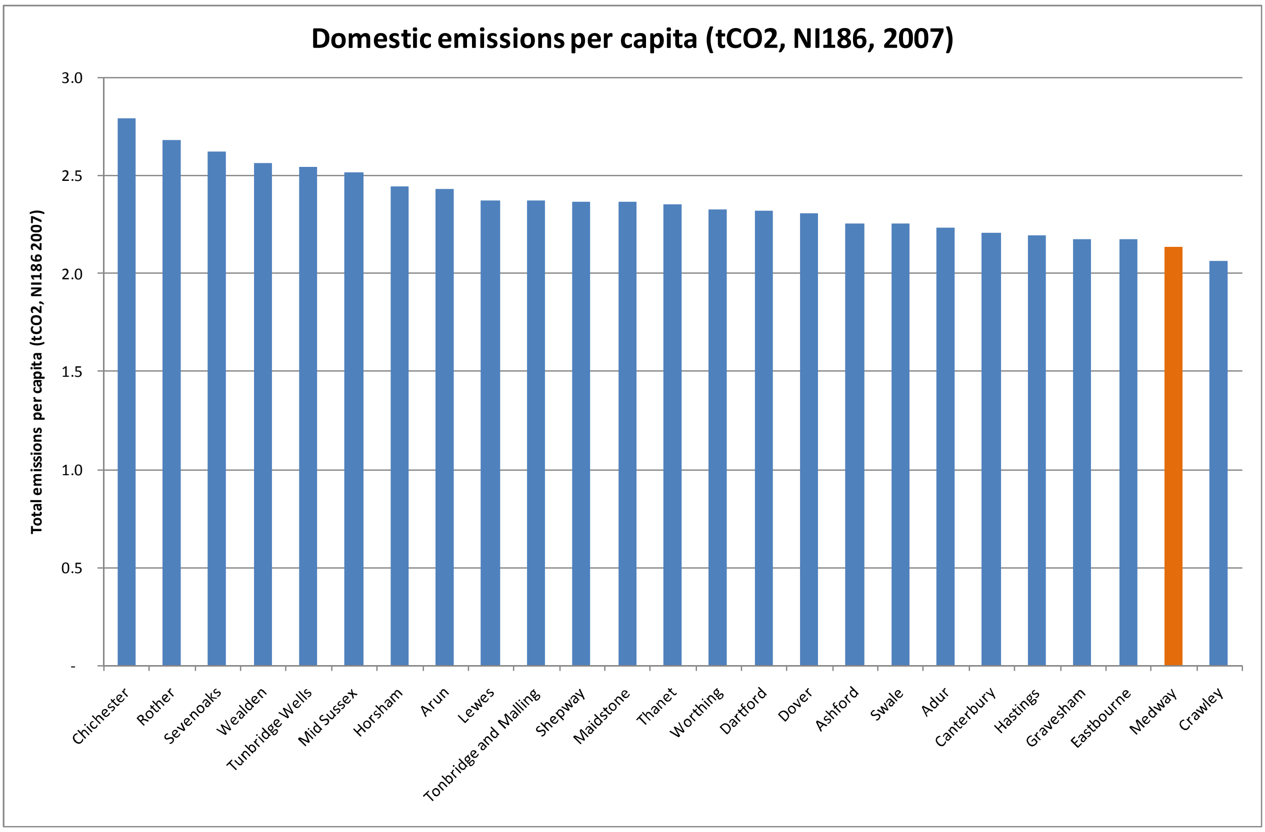


Figure 3.5: Per Capital Domestic Emissions (NI186, DECC, 2007)

Both total and domestic emissions in Medway are shown to be low in comparison with other local authorities in the area. This can probably be attributed to an extent to the high level of commuting out of Medway for employment and the characteristics of the housing stock.

3.4 Local Emissions Distribution

Using 2001 Census data, a map of the distribution of emissions within the Unitary Authority has been generated for the domestic element of the building stock. This is displayed below:

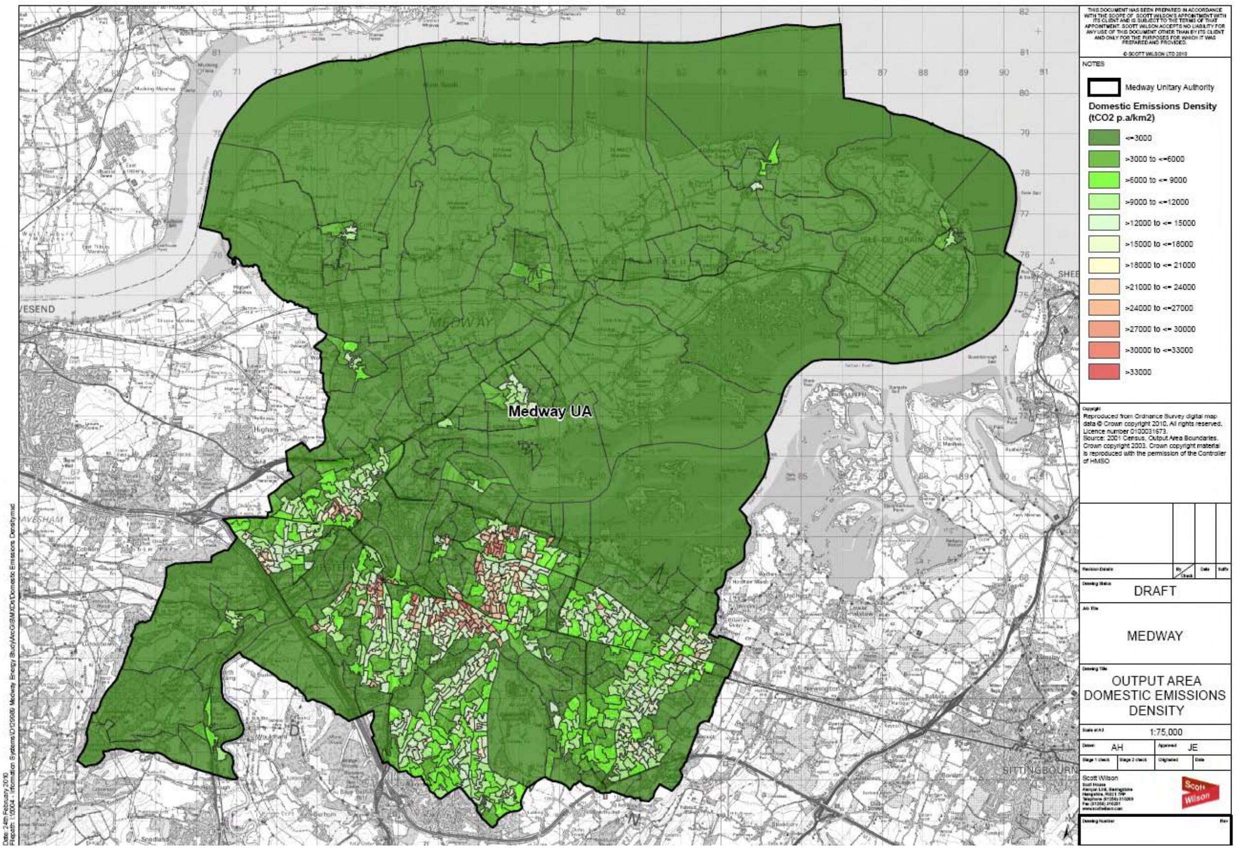


Figure 3.6: Output Area Domestic Emissions Density

The above figure illustrates both the rural nature of the Hoo Peninsula and the urban centres in the southern half of the UA area.

3.5 Emissions Projections

As a core element of this study, Scott Wilson has carried out carbon emissions projection modelling for the period until the end of 2026. Using DECC energy consumption information as the starting point for analysis, the level of impact on the different policy options for energy is investigated. It must be noted that in contrast to NI186 emissions figures (which adopt different year on year emissions factors that reflect historic generation fuel mix), the analysis contained within this section adopts Part L2A (2006) emissions factors, and hence the base figures for emissions differ somewhat from the NI186 figures shown above.

3.5.1 Domestic Emissions Scenarios

We have modelled three policy scenarios, equivalent to minimum Government Standards (Option 1), an accelerated timetable of imposition of Government standards (Option 2), and a third option which is more ambitious in its aspirations, imposing zero carbon standards even earlier than under Policy Option 2. The three scenarios are represented by the following timetables of Code for Sustainable Homes Levels:

CFSH Levels	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Option 1	0	3	3	3	4	4	4	6
Option 2	3	4	4	4	5	5	6	6
Aspirational standards	3	4	5	5	6	6	6	6

Table 3.3: Modelled CSH scenarios

3.5.2 Housing Projections

Drawing on information provided from the Council database, Scott Wilson has compiled the following projections of housing numbers for the plan period. This summary has been used to assess the impact of the policy options outlined above.

	Total new housing numbers	Strategic Sites - breakdown			Total developments minus large sites
		Chatham Centre and Waterfront	Lodge Hill/ Chattenden	Rochester Riverside	
Completed 2006/2007 - 2008/2009	2266	113	n/a	n/a	2153
2009/10	1000	0	0	0	1000
2010/11	577	0	0	0	577
2011/12	1104	50	100	50	904
2012/13	1374	75	200	100	999
2013/14	1685	100	300	150	1135
2014/15	1643	150	300	200	993
2015/16	1408	175	300	200	733
2016/17	1346	175	300	200	671
2017/18	1135	150	300	200	485
2018/19	975	150	300	200	325
2019/20	915	150	300	200	265
2020/21	887	150	300	200	237
2021/22	775	150	300	200	125
2022/23	676	150	300	100	126

	Total new housing numbers	Strategic Sites - breakdown			Total developments minus large sites
		Chatham Centre and Waterfront	Lodge Hill/ Chattenden	Rochester Riverside	
2023/24	475	150	300	0	25
2024/25	365	65	300	0	0
2025/26	347	47	300	0	0
2026+	800	0	800	0	0

Table 3.4: Housing projections over plan period

Medway's latest Annual Monitoring Report (2009) states that 3,811 net additional dwellings were built in the authority between 2001 and 2007. In the next 5 years it is predicted a further 5,970 will be completed, with 1,487 in the following 5-year period and 917 in the five years after that.[29]

3.5.3 Domestic Emissions Projections

Given the policy scenarios and housing build projections outlined above, the following domestic emissions scenarios have been modeled.

[29] DRAFT SHMA, 2009

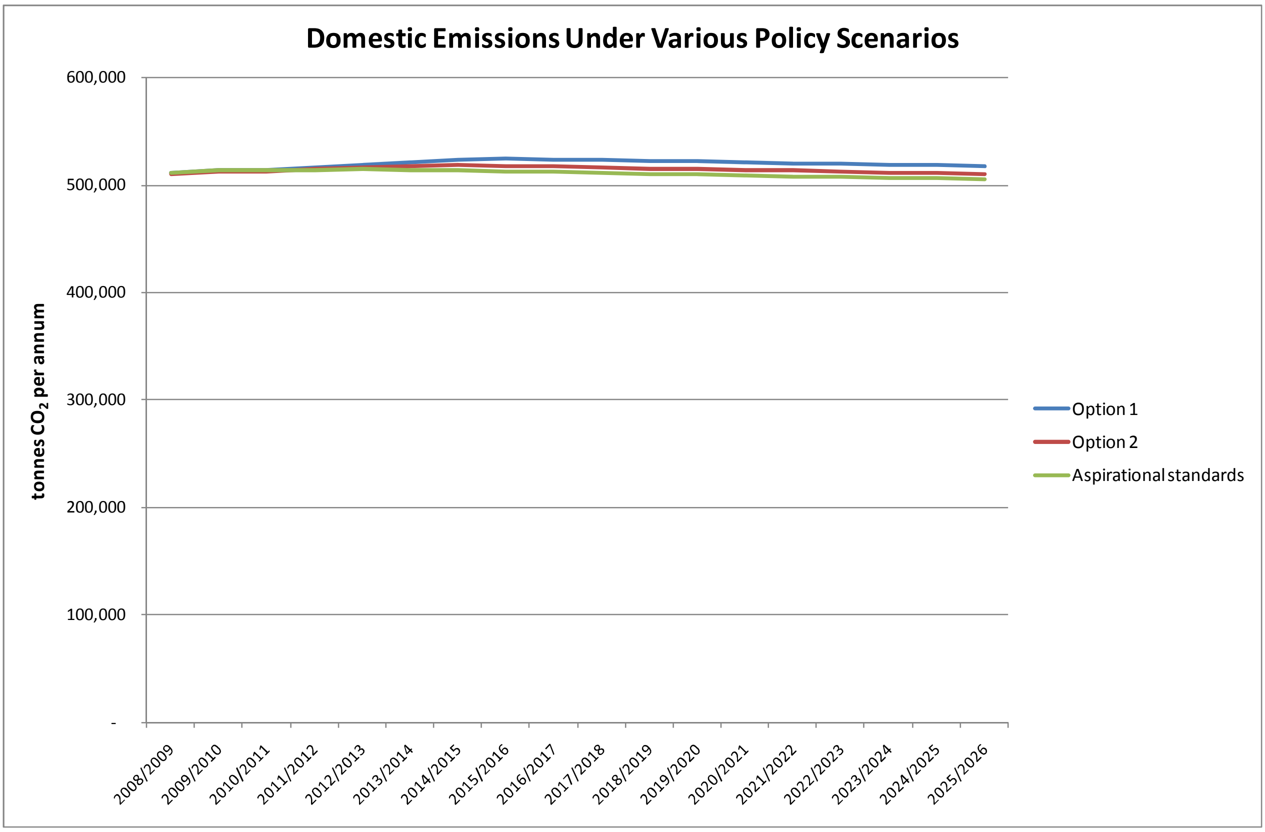


Figure 3.7: Domestic emissions projections under various policy scenarios

This graph is a key finding of this study. It illustrates the degree to which the acceleration of the imposition of standards will impact overall sector carbon emissions.

It must be noted that these modelling results represent a scenario where all new homes projected to be built are subject to the emissions requirements of the policy scenarios, rather than introducing a policy size threshold level above which more challenging environmental targets would be implemented,[30] or distinguishing between the strategic sites and non-strategic site new-build elements .

3.5.4 Commercial / Industrial Policy Scenarios

We have modelled three policy scenarios as for the domestic sector, equivalent to minimum Government Standards (Option 1), an accelerated timetable of imposition of Government standards (Option 2), and a third option which is more ambitious in its aspirations, imposing zero carbon standards even earlier than under Policy Option 2. The three scenarios are represented by the following timetable:

[30] A minimum number of 10 dwellings often constitutes a large development to which renewable energy policy targets apply.

	% reduction in emissions from….	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020
Option 1	regulated energy	0%	25%	25%	25%	44%	44%	44%	100%	100%	100%	100%
	non-regulated energy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Option 2	regulated energy	25%	44%	44%	44%	100%	100%	100%	100%	100%	100%	100%
	non-regulated energy	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%	100%
Aspirational standards	regulated energy	44%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	non-regulated energy	0%	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%

Table 3.5: Non-domestic emissions reductions by policy options

3.5.5 Commercial/ Industrial New Build Rates

The projections for Commercial / Industrial uses have been derived from the Strategic Land Availability Assessment[31] and the Annual Monitoring Report 2009. These documents give periods of anticipated development (e.g. 2014 – 2016), but in order to conduct an annual assessment of the impact of bringing national policy targets forward, the annual anticipated build-out rates for this sector have been derived by evenly spreading the period totals across each year (e.g. if total = 900m^2 over the 3 years of 2014 to 2016, then the modeling assumes 300m^2 in each year).

The following totals for future employment uses (Use Classes Order types B1, B2, B8) and retail (A1, A2, A3, A4 and A5) have been assumed.

Square metres of development	B1	B2	B8
Employment uses (m^2)	203,775	358,180	363,205

Table 3.6: Employment projections (total to end of plan period)

[31] Medway Strategic Land Availability Assessment (SLAA) – Draft Methodology and Project Plan, December 2008

Square metres of development	A1	A2	A3	A4	A5
Retail uses (m^2)	101,997	18,465	18,780	6,821	324

Table 3.7: Retail projections (total to end of plan period)

The existing baseline energy consumption figures for the existing Commercial and Industrial sectors have been derived from DECC statistics[32].

3.5.6 Commercial Emissions Projections

Given the policy scenarios and commercial / industrial build projections outlined above, the following emissions projections have been developed:

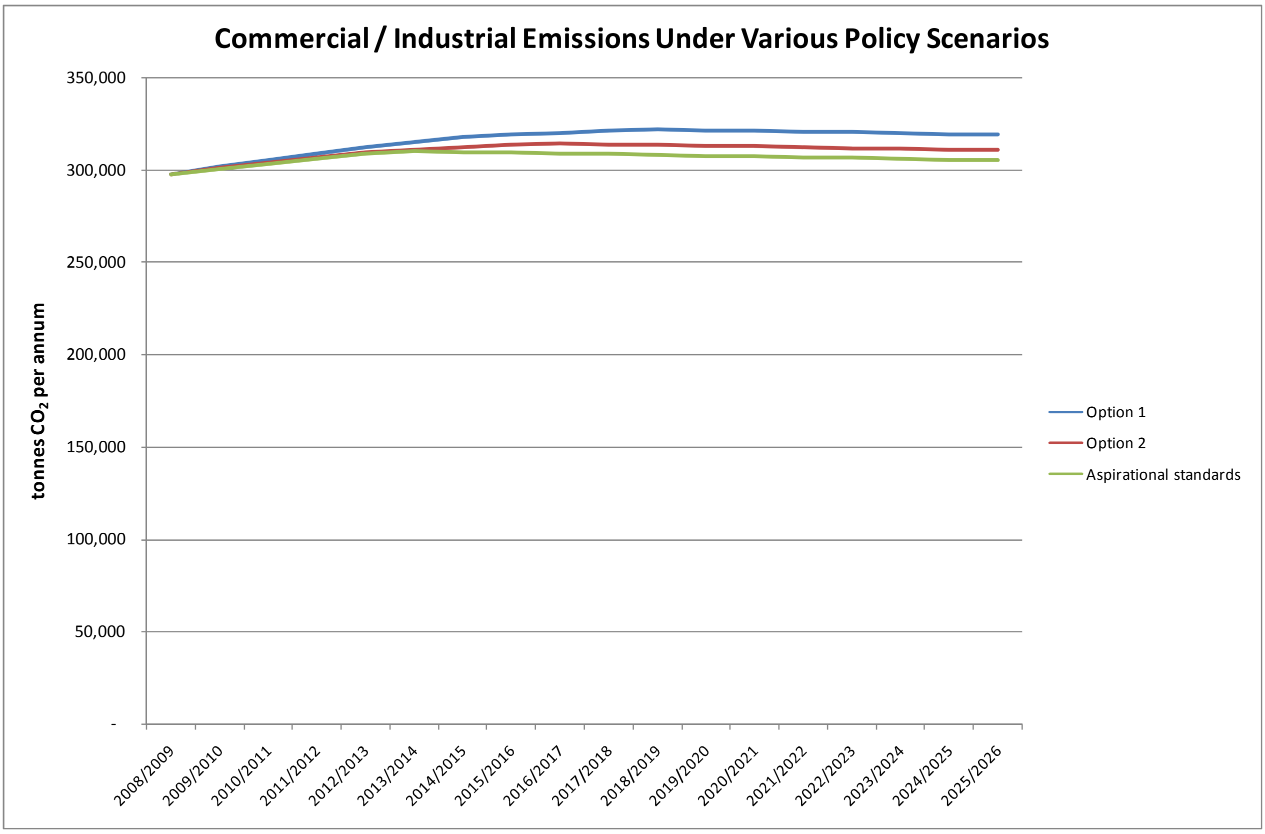


Figure 3.8: Commercial emissions projections under varying policy scenarios[33]

[32] Publication URN 10D/487A, DECC.
[33] Please note that these emissions have been calculated from energy consumption projections and emissions factors. The emissions factors that have been adopted in calculation are those from the Building Regulation Approved Document Part L2A (2006).

3.6 Implications for Policy

The figures above for domestic and commercial emissions projections illustrate clearly that there is only a **limited level of impact on overall building stock emissions that new-build policy can make**. If the overall goal of Medway's policy framework is to reduce global carbon emissions, then this analysis strongly points towards the need for measures that target the emissions of existing buildings as well as new constructions.

These figures differ from those used in the NI186 methodology, which reflect the actual recorded national generation mix. Projection of the generation mix into the future is beyond the scope of this report and hence fixed figures have been adopted.

4 Constraints & Opportunities Analysis

4.1 Introduction

This section provides an analysis of low carbon and renewable technologies within Medway: it reviews existing energy studies relevant to Medway specifically or the South East generally and assesses the renewable energy potential across Medway with respect to:

- Wind
- Biomass, including Energy from Waste
- Solar
- Hydropower
- Heat pumps

The section also investigates specific opportunities for implementing renewable energy within the Strategic Sites agreed upon with Medway Council, testing the implications of different onsite renewable energy generation targets (10%, 25% and 35%) and Code Levels.

4.2 Electricity Distribution Network

Medway's power generating capacity, using conventional resources, is of national significance, as is the supply it provides for gas central heating. Some of that capacity needs to be replaced to meet EU emissions targets and a decision is awaited on the proposed replacement coal station at Kingsnorth.

Despite some progress in developing generating capacity from renewable resources, all evidence points to a national energy gap around 2014/15. Medway is therefore certain to remain a focus for new or replacement generating capacity.

It is increasingly likely that new conventional capacity will be tied to carbon capture and storage technology being fitted and this would require a pipeline network to depleted North Sea gas fields. There is also an exceptional opportunity to re-use waste heat through a district heating grid and a replacement Kingsnorth station alone could meet the needs of the equivalent of 100,000 homes.

The UK, however, does not have a tradition of district heating and retrofitting a pipe network would be a substantial undertaking. New legislation would be required to give a provider the same powers to install a network as other utility companies. Yet, despite the difficulties, Medway could be the focus for an initiative of national importance. An essential first step would be to require new developments to install a heating grid and this is a role for the Core Strategy.

A network distribution map for Medway has been provided in Appendix B: Electricity Distribution Infrastructure in Medway.

4.3 Kingsnorth District Heating Study

Kingsnorth Power Station is located on the Hoo Peninsula within Medway Unitary Authority. The operators, E.ON UK are planning to replace the existing coal-fired power station with a new facility that would comprise two units of 800MWe capacity each. E.ON commissioned a report in 2008 to assess the feasibility of developing a district heating network with the new power station as the primary heat source[34].

Several scales of district heating network were investigated, ranging from local schemes supplying the Chattenden development only, to a large scheme supplying the Medway Towns and development in Gravesham and Dartford. None of the schemes analysed were found to be economic against E.ON's financial criteria. However, the least negative NPV was found for a scheme which was for the supply of heat to the Medway Towns only. Further, it was also shown that the implementation of district heating could be viable in certain circumstances – e.g. with energy price fluctuations and taking into account the value of carbon emissions saved.

It is important to note that the District Heating feasibility study takes account of the potential development at Lodge Hill, Chattenden, and that this strategic site's contribution towards improving the economics of a district heating scheme linking Kingsnorth with the Medway Towns has been assessed.

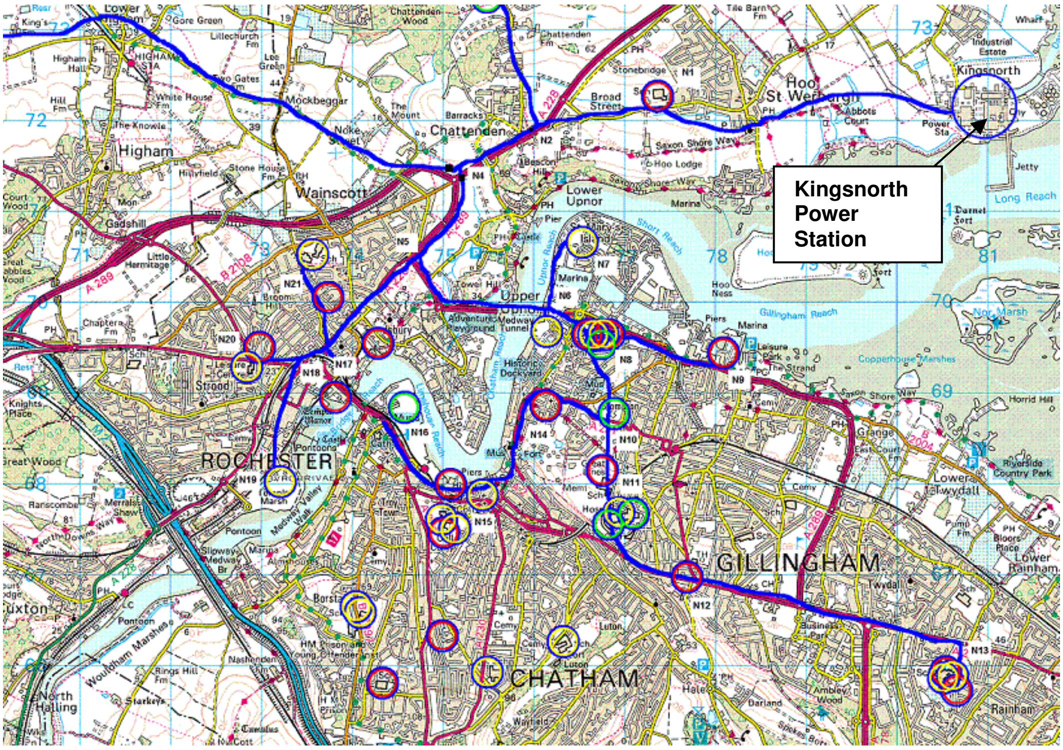


Figure 4.1: Location of Heat Demand

[34] Kingsnorth District Heating Opportunity Feasibility Study, Faber Maunsell, March 2008.

The key aspect of this study to note is that there is a swiftly changing political / policy backdrop against which technologies such as district heating must be assessed. It is Scott Wilson's recommendation that should the cost of heat or the value of carbon savings increase through national policy interventions, the viability of the connection to Kingsnorth should be reassessed. The timescale of development of Lodge Hill, Chattenden is important to bear in mind in this context, as this site forms an important 'stepping stone' in the linkage between Kingsnorth and the wider urban areas of Medway.

4.4 Renewable Energy Potential in Medway

The South East Plan sets out the regional targets that flow from those set out nationally. Over the period to 2026, the region needs to progress from 5.5% of total electrical generation coming from renewable sources to 16%. This will require, by 2010, 620 MW of installed capacity increasing to 1,750 MW by 2025. Medway is not disaggregated from Kent in the South East Plan but Policy NRM 14 requires Kent and Medway combined to have a land-based renewable energy capacity of **111 MW in 2010** and **154 MW by 2016**, as illustrated in Figure 4.2.

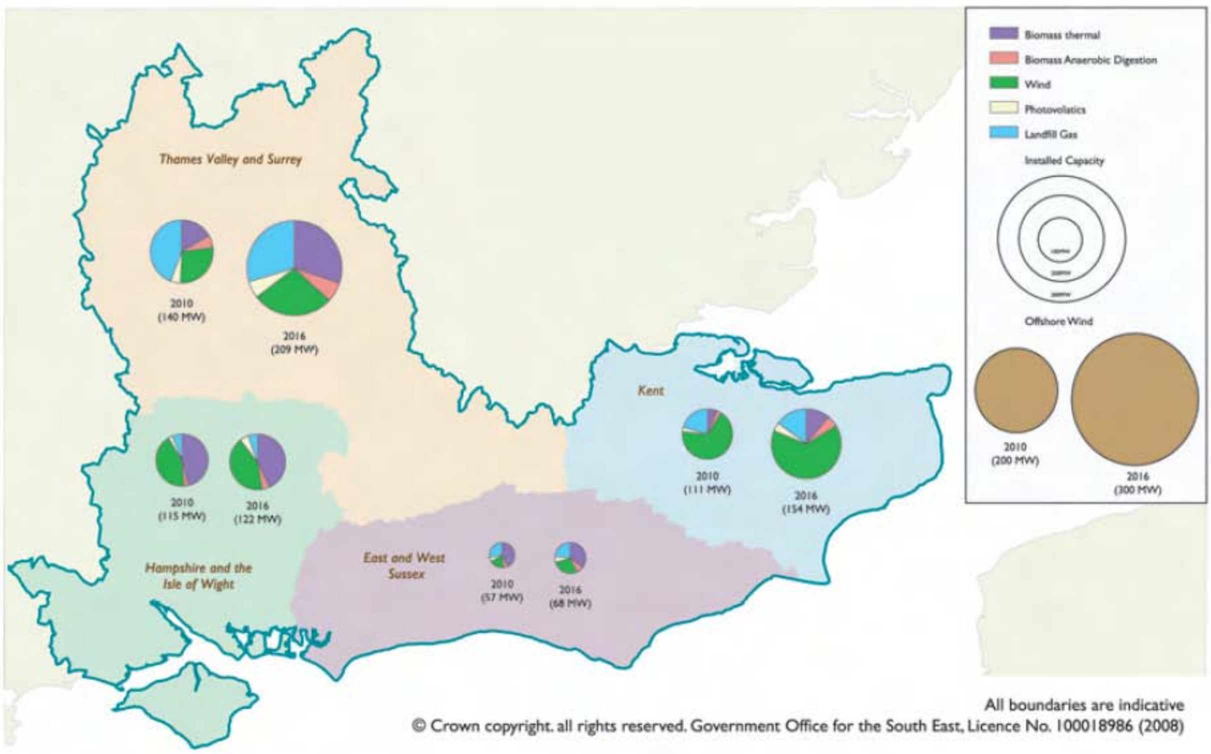


Figure 4.2: Indicative sub-regional renewable energy potential 2010-2016 (Diagram NRM4 from the South East Plan).

Medway has a carbon dioxide per capita emission of 4.9 tonnes per annum. Most of this comes from the domestic market, with the Industrial and Commercial sector also a significant contributor. The least comes from road transport (see Figure 3.1).

The remainder of this Chapter explores the low and zero carbon energy potential in Medway, broken down into the different technologies. We have followed the methodology outlined in the latest Defra guidelines, titled *Renewable and Low Carbon Energy Capacity Methodology*. For each technology, there are three sections;

- An introduction, describing the technology;
- A district-wide opportunity analysis that includes Stage 1 – Naturally Available Resource and Stage 2 – Technically accessible resource of the Renewable and Low Carbon Energy Capacity Methodology; and
- A district-wide constraints analysis that includes Stage 3 – Physical Environment Constraints and Stage 4 – Planning and Regulatory Constraints of the Renewable and Low Carbon Energy Capacity Methodology.

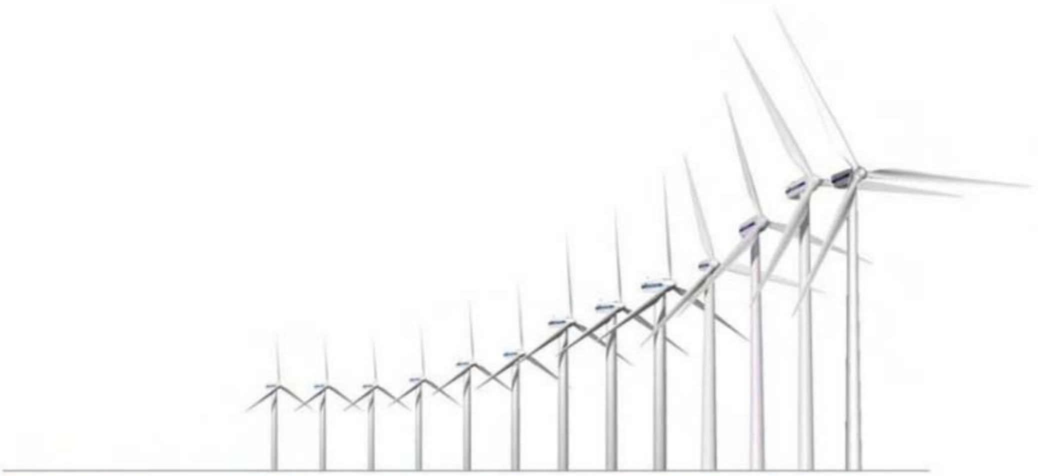
4.4.1 Wind Energy Potential

On-shore (commercial scale)

Introduction

Wind turbines convert a proportion of the power in wind into electricity via a generator. There is a wide variety of wind turbines with different power capacities. Generally, the larger the turbine the more power it is able to generate. Commercial scale wind refers to on-shore wind farm developments for commercial energy generation and supply. Most such developments are connected to the grid, however, private-wire schemes are also an option and some already exist. Configurations of groups of wind turbines or individual ones are used.

Assessing the resource potential and the deployment opportunities relates primarily to the wind speeds available within the region and the ability of current technology to harness this resource in terms of turbine design (size, efficiency) and installation requirements. Figure 4.3 below shows the size and power of a range of Vestas wind turbines. The largest turbine, the V90, is able to generate up to 9,152 MWh/year, which is enough to supply the electrical demand for approximately 2,000 homes.



Product/Rotor diameter (m)	V15	V17	V19	V20	V25	V27	V39	V44	V47	V52	V66	V80	V90
Year of installation	1981	1984	1986	1987	1988	1989	1991	1995	1997	2000	1999	2000	2002
Capacity (kW)	55	75	90	100	200	225	500	600	660	850	1750	2000	3000
MWh/year	217	265	301	346	481	647	1304	1581	1947	2530	4705	6768	9152

Vestas Turbine evolution

Figure 4.3: Turbine Capacity and Output

Wind Speed Review

The following GIS representation provides a summary of wind speeds in Medway UA at 45m above ground level.

Opportunity analysis

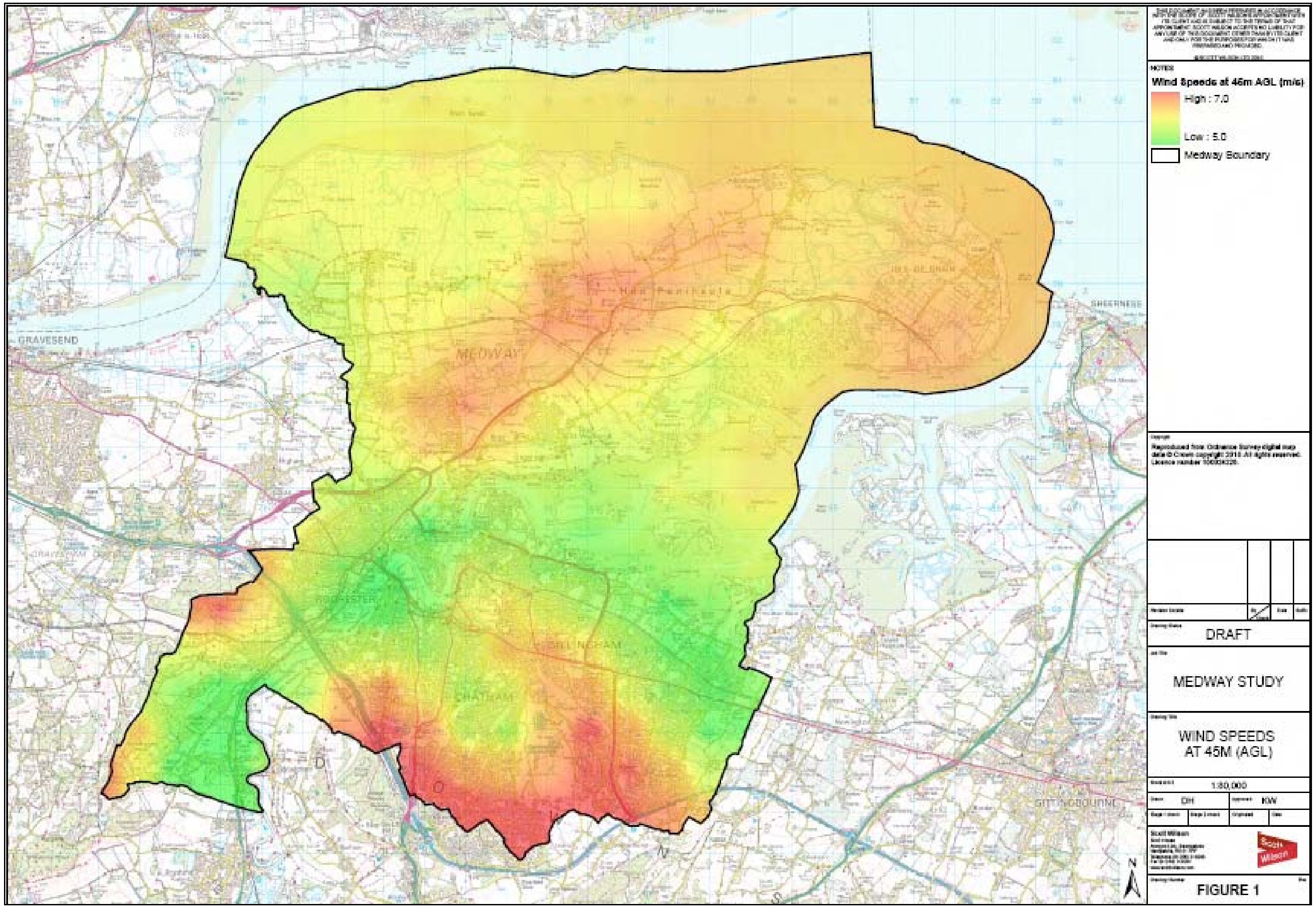


Figure 4.4: Assumptions for large scale wind resource at 45 m above ground under an unconstrained land scenario.

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

See GIS constraints and opportunities evaluation below:

Parameter description	Data
Total area in Medway with wind speeds **above 5 m/s**	192 km^2
Wind turbine density	9 MW/km^2

Given the assumptions above, the theoretical potential installed capacity in Medway from wind is **1,728 MW** (1.7 GW).

Constraints analysis

The figure below shows all the different constraints for large scale wind superimposed onto a single GIS map. Some of these constraints are critical, rendering installation of large scale wind impossible, some mean that installing large wind on those sites would have an additional difficulty, but it would still be possible.

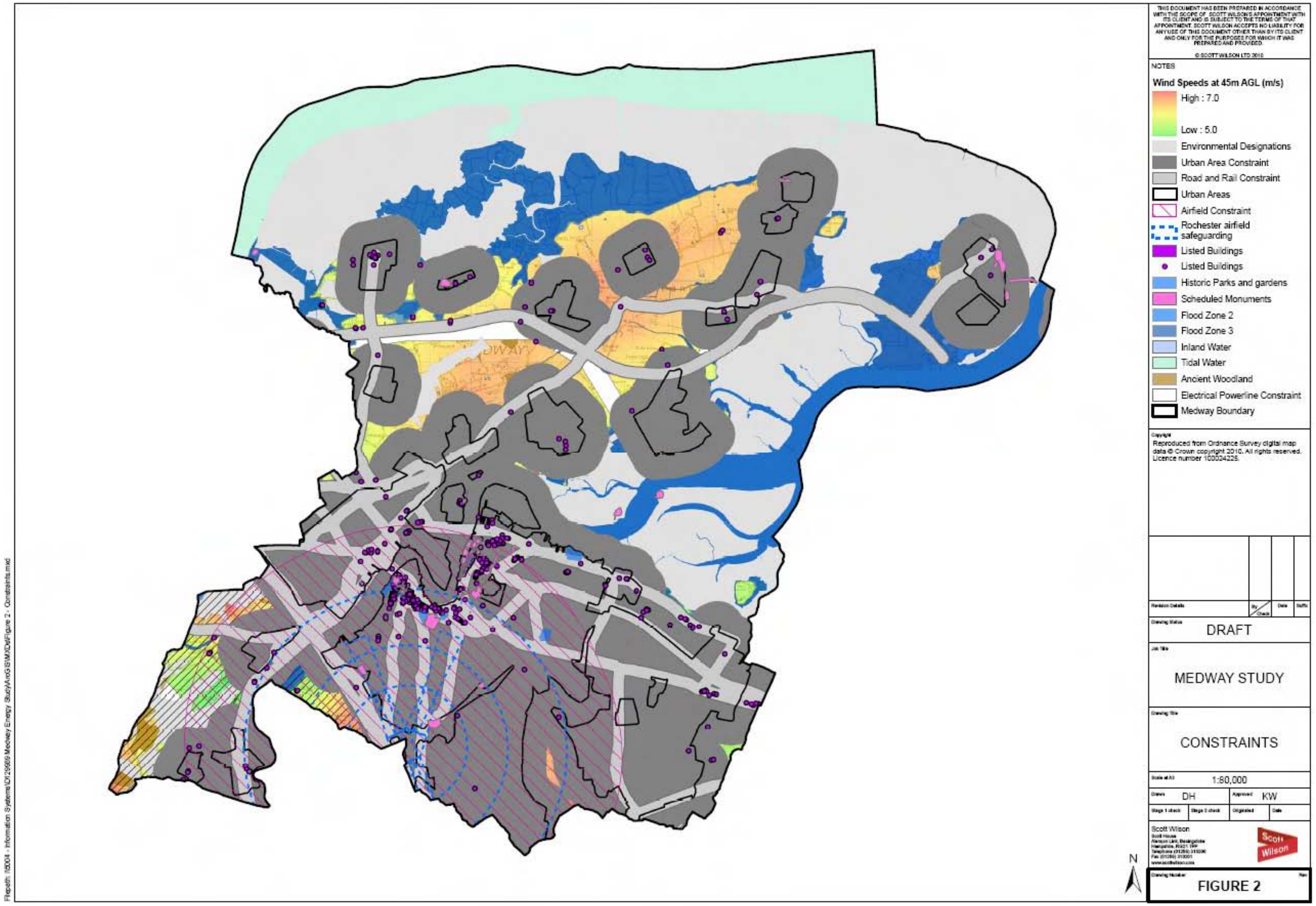


Figure 4.5: Constraints and opportunities overlaid via GIS in Medway

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

- Non-accessible areas, such as roads, railways, level crossings, inland waters, built-up areas, airports and MOD training sites;
- Exclusion areas, such as ancient semi-natural woodland, sites of historic interest, buffers around roads and rail lines, buffers around build-up areas, buffers around airports and airfields, Civil Air Traffic Control constraints, MOD training areas and explosive safeguard areas;
- Designated landscape and nature conservation areas; and
- MOD constraints, such as MOD sites, air defense and air traffic control radar, other safeguarded areas, danger areas and MOD byelaws.

Parameter description	Data
Total unconstrained area in Medway with wind speeds above 5 m/s at 45 m above ground	30 km^2
Wind turbine density	9 MW/km^2

Following an assessment of all constraints, the actual potential for wind capacity in Medway is **270 MW** the area available as illustrated in the GIS figure below.

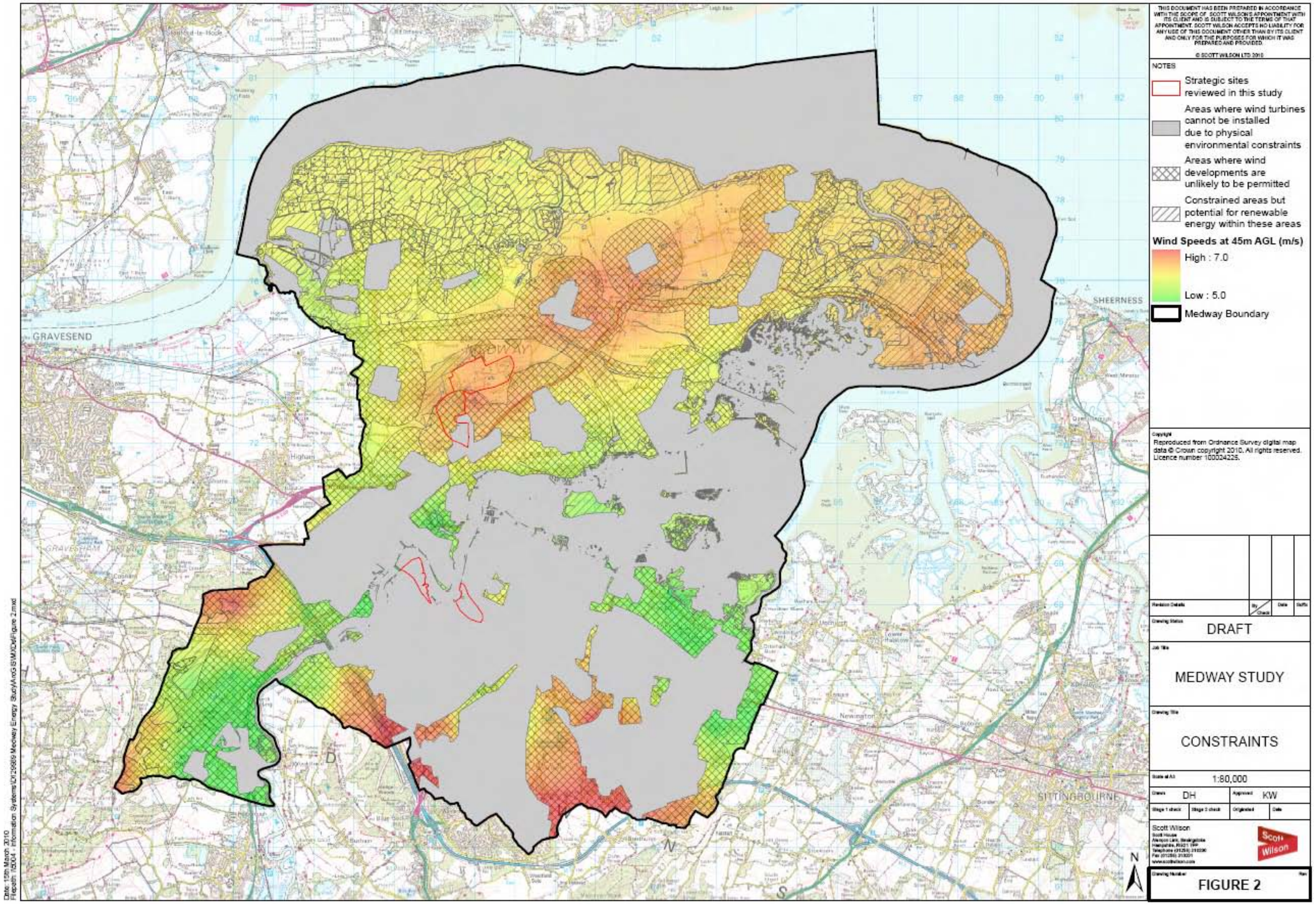


Figure 4.6: Areas in Medway constrained for large wind

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

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

On-shore (small scale)

Description of the technology

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

The majority of small scale wind installations are ground-based developments with only few that are building integrated (on top of roofs). Small scale ground-based turbines are viable at lower wind speeds. They are typically installed on-site and supply the on-site demand first, before exporting to the grid. This means that they need to be located near the built-up areas, extending the deployment of wind capacity into areas where large developments are likely to be significantly constrained. The number of small wind installations is in practice a function of the number of buildings or sites and not deployable on a per km^2 basis.

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

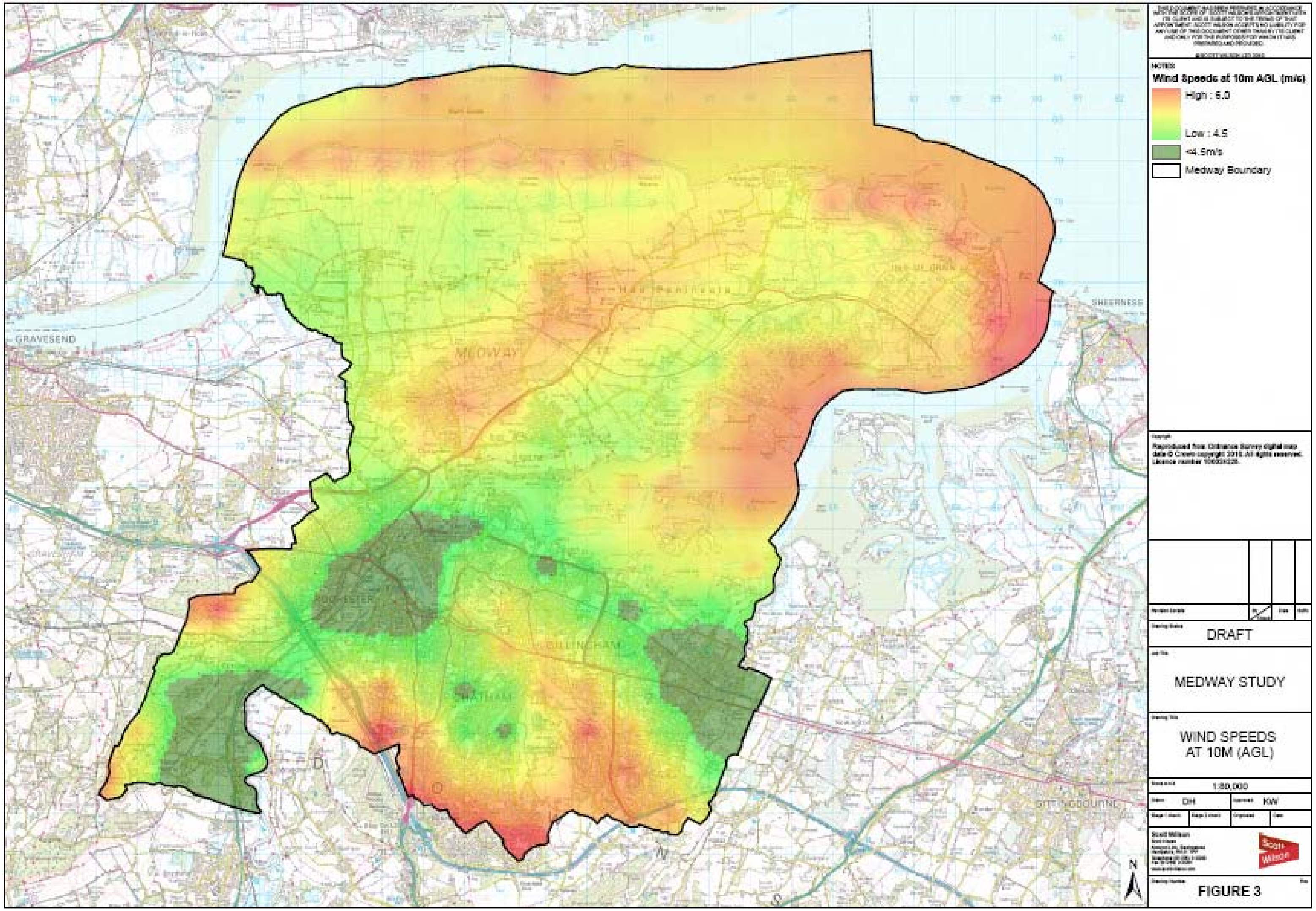


Figure 4.7: Wind speeds above 5 m/s in Medway

Assuming areas with wind speeds greater than 5.0 m/s are suitable for small wind (shown in Figure 4.7 above), a density of 5 dph (taking into account a mix of spaces, including non-residential floorspace and large non-built-up areas) and a turbine rated output of 2 kW, the following results have been obtained:

Parameter description	Data
Total area with wind speeds greater than 5.0 m/s at 10 m above ground	171 km^2
Total number of dwellings with average wind speeds above 5.0 m/s at 10 m above ground	85,665
Wind turbine size (installed capacity per turbine)	2 kW

Based on the assumptions above the theoretical potential installed capacity from small scale wind in Medway is **171 MW**.

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

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

4.4.2 Biomass Resource Potential

Description of Biomass Fuel

According to DECC guidance, biomass is a diverse category with regard to the type of available fuels, fuel conversion technology and type of energy output.

Fuels

Different fuel categories have been used in the literature and a single agreed categorisation is still difficult to identify. The EU Renewable Energy Directive and the UK Biomass Strategy provide more comprehensive, and, in fact, legally binding definitions for biomass fuels.

Fuels fall under three broad categories depending on their source;

- Plants (woody or grassy)
  - **Virgin wood** - Wood can be derived from conventional forestry practice, such as thinning and trimming, as part of sustainable management of woodland. It can also be derived from tree surgery operations and the management of parks, gardens and transport corridors. The wood can come in a range of physical forms such as bark, logs, sawdust, wood chips or wood pellets.

  - **Energy crops** - Energy crops are grown specifically for use as fuel and offer high output per hectare with low inputs. The main type of energy crops is short rotation coppice such as willow, or forestry species such as eucalyptus or poplar. Poplar and willow are the most popular crops with an achievable yield of around 8 tonnes per year.

  - **Agricultural residues** - Agricultural residues are of a wide variety of types, and the most appropriate energy conversion technologies and handling protocols vary from type to type. Sources can include arable crop residues such as straw or husks, animal slurries or organic material from excess production or insufficient market, such as grass silage.

  - **Industrial wood waste** - Some woody material generated as a waste, residue or co-product by manufacturing, processing or other industry may have received some kind of treatment, such as with preservative or stain. This may include construction and demolition wood wastes, used pallets and waste wood, offcuts and co-products from the manufacture of furniture and other wood products.

- Animals (manure, slurry)
- Human activity (commercial, industrial and municipal waste)
  - **Industrial waste and co-products** - Many industrial processes and manufacturing operations produce residues, waste or co-products that can

potentially be used or converted to biomass fuel. Wood waste can be utilised by a range of thermal conversion technologies such as a boiler for the generation of heat for space heating or process heat, or used for electricity generation in a dedicated system or combined heat and power (CHP) co-generation system.

Conversion Technology

There are three main processes currently available and used:

- Direct combustion of solid biomass;
- Pyrolysis and gasification of solid biomass; and
- Anaerobic digestion of solid or liquid biomass.

Energy Output

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

This section will review in detail any information publicly available to determine the opportunities and constraints for biomass deployment in Medway for the following biomass types:

- Managed woodland
- Energy crops
- Waste wood
- Agricultural arisings (straw)
- Municipal Solid Waste
- Landfill gas
- Sewage gas

Biomass is considered to be a carbon neutral source of energy, as it emits the carbon it had captured during its lifetime. Two considerations that need to be addressed for biomass are air quality issues and storage space. Biomass emits NO_x emissions, therefore biomass boilers are not appropriate for sites in Air Quality or Smoke Management Areas. Further factors that need to be considered are the high volumes of storage space required for wood pellets or chips and easy access of the storage space from the main road for ease of refuelling.

4.4.2.1 Managed Woodland

Opportunity analysis

There is no information publicly available to determine the amount of biomass from managed woodland specific to Medway. Nevertheless, a study undertaken by the Forestry Commission on behalf of Kent County Council, published in March 2010, indicates that total woodland area in Kent is 395 km^2, of which less than 50 km^2 is conifer woodland and at least 10 km^2 have been managed as coppice. This is shown below in Figure 4.8.

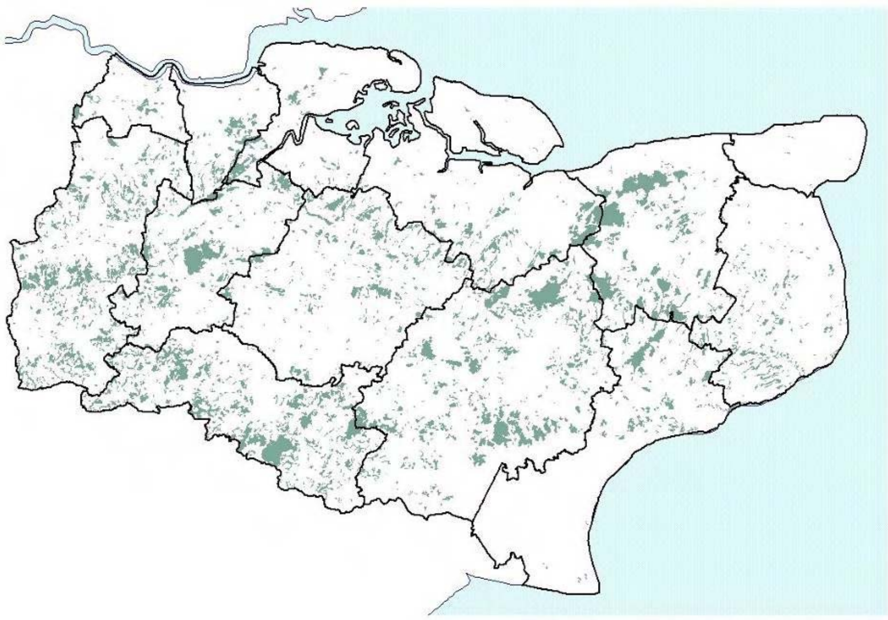


Figure 4.8: Woodland cover in Kent

Managed woodlands are shown in Figure 4.9 below.

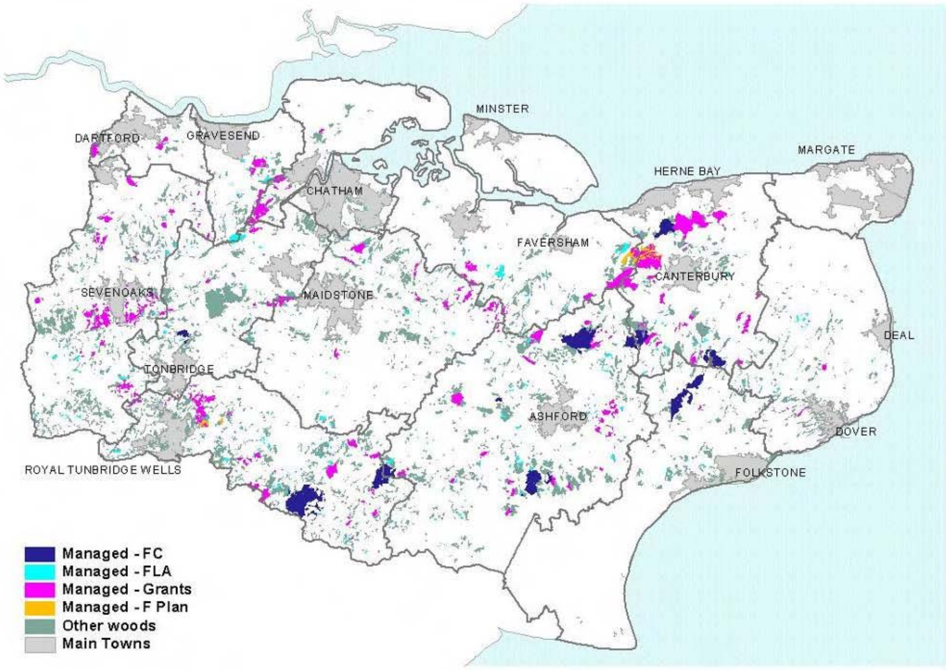


Figure 4.9: Managed woodlands in Kent

A summary of the breakdown of the managed woodland is provided below:

Forestry Commission Woodland	3,540 hectares	The FC actively manages its woodlands, harvesting most of the increment on a sustainable basis. However, the markets for certain crops like sweet chestnut coppice have been poor for some years and there is the potential to harvest slightly more wood sustainably if the market for the produce were available.
'Private' woodland subject to a felling licence	1,500 hectares	While this woodland is 'technically' managed there is potential to sustainably harvest more wood from these woods if the market for the produce were available.
'Private' woodland subject to a current English Woodland Grant Scheme	6,900 hectares	
Private woodland subject to a long term forest plan	350 hectares	
Remaining woodland area	27,200 hectares	There is currently very limited harvesting proceeding. However, the potential exists if the markets become available.
Total woodland area:	**39,490 hectares**	

Following this analysis, the Forestry Commission expect a potential sustainable yield summarised below:

Woodland type:	**Area**	**Estimated potential growth per hectare per year**	**Estimated potential growth per year**
Conifer	4,540 hectares	8 m^3	36,320 m^3
Broadleaved	23,660 hectares	4 m^3	94,640 m^3
Coppice	9,410 hectares	6 m^3	56,460 m^3
Permanent Open Ground (within the wood)	1,880 hectares	0 m^3	0 m^3
Total:	**39,490 hectares**		**187,420 m^3**

Constraints Analysis

The Forestry Commission estimates that it should be possible to attract half of the sustainable yield for use as woodfuel, if the markets become available, i.e., around 90,000 m^3 per year. According to their in-house calculations, this would be sufficient fuel for approximately **90 MW** (thermal) of heating capacity.

A volume of 90,000 m^3 translates into 52,500 odt.[35] At a rate of 6,000 odt per annum for each 1 MW of electricity, the total capacity from managed woodland is **8.8 MW**.

In its report to Kent County Council, the Forestry Commission encourages KCC to:

(a) Lead by example by installing woodfuelled heating systems in appropriate County buildings, a process that has already been started with Kent County Council undertaking the evaluation of opportunities for schools and the installation of the 500kW woodfuelled boiler at Valley Park Community College in Maidstone and the system at Shorne Country Park.

(b) Encourage the use of locally sourced wood as a sustainable fuel in planning guidance and encourage local authorities to do the same.

(c) Provide high quality advice and support to communities and organisations considering installing woodfuel heating systems.

Biomass Pellet and Chip Suppliers

The following illustrates a review of biomass wood fuel suppliers in closest proximity to Medway UA. The inner circle shows the suppliers within a 35 m radius from the centre of Medway and the outer circle at 70 m. Suppliers have been categorized according to the fuel type that they can deliver; wood chips or pellets.

[35] http://www.beacon-stoves.co.uk/wood/wood-as-fuel.shtml

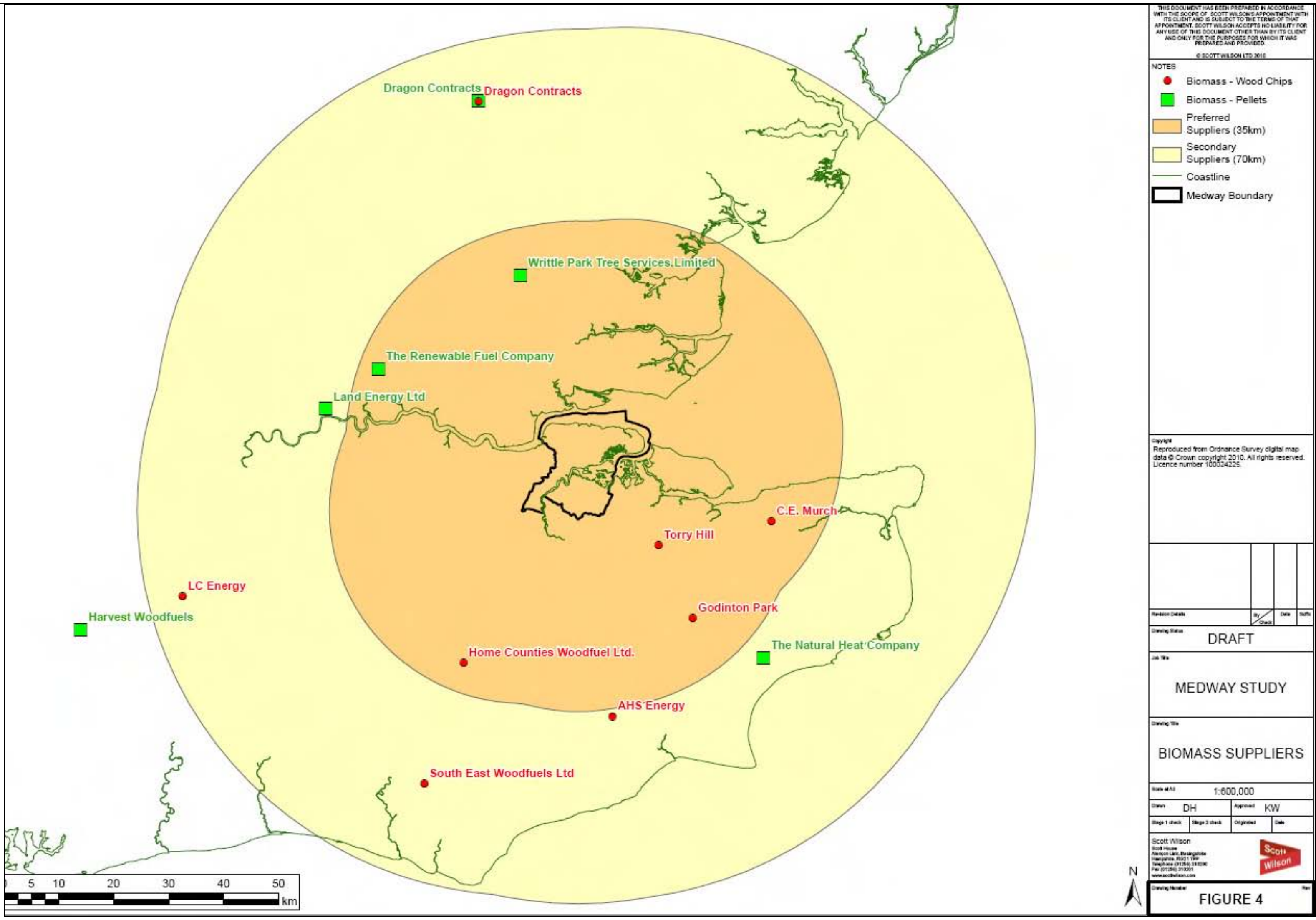


Figure 4.10: Biomass fuel suppliers within 35 km (darker) and 70 km (beige) from the centre of Medway.

4.4.2.2 Energy Crops

Opportunity analysis

There is no information available in the public domain specific to energy crop generation within Medway. The following information is available for the South East region.

Miscanthus:

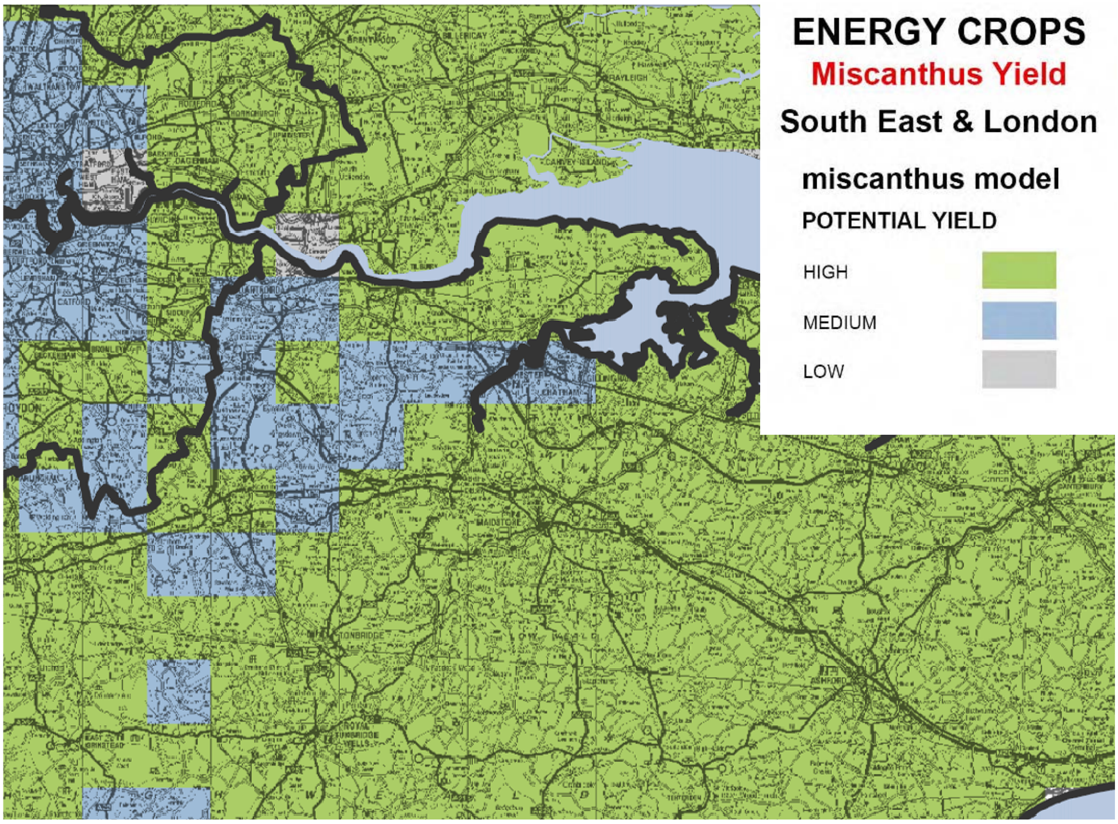


Figure 4.11: Yield Map for Miscanthus in Medway

The above figure from Defra[36] identifies areas where high, average and low miscanthus yields may occur. About 78% of the total area of Medway has been identified as having high potential for yield of miscanthus, mainly on the Hoo Peninsula and the southern parts of the UA. Rochester and Chatham largely being built-up areas, have medium scope for miscanthus.

Assuming most of the land with favourable conditions for miscanthus is likely to also be used for agriculture, infrastructure and buildings, it is likely that no more than 10% could indeed be used for miscanthus. This translates into a total area of 14.9 km^2, i.e., just under 1,500 hectares. At a yield of 15 ODT/ha/year there is a production of 22,500 ODT miscanthus/year.

[36] Maps for Energy Crop potential yields: http://www.defra.gov.uk/foodfarm/growing/crops/industrial/energy/opportunities/se.htm

Electricity: For a standard calorific value of 6,000 ODT/year this translates into **3.8 MW** of capacity from miscanthus potentially generated within Medway.

Heat: For a worst case scenario for a standard calorific value of 12.5GJ/ODT this translates into an **8.9 MW** capacity of heat from miscanthus generated within Medway.

Short Rotation Coppice (SRC):

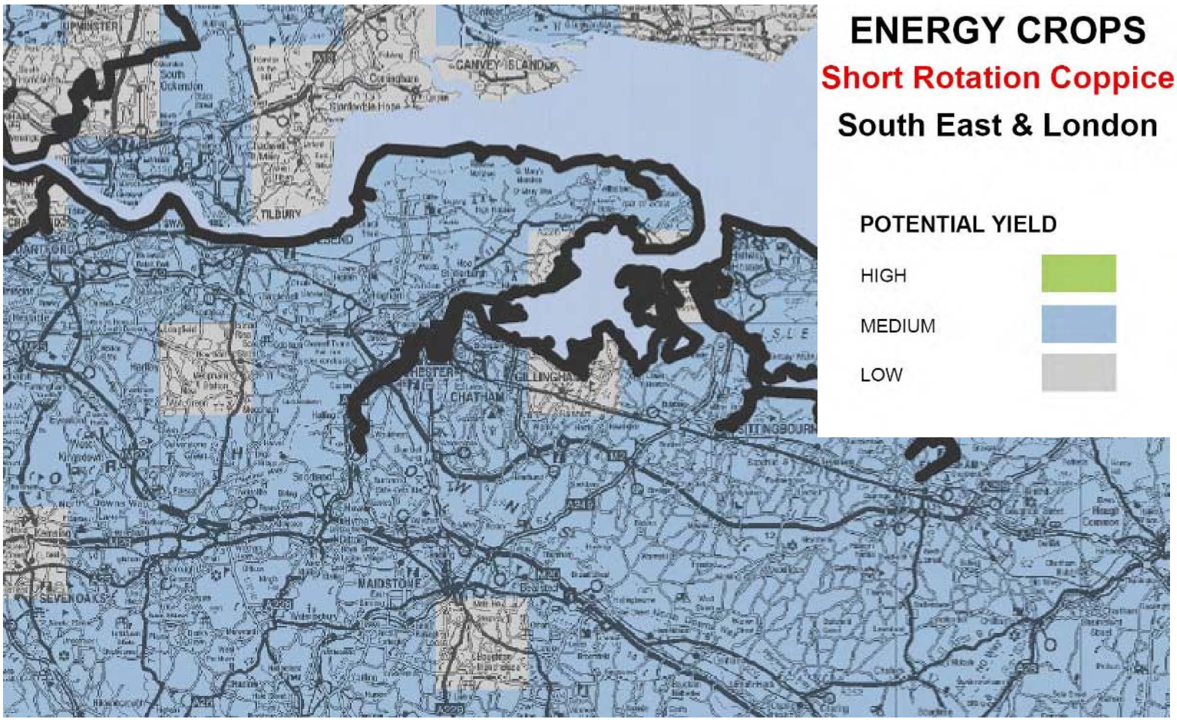


Figure 4.12: Yield Map for Short Rotation Coppice in Medway

The above map from Defra identifies areas where high, average and low SRC yields may occur. The vast majority of the UA, about 95% of it, is classified as having medium potential yield. The main exceptions where potential is limited are in Gillingham and small plots of land on the Hoo Peninsula.

Assuming most of the land with relatively favourable conditions for miscanthus is likely to also be used for agriculture, infrastructure and buildings, it is likely that no more than 10% can be used for SRC. Since SRC is less efficient than miscanthus, it is reasonable to assume that even a smaller proportion of available land will be used for SRC crops, i.e., a percentage of 5%. This translates into a total area of 9.1 km^2, i.e., just over 900 hectares. At a yield of 10 ODT/ha/year there is a production of 9,000 ODT_{SRC}/year.

Electricity: For a standard calorific value of 6,000 ODT/year this translates into **1.5 MW** of capacity from SRC generated within Medway.

Heat: For a worst case scenario for a standard calorific value of 12.5GJ/ODT this translates into a **3.4 MW** capacity of heat from SRC generated within Medway.

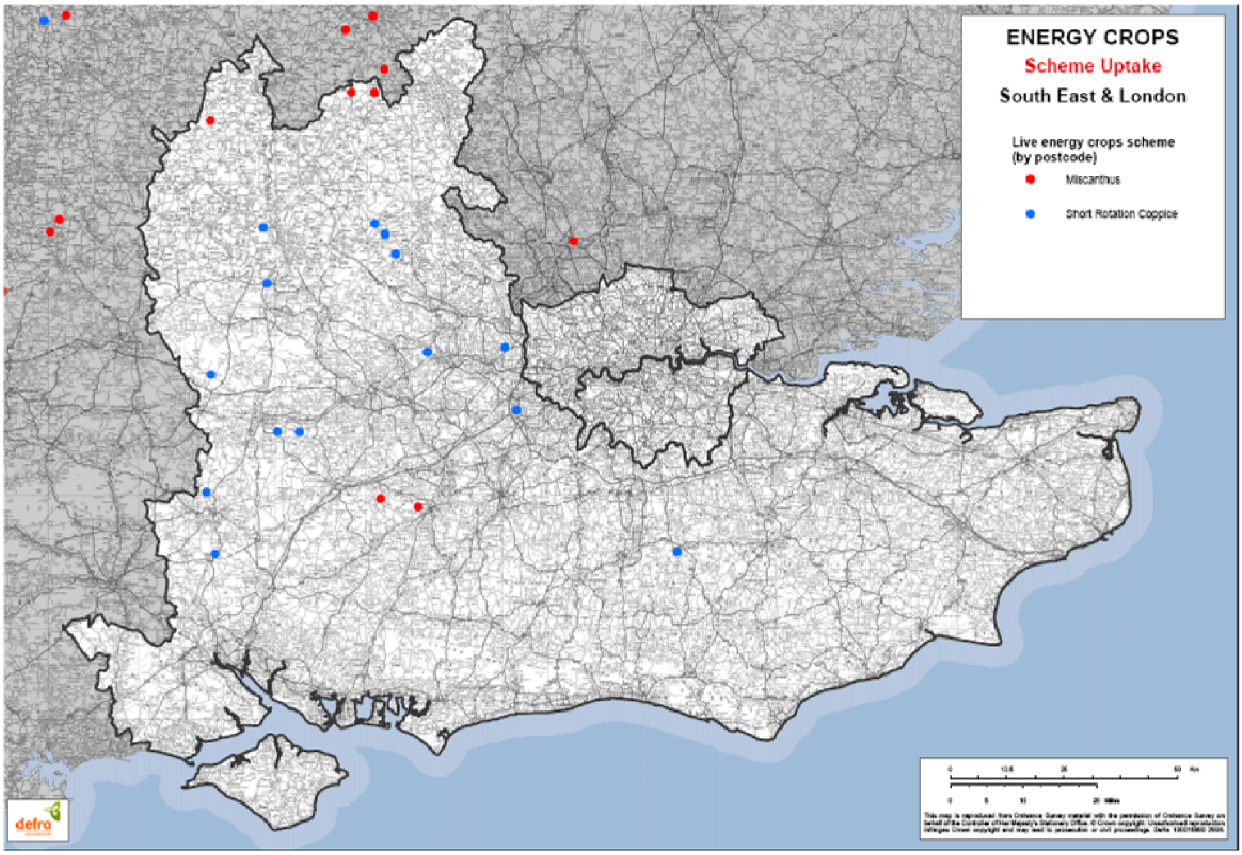


Figure 4.13: Existing Energy Crop Locations

The outputs of the Defra study shown above suggest that there are currently no existing energy crop schemes in Medway (Figure 4.13). There are several limitations to the modelling work carried out by Defra, which have been acknowledged in their study. The model input data includes data on soil types and structure, average rainfall and climatic conditions used to estimate the potential yield of the energy crops. The analysis also used data derived from disaggregation of selected sample studies carried out in the region and therefore locally specific conditions have not been assessed.

The map below from the Forestry Commission identifies areas of existing energy crops, planted under the 2000 – 2006 Energy Crops Scheme. This map allows consideration of opportunities to develop biomass projects and energy supply chains.[28]

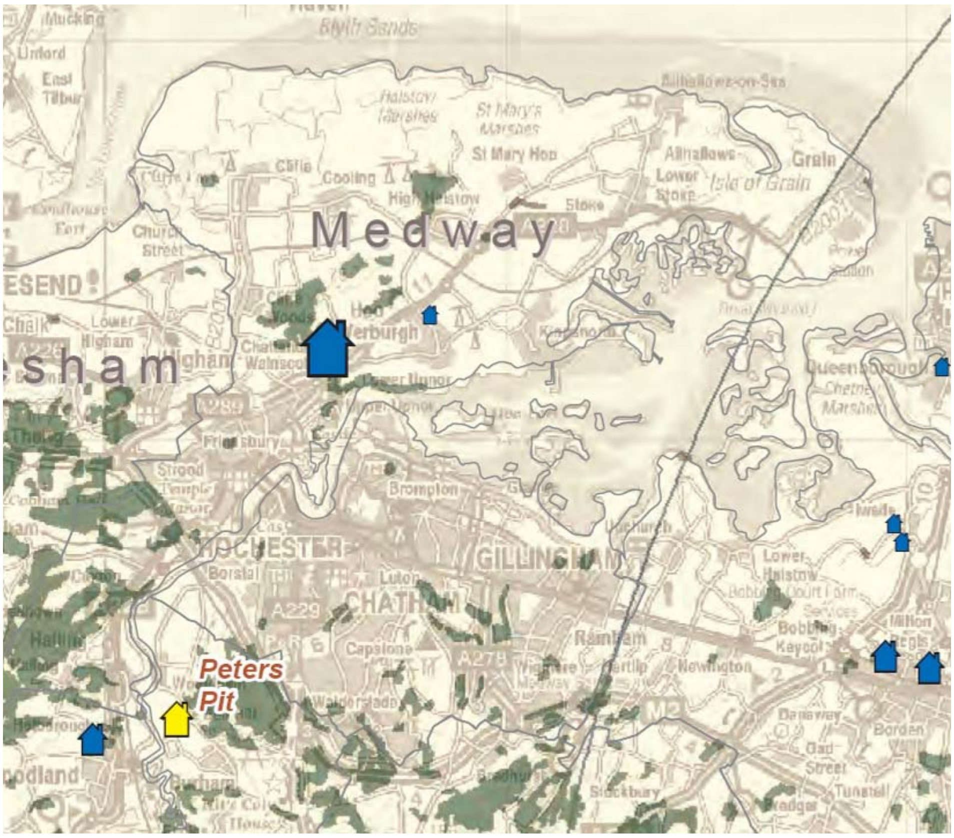


Figure 4.14: Existing energy crop locations

Figure 4.14 above shows the distribution of virgin biomass resource and locations of major waste wood and wood aggregators. These major sites are to the south of Chatham and on the Hoo Peninsula. While specific data is unavailable, biomass is an option that should be further pursued on an individual site basis.

Waste Wood

Opportunity Analysis

Waste wood in the South East is estimated at 850,000 ODT.[37] This translates into a theoretical capacity of **14.2 MW** of electricity and **12.9 MW** of heat generated from waste wood within the South East.

Constraints Analysis

Due to competing uses it has been assumed that only 50% of the total waste wood resource is available for energy. This translates into a capacity of **7.1 MW** of electricity and **6.5 MW** of heat generated from waste wood in the South East.

Agricultural Arisings

Opportunity Analysis

Forest Research has estimated the amount of regional agricultural arisings to be 144,645 ODT. This translates into **24.1 MW** of electricity generated from agricultural arisings within the South East.

Constraints Analysis

We have assumed that 50% of the above resource will be used as feedstock, bringing the amount of electricity generated down to **12.1 MW**.

Municipal Solid Waste (MSW)

Opportunity Analysis

According to Defra's quarterly MSW statistics report, there are 129,350 tonnes of MSW generated in Medway each year. Based on this figure and on the assumption that each 10 kilo-tonne of MSW equates to 1 MW capacity, total capacity in Medway amounts to **13 MW** from Municipal Solid Waste.

Constraints Analysis

There are no significant constraint parameters identified, therefore the figure stands at **13 MW** of energy generated through MSW in Medway.

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

[37] http://www.forestry.gov.uk/pdf/eng-see-3-woodfuel-resources.pdf/$FILE/eng-see-3-woodfuel-resources.pdf

Type of biofuel	Electricity (MW)	Heat (MW)	Reference Area
Managed Woodland	8.8	90	Kent County
Energy Crops – Miscanthus	3.8	8.9	Medway
Energy Crops - SRC	2.3	5.4	Medway
Waste Wood	7.1 *(0.07)*	6.5 *(0.07)*	South East *(Medway)**
Agricultural Arisings (straw)	12.1 *(0.12)*	Not efficient	South East *(Medway)**
Municipal Solid Waste (MSW)	Not applicable	13	Medway

**This is an indicative figure, calculated on an area-based scaling factor of 0.01 (Medway as part of the South East).*

Compared with the South East predicted energy capacity of 111 MW by 2010 and 154 MW by 2016, Medway in terms of its capacity is estimated to contribute **15MW$_e$** and **36MW$_t$.**

4.4.3 Hydropower

Hydropower involves harnessing the power of flowing or falling water through a turbine in order to produce electricity. The parameters determining the amount of electricity produced include the turbine generating capacity, the turbine discharge flow (the water passing through the turbine at any given time, which will change depending on the time of the year) and available head (the vertical distance between the point where the water is at its highest and the turbine). The larger the head, the more gravitational energy can be converted to electrical energy. Hydropower can also be combined with storage (pumped storage), by pumping water from a low elevation to a high elevation at times of plentiful supply of electricity for release when needed.

Hydroelectric schemes are classified into three major categories based on their installed capacities; large hydro; medium hydro; and small hydro schemes. Small hydro schemes are further categorised as mini-, micro- and pico-hydro schemes. The definition of hydro scheme sizes varies from country to country. Table 4.1 below illustrates the classification widely followed in UK.

Scale Description	Installed Capacity
Large hydro	50 MW and above
Medium hydro	5-50 MW
Small hydro*	Below 5 MW
Mini-hydro	500 kW-5 MW
Micro-hydro	500 kW -10 kW
Pico-hydro	Below 10 kW

**Small hydro further categorised into mini-, micro- and pico-hydro.*

Table 4.1: Hydropower classification widely followed in the UK

An analysis at the highest level demonstrates that Medway offers no opportunities for large, medium and small scales of hydro installations due to limited available head and the river flow conditions of the district. However, results from a preliminary feasibility review to explore opportunities for Micro- and Pico-scale installations within Medway are presented below.

<u>Flow data within Medway</u>

The Environment Agency measures the flow rate in most significant rivers and streams in UK, and data from around 1,300 gauging stations can be obtained from ‘Centre for Ecology & Hydrology’ (CEH) in Wallingford or from CEH’s web pages. Medway falls under the Environmental Agency Southern region.

Based on the above list, SW has identified no gauge stations within Medway DC boundaries. However we have identified a nearest up-stream gauge station which provides daily measured long term flow data and flow distribution curve (FDC) for Medway at Teston. The identified FDC of river Medway at Teston is illustrated below.

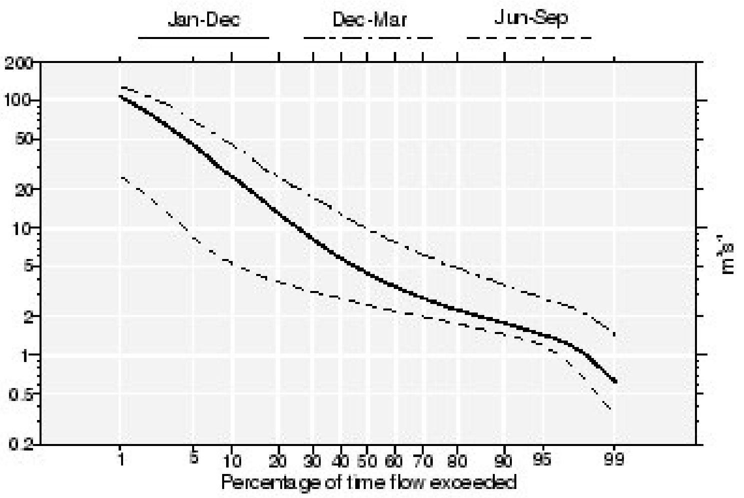


Figure 4.15: Flow Distribution Curve- River Medway at Teston (Gauge Station 40003)

Head

Considering the geography of Medway, the maximum feasible head for a site appears to be in the range of 0.5 m. The lower limit of head is often restricted by turbines that are available in the hydropower industry. Until recently it was thought that schemes with less than 3m head were not economically viable and any sites below 3m head were often called 'ultra low head'. However propeller and Kaplan type turbines now offer minimum head up to 1m.

Compensation Flow

An uncontrolled abstraction of water from rivers & streams for power generation purposes may lead to sections of the rivers/streams suffering from dry conditions. To avoid such conditions, a percentage of the river flow will need to by-pass the hydropower scheme for environmental reasons. In abstraction schemes, where water is diverted from the main course of the river, this percentage flow is termed as compensation flow. Compensation flow is needed to maintain the ecology and aesthetic appearance of the river/stream in the depleted stretch. Compensation flow is also termed as reserved flow, residual flow or minimum environmental flow. Guide to UK mini hydro developments suggests that the amount of compensation flow will depend on site-specific concerns, but a reasonable first estimate will lie between the Q_{90} and Q_{99} values of river flow. In the above example (Teston gauge station), the compensation flow could be circa 1.9 m^3/s (Q_{90} flow from FDC above), however for any hydropower development this figure should be agreed with the Environmental Agency.

Available flow

British hydro power association's guide to mini hydro installation states that:

It is unlikely that schemes using significantly more than the mean river flow (Q_{mean}) will be either environmentally acceptable or economically attractive. Therefore the turbine design flow for a run-of river scheme (a scheme operating with no appreciable water storage) will not normally be greater than Q_{mean}. The exception would be a scheme specifically designed to capture very high winter flows, which is very rare in mini-hydro applications.

In this model, SW therefore assumed the mean flow at Teston (10.9 m^3/s) as the design flow and 1.9 m^3/s as the allowed Q_{90} compensation flow. Although the model discussed in this example can be used to illustrate the generic level of hydro power potential within Medway DC, It should be also noted that different project locations will have different flow conditions based on several factors such as evaporation rate, soil conditions, catchment area, upstream water abductions and diversions, etc.

<u>Opportunities within Medway</u>

The results indicate that although ample flow conditions exist, due to the poor net available head of the region, even 'ultra low head' schemes would not be viable within Medway using impulse or reaction turbine types. It should be also noted that the Thames Valley Energy study in 2004 has identified no low head sites within Medway DC. These results are also consistent with The Environment Agency's findings, which identified no opportunity for hydropower in Medway (see Figure 4.16 below).

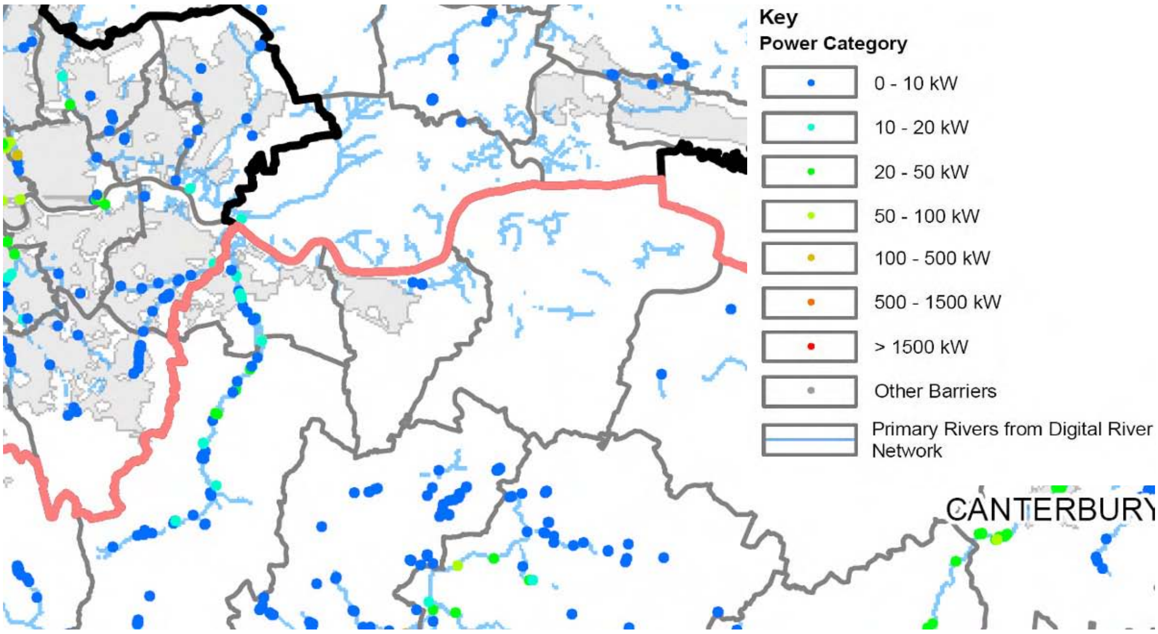


Figure 4.16: Environment Agency map on hydropower potential in the South East.

4.4.4 Micro-generation

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

Micro-generation technologies cover the full range of renewable energy categories: wind, solar, biomass, hydropower and heat pumps. In terms of assessing the regional opportunities and constraints for deployment, some of these categories are already captured in full in the earlier sections of this chapter. Their full potential is not directly constrained by the built environment and more specifically by what can be installed onsite as other deployment options are available, such as off-site or large scale capacity deployment. These categories include biomass and hydropower.

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

4.4.4.1 Solar Water Heating (SWH)

Solar thermal collects heat from the sun to produce hot water. A typical solar collector can generate around 500kWh/m^2/yr. Solar Water Heating (SWH) depends on three site-specific factors:

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

SHW systems are suitable for most domestic buildings, where the biggest potential exists and for some energy-intensive non-domestic buildings. The assessment therefore focuses on the residential building stock.

Assumptions

Description	Proportion of appropriate roof space (%)	Total number of buildings	Capacity per building type (kW)	Capacity (MW)
Existing roof space				
Domestic properties	25%	102,850	2	51.4
Commercial properties	40%	6,697	0	0
Industrial properties	80%	744	0	0
New development				
Domestic properties	50%	16,500	2	16.5
			Total Capacity (MW)	**68**

Following the DECC methodology, the total capacity for Solar Hot Water in Medway is **68 MW**.

Solar Photovoltaics (PV)

Photovoltaic systems produce electricity from sunlight through semiconducting cells utilising the photo-electric effects to generate electrical energy. Photovoltaic panels come in modular panels, which can be fitted to the top of roofs, but other building-integrated panels are also available. Similarly to SHW, solar PV depends on:

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

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

Assumptions

Description	Proportion of appropriate roof space (%)	Total number of buildings	Capacity per building type (kW)	Capacity (MW)
Existing roof space				
Domestic properties	25%	102,850	2	51.4
Commercial properties	40%	6,697	5	13.4
Industrial properties	80%	744	10	6.0
New development				
Domestic properties	50%	16,500	2	16.5
			Total Capacity (MW)	**87**

Following the DECC methodology the potential capacity in Medway from solar Photovoltaics is **87 MW**.

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

4.4.4.2 Heat Pumps

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

- Open loop systems typically pump warmer water up from an aquifer returning it at a lower temperature; these systems tend to be larger and more suitable for commercial buildings.
- Closed loop systems, where liquid circulates through a closed tube put in the ground, which absorbs the ground heat.

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

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

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

Assumptions

Description	Proportion of appropriate roof space (%)	Total number of buildings	Capacity per building type (kW)	Capacity (MW)
Existing stock				
Domestic: off-grid	100%	1,001	5	5.0
Domestic: detached and semi-detached	75%	45,284	5	165.2
Domestic: terraced	50%	43,257	5	112.6
Domestic: flats	25%	12,919	5	18.3
Commercial properties	25%	6,697	100	167.4
New development				
Domestic properties	50%	16,500	5	41.3
			Total Capacity (MW)	**497**

4.4.5 Summary of Renewable Energy Capacity in Medway

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

Technology	Potential Capacity (MW)
Large wind	270
Small wind	171
Biomass – Electric (Waste Wood and Agricultural Arisings)	0.2
Biomass – Heat (Municipal Solid Waste, miscanthus and Waste Wood)	22
Hydropower	0
Solar Hot Water	68
Photovoltaics	87
Heat Pumps	497

The above capacities are indicative only and consideration should be given to the principle of additionality; for example, if all available roofspace in domestic buildings is used for Solar Hot Water, then the capacity estimate for Photovoltaics is unrealistic. It is worth noting that the vast majority of this renewable energy capacity is derived from heat pumps. However, in order to translate this technical potential into actual installations, the inertia for building owners/ occupiers to overcome would significantly limit the realistic authority-wide potential.

Taking into account the above points, we have estimated the total capacity in Medway to be approximately **641 MW**.

4.4.6 Energy Opportunities Map and Conclusions

Following the above analysis of the potential for low and zero carbon technologies in Medway, an Energy Opportunities Map has been developed using GIS, illustrated in Figure 4.18, which identifies areas favourable for specific technologies in Medway.

Suitable conditions exist on the Hoo Peninsula (over 5m/s) for large wind, shown in Figure 4.17 below, subject to restrictions from built-up areas, environmental land designations, etc., however small wind, is illustrated to viable on most of the Hoo Peninsula and in the south and parts of the south-west of the Unitary Authority. Large scale wind is only viable for the Lodge Hill development.

The Energy Opportunities Map also illustrates district heating opportunity areas based on location of potential anchor loads. Each of the Strategic Sites demonstrates potential for

District Heating; in Lodge Hill, Kingsnorth power station and a leisure centre to the north-west of the development site could be used, in Rochester Riverside the University of Creative Arts and a number of schools, in Chatham Centre and Waterfront there is a hospital, a number of schools and two leisure centres which have the potential to link up to a network, subject to further detailed evaluation.

Areas suitable for solar technologies are also identified, i.e., areas where built environment is likely to have a south, south-east or south-west aspect. Finally, areas designated as Air Quality Management Areas, where biomass boilers would be restricted, are identified on the Map. Currently these are limited to High Streets; however, as development progresses or if pollution were to worsen, these might extend to areas within the Strategic Sites.

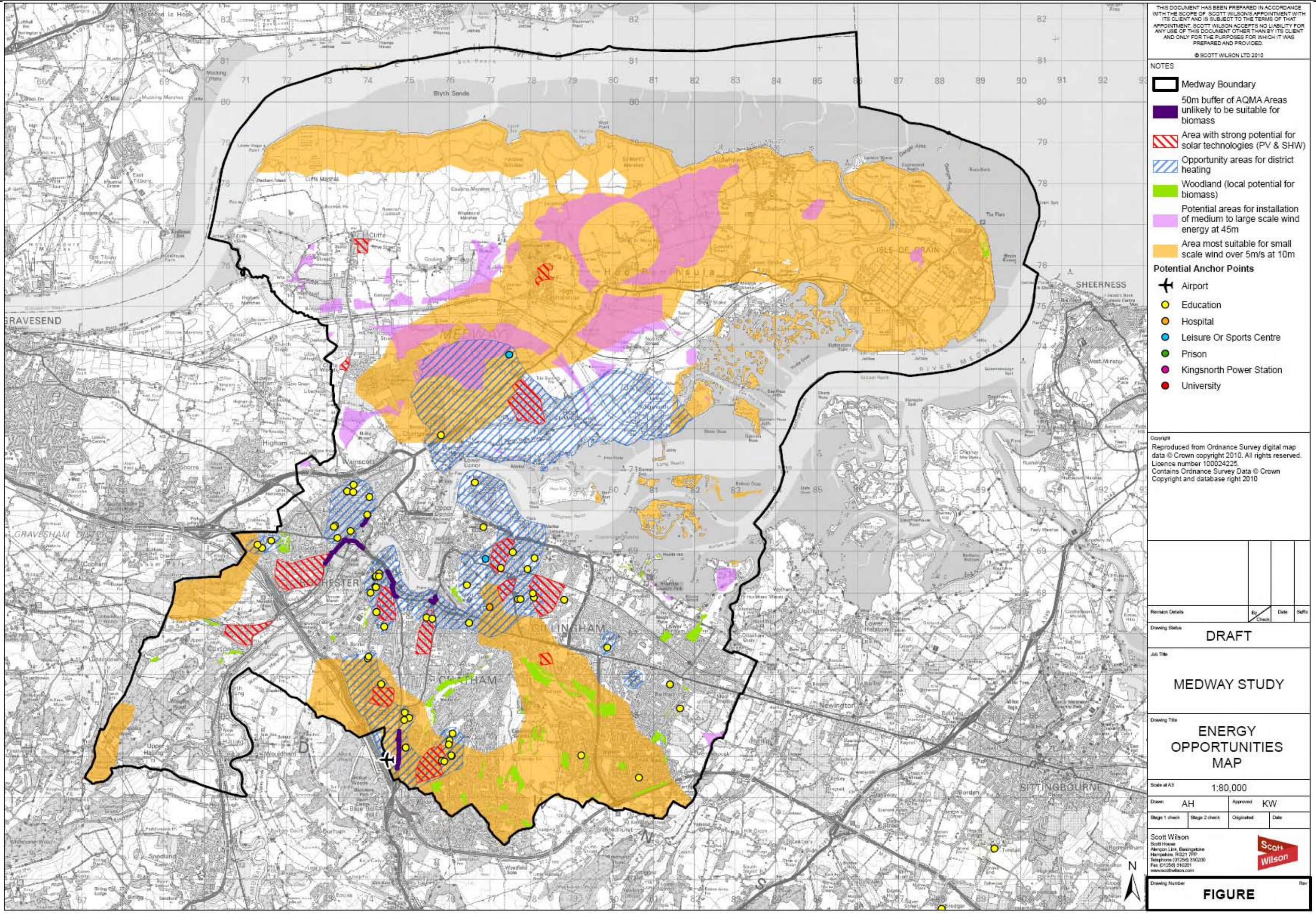


Figure 4.17: Energy Opportunities Map in Medway.

5 Strategic Development Sites

5.1.1 Introduction

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

Strategic Sites were identified and agreed with the Council. These reflect an appropriate cross-section of Medway in respect to development characteristics and typology. This chapter focuses on the low and zero carbon energy potential in each of the three Strategic Sites, tying them to different Code for Sustainable Homes levels and percentage improvement over Building Regulations 2006 for non-residential buildings. The sites explored in detail are: Lodge Hill; Rochester Riverside; and Chatham Centre and Waterfront.

Targets in the Code for Sustainable Homes are expressed in terms of the Dwelling Emission Rate over the Target Emission Rate as calculated through the government's Standard Assessment Procedure (SAP). These emission rates take into account both passive measures (orientation, internal heat gains, building fabric performance, etc.) and active measures (low or zero carbon technologies) to reduce carbon dioxide emissions. Expressed in percentage dioxide emissions for the different Code levels the following is expected; a 25% reduction from 2010, 44% from 2013, and zero carbon homes from 2016 (100% reduction on Part L regulated emissions and an additional 50% to account for unregulated emissions, i.e., a total of 150%).

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

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

5.1.2 Methodology

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

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

- Large wind – based on the Energy Opportunities Map (Figure 4.17), large wind is only viable around Lodge Hill where there are unconstrained sites that could house turbines at such a scale.
- Small wind – the wind speeds around Rochester Riverside and Chatham Centre and Waterfront were found too low for small wind based on current and expected wind turbine technology. For the site at Lodge Hill we have assumed a maximum number of 50 small-scale turbines.
- Biomass boilers – while these can greatly contribute towards meeting the lower levels of the Code and Building Regulations up to 2018, they are inappropriate for zero carbon homes and non-residential buildings, unless for individual dwellings, and so have been excluded. Biomass boilers mentioned in the tables below refer to centralised systems, unless stated otherwise.
- Solar Hot Water (SHW) – due to the density of development, we have assumed that no more than 4.5 m^2 per dwelling or per 70 m^2 of non-residential floorspace is viable. This limit applies to blocks of flats.
- Photovoltaics (PV) – similar to SHW.
- Air and Ground Source Heat Pumps – the contribution of these technologies is limited by the space heating load. Therefore, up to 4% of emissions reductions can be met through Air Source Heat Pumps and up to 14% through Ground Source Heat Pumps. This discrepancy is related to the different Coefficients of Performance that we have assumed for each for each (3:1 for Ground Source and 2.5:1 for Air Source).
- Biomass Combined Heat and Power (CHP) – the cost of installation would be too high for the lower levels of the Code and early Building Regulations. The efficiency of conversion into electricity has been taken as 25% and into heating as 45%.
- Gas-fired CHP – similar to biomass CHP. The efficiency of conversion into electricity has been taken as 34% and into heating as 39%.

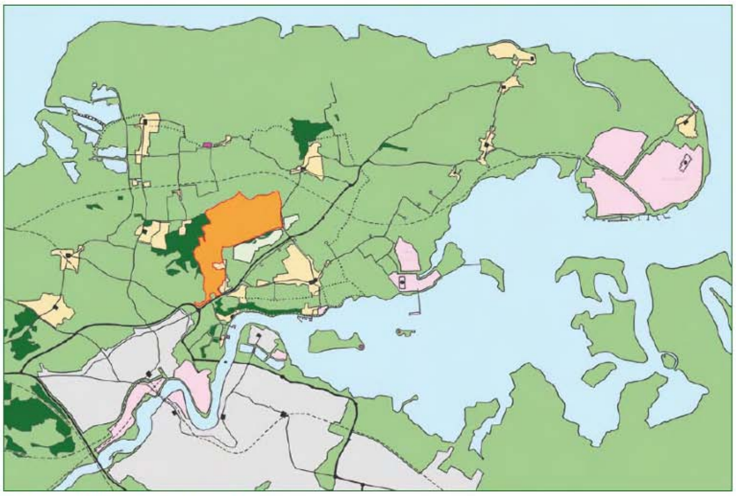
The sizing of these technologies is based on the amount of installed capacity, area or electrical output required to mitigate the required carbon dioxide emissions following the reduction from simple or advanced energy efficiency measures. Following a separate analysis of the domestic and non-domestic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

5.2 Lodge Hill, Chattenden

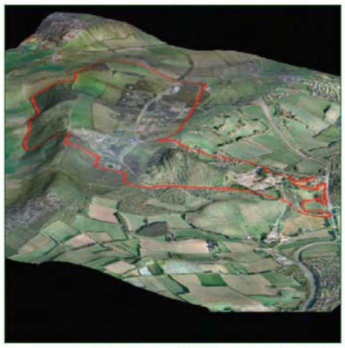
5.2.1 Introduction

The Defence Estate at Lodge Hill and Chattenden covers around 400 hectares (approximately 4 km^2). This includes large woodland areas (including the Chattenden Woods SSSI), some agricultural land and other areas that can be categorised as Greenfield; these latter amount to around 70 hectares. The majority of the balance of the site is previously developed land, comprising the former barracks and MoD training areas.

The previously developed areas of the site have been assessed as sufficient to accommodate around 5,000 homes and 20 – 25 hectares of employment land, plus all the associated services and facilities that are expected within a development of this scale.



The Lodge Hill site in its wider context



The topography of Lodge Hill (4x magnification)

Figure 5.1: The site at Lodge Hill, Chattenden, and landscape designated areas surrounding it.

5.2.2 Site Development Context

Development at Lodge Hill is expected to start in 2010 and by the end of the Plan period 5,000 dwellings are expected to have been built. An area of 48,514 m^2 of non-residential floorspace has been assumed. Total regulated CO_2 emissions for the site at completion under current benchmarks representing Part L 2006 compliance amount to 21,788 tCO_2/year and the total energy demand to 73,561 MWh/year.

The tables below summarise the phasing and the implications that the Code for Sustainable Homes and anticipated Building Regulations will have on Lodge Hill in terms of emissions reductions.

Number of dwellings	Phasing	Code level	Regulated CO_2 emissions if built to Part L 2006 compliant standards ($kgCO_2$/year)	Emissions to be displaced to meet anticipated regulatory standards (including emissions to be displaced through allowable solutions) ($kgCO_2$/year)
300	2010/13	3	494,478	123,620
900	2013/16	4	1,483,434	652,711
900	2016/18	6	1,483,434	2,373,494
2900	2019+	6	4,779,954	7,647,926

Table 5.1: Breakdown of residential development at Lodge Hill by phasing, Code levels and regulated CO2 emissions.

Floorspace (m^2)	Phasing	Building Regulations improvement over BR 2006	Regulated CO_2 emissions ($kgCO_2$/year)	Emissions to be displaced to meet anticipated regulatory standards (including emissions to be displaced through allowable solutions) ($kgCO_2$/year)
-	2010/13	25%	0	0
-	2013/16	44%	0	0
12,370	2016/19	49%	1,144,462	503,563
36,144	2019+	120%	3,344,158	4,012,990

Table 5.2: Breakdown of non-residential development at Lodge Hill by phasing, Building Regulations percentage improvement and regulated CO_2 emissions.

To summarise:

Phasing	Emissions to be displaced ($kgCO_2$/year)
2010/13	**123,620**
2013/16	**652,711**
2016/19	**2,877,057**
2019+	**11,660,916**

5.2.3 Technologies Feasibility

The analysis of wind speeds and site constraints indicates that there are some sites to the north of Lodge Hill that could be used for large wind. Wind speeds are also favourable for stand-alone small-scale turbines.

As discussed in Section 4.3.2 above, there is significant biomass resource in the South East, which would need appropriate supply chains to be set up for its full exploitation. While currently there are very few Air Quality Management Areas in Medway, all of which are found around busy roads, air pollution may need to be taken into account as development progresses in Lodge Hill.

Other forms of micro-generation, including biomass boilers, heat pumps, solar hot water and PV, need to be considered on an individual dwelling basis. No particular constraints have been identified for any of these technologies at this stage. Sites with increased opportunity for solar technologies have been identified in the Energy Opportunities Map.

Finally, district heating and biomass-/ gas-fired CHP are technically feasible and appropriate development densities should be encouraged to ensure maximum cost-efficiency in their deployment.

5.2.4 Energy Strategies for Different Code Levels

Based on the available technologies at Lodge Hill as presented above, the following table summarises different scenarios for meeting the residential and non-residential targets over time.

Phase 1: 2010 – 2013

The table below presents scenarios for meeting the CO_2 reduction target required for the 300 dwellings under **Code Level 3** (there is no non-residential floor area planned for 2010/13). The three scenarios look at combining energy efficiency with microgeneration.

2010 – 2013 **Domestic: Code 3 – 25% reduction in regulated CO_2 emissions**		
Scenario	**Options**	**Description**
A	Energy efficiency	Improved building fabric and optimal orientation.
	Solar Hot Water	330 m^2 of SHW panels installed on suitable roofspace, i.e., about 1.5 m^2 installed on each of the expected new dwellings (or about 3 m^2 on each, if only half the dwellings are suitable).
	Air Source Heat Pumps	A total of just under 843 MW_{th} output capacity to meet just over half the space heating needs of the residential element of the development.
B	Energy efficiency	As above.

2010 – 2013 **Domestic: Code 3 – 25% reduction in regulated CO_2 emissions**		
	Photovoltaics	435 m^2 of PV panels installed on suitable roofspace, i.e., less than 1.5 m^2 installed on each of the expected new dwellings (or about 2.5 m^2 on each, if only half the dwellings are suitable).
	Ground Source Heat Pumps	A capacity of 165 MW_{th} for the whole development, equivalent in output to meeting about a third of the space heating requirement of each new dwelling. Installed in larger, ground floor dwellings without solar technologies.
C	Energy efficiency	As above.
	Biomass boiler	A biomass boiler rated at approximately 53 kW_{th} to meet space heating and hot water requirements. This is equivalent to a small commercial or large domestic sized unit. Installed on a centralised basis.

The above preliminary calculations show that Code level 3 can be met through energy efficiency and different combinations of microgeneration technologies or a centralised biomass system. Each of the above scenarios reduces carbon dioxide emissions by 25%, i.e., by 124 tCO2/year.

5.2.4.1 Notes on Energy Efficiency for Code for Sustainable Homes Level 3

Passive design measures are strongly encouraged by government in the Energy Hierarchy as a means to reduce emissions. It is worth noting that implementing such measures will also reduce the amount and cost of Low or Zero Carbon (LZC) technologies required to meet any energy demand reduction targets onsite.

Preliminary calculations show that an energy efficiency of 15% can be achieved in a typical home with Best Practice U-values and south-west or south-east orientation. Up to 25% energy efficiency can be achieved, which would meet Code 3 compliance requirements without the contribution of any LZC technologies; however this is may not always be the most cost-effective option for meeting Code 3. It is not possible to meet Code levels above level 3 through energy efficiency alone.

Phase 2: 2013 – 2016

The table below presents scenarios for meeting the CO_2 reduction target required for the 900 dwellings under **Code Level 4** (there is no non-residential floor area planned for 2013/16). The three scenarios look at combining energy efficiency with microgeneration and medium/ large scale technologies.

2013 – 2016 **Domestic: Code 4 – 44% reduction in regulated CO2 emissions**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Photovoltaics	2,610 m^2 of PV panels installed on suitable roofspace, i.e., about 3 m^2 installed on each of the expected new dwellings.
	Small wind	9No. turbines of capacity 6 kW each, amounting to a total of 54 kW of electricity per year.
	Ground Source Heat Pumps	A capacity of 1,190 MW_{th}, equivalent in output to meeting almost all of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
B	Energy efficiency	Improved building fabric and optimal orientation.
	Biomass boiler	A biomass boiler rated at approximately 460 kW_{th} to meet space heating and hot water requirements. This is equivalent to a small commercial or large domestic sized unit. Installed on a centralised basis.
C	Energy efficiency	As above.
	Photovoltaics	1,310 m^2 of PV panels installed on suitable roofspaces, i.e., 1.5 m^2 installed on each of the expected new dwellings.
	Gas-fired CHP	An output of 330 kW_e.

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

5.2.4.2 Small wind

Under Scenario A, small scale wind would displace 2% of emissions, i.e., about 30 tCO_2/year, however, this could mount to 10% of emissions (see Phases 3 and 4), i.e., up to 480 tCO_2/year. Aesthetic factors would need to be considered, in particular in terms of cumulative impacts. A 6kW turbine is approximately 12 m high.

5.2.4.3 Combined Heat and Power (Gas-fired)

In order for Combined Heat and Power (CHP) and district heating to be viable, the density of development will need to be appropriate. It is worth noting, that as the required emissions to be displaced increase, CHP becomes a more cost-effective option compared to microgeneration. Therefore, in order to ensure that the energy requirements can be met in the most cost-effective way during the later phases of development, it is suggested that the CHP unit be oversized for the requirements of the early phases. In order to meet total requirements from 2010 to 2016, a plant with an output in the order of **1,460 kW_e** would need to be installed.

5.2.4.4 Phase 3: 2016 – 2019

The table below presents scenarios for meeting **Code Level 6** energy requirements for the 900 dwellings expected to be built from 2016 until the end of the plan period and an improvement of **49% over Building Regulations 2006** for the 12,370m^2 of non-residential development. Code 6 includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 150% improvement over Building Regulations Part L 2006 for domestic regulated energy.

While microgeneration could contribute towards meeting the overall target, most of the reductions will need to be met through efficient, large scale technologies or the allowable solutions mechanism. The scenarios below assume all emissions are displaced by onsite technologies. Examples for Gas-fired and Biomass CHP and Large scale wind are presented below.

2016 – 2019 **Domestic: Code 6 – 150% reduction in regulated CO_2 emissions (includes unregulated emissions)** **Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO_2 emissions)**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Gas-fired CHP	An output of 1,360 kW_e. See note on sizing the gas-fired CHP above (Section 5.2.4.3).
	Ground Source Heat Pumps	A capacity of 2,304 MW_{th}, equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
	Photovoltaics	7,835 m^2 of PV panels installed on suitable roofspace, i.e., less than 5.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
B	Advanced energy efficiency	As above.
	Biomass CHP	Biomass CHP to generate 350 kW_e per year.
	Biomass boiler	Boiler efficiency of 90% to generate 355 kW_{th} (potentially for dwellings

2016 – 2019 **Domestic: Code 6 – 150% reduction in regulated CO_2 emissions (includes unregulated emissions)** **Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO_2 emissions)**		
Scenario	**Options**	**Description**
		that cannot be connected to the biomass CHP unit).
	Small wind	42No. turbines of capacity 6 kW each, amounting to a total of just over 250 kW of electricity per year.
C	Advanced energy efficiency	As above.
	Large Wind	1No. commercial scale wind turbine rated at 2.5 MW to meet 1,550 kW_e.

Further to the technologies described above, the following options have been explored in the two scenarios above for Code 6 compliance:

5.2.4.5 Large Wind

Large wind is one of the most cost-effective ways to reduce carbon emissions. Suitable sites have been identified within close proximity of Lodge Hill (refer to Chapter 4). Large wind has the potential to meet the site's entire emissions reductions requirement for Code 6.

5.2.4.6 Biomass CHP

Biomass CHP combines the efficiency in fuel conversion of CHP with the low carbon intensity of biomass to enable significant CO_2 savings to be delivered. Similarly to gas-fired CHP, it should be considered at the earliest opportunity whether this technology should be oversized to meet the requirements of several phases, in order to meet the requirements of future phases cost-effectively. While for the needs of this particular phase a biomass CHP unit of 350 kWe would be adequate, it is recommended that a unit of total output of **2,000 kW_e** be installed. This would meet the needs in Lodge Hill for all development between 2013 and 2019. It would not be possible to meet requirements after 2019 through gas-fired CHP coupled with microgeneration.

5.2.4.7 Phase 4: 2019+

The table below presents scenarios for meeting the **zero carbon** requirements for the remaining 2900 dwellings and 36,144 m^2 of non-residential development expected from 2019 and until the end of the plan period. This includes all regulated energy and occupant electricity, resulting in an estimated average overall percentage requirement of 150% and 120% improvement over Building Regulations Part L 2006 for domestic and non-domestic buildings respectively.

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

2019+ **Non-domestic: Building Regulations 2019+ (54% reduction in regulated CO_2 emissions plus allowable solutions for zero carbon non-domestic buildings, i.e., 120% reduction)**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency (20%)	As above.
	Biomass CHP	Biomass CHP to generate 1,770 kW_e per year.
	Small wind	42No. turbines of capacity 6 kW each, amounting to a total of 240 kW of electricity per year.
	Photovoltaics	6,732 m^2 of PV panels on suitable roofspace, i.e. less than 2.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
B	Advanced energy efficiency	As above.
	Large Wind	4No. commercial scale wind turbines rated at 2.5 MW to meet 7,685 kW_e.

5.2.5 Conclusions for Lodge Hill

Lodge Hill is the only site where large wind is potentially viable. This analysis suggests that in the earlier phases of scheme development, several options are available for microgeneration combinations and for the later phases it means that large wind could be an alternative to biomass CHP that requires less infrastructure. It is not considered to be possible to meet carbon reduction requirements after 2019 through gas-fired CHP coupled with microgeneration using on site measures alone.

5.3 Rochester Riverside

5.3.1 Introduction

Rochester is an historic district centre with a waterfront that is to be developed over the next two decades to include domestic, retail, offices, cultural and other buildings. It is located near the old town centre, towards its north-east and covers a total area of 64 hectares (0.64 km^2). It is shown on the map below.

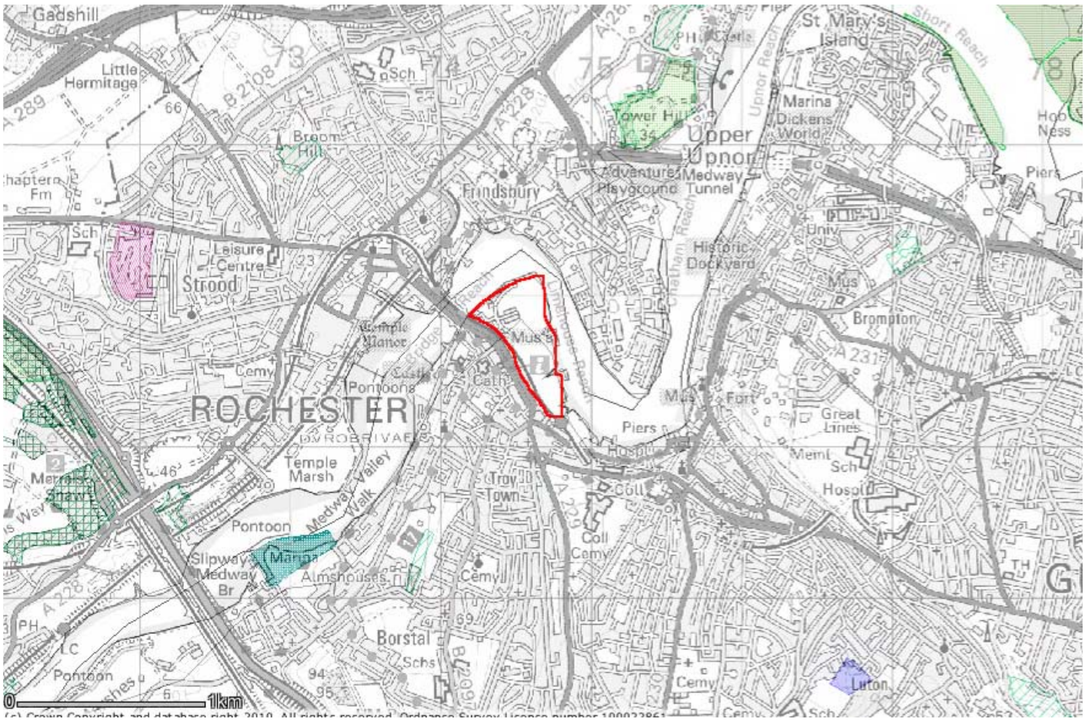


Figure 5.2: Rochester Riverside

5.3.2 Site Development Context

Development at Rochester Riverside is expected to start in 2010 and by the end of the Plan period 2,000 dwellings are expected to have been built. An area of 19,800 m^2 of non-residential floorspace has been assumed. Total CO_2 emissions for the site at completion under current benchmarks representing Part L 2006 compliance amount to 9,476 tCO_2/year and the total energy demand to 32,337 MWh/year.

The tables below summarise the phasing and the implications the Code for Sustainable Homes and anticipated Building Regulations will have on Rochester Riverside in terms of emissions reductions.

Number of dwellings	Phasing	Code level	Regulated CO_2 emissions if built to Part L 2006 compliant standards ($kgCO_2$/year)	Emissions to be displaced to meet anticipated regulatory standards (including emissions to be displaced through allowable solutions) ($kgCO_2$/year)
150	2010/13	3	274,710	68,678
550	2013/16	4	1,007,270	443,199
600	2016/18	6	1,098,840	1,648,260
700	2019+	6	1,281,980	1,922,970

Table 5.3: Breakdown of domestic development at Rochester Riverside by phasing, Code levels and regulated CO_2 emissions.

Floorspace (m^2)	Phasing	Building Regulations improvement over BR 2006	Regulated CO_2 emissions if built to Part L 2006 compliant standards ($kgCO_2$/year)	Emissions to be displaced to meet anticipated regulatory standards (including emissions to be displaced through allowable solutions) ($kgCO_2$/year)
1,368	2010/13	25%	138,307	34,577
4,104	2013/16	44%	414,922	182,566
6,152	2016/19	49%	621,978	304,769
8,176	2019+	120%	826,608	991,930

Table 5.4: Breakdown of non-domestic development at Rochester Riverside by phasing, Building Regulations percentage improvement and regulated CO_2 emissions.

To summarise:

Phasing	Emissions to be displaced ($kgCO_2$/year)
2010/13	103,255
2013/16	625,765
2016/19	1,953,029
2019+	2,914,900

5.3.3 Technologies Feasibility

Rochester Riverside is near the town centre, benefiting from higher densities, however lacking the space that Lodge Hill has.

While the wind speeds are high enough for large scale wind to be viable at Rochester Riverside, the site constraints analysis indicates that there is no opportunity for large wind. Wind speeds are below 4.5 m/s therefore stand-alone small-scale turbines are not an option either.

As discussed in Section 4.3.2 above, there is significant **biomass** resource in the South East, which would need appropriate supply chains to be set up for its full exploitation. While currently there are very few Air Quality Management Areas in Medway, all of which are found around busy roads, air pollution may need to be taken into account as development progresses in Rochester Riverside.

Other forms of **micro-generation**, including biomass boilers, heat pumps, solar hot water and PV, need to be considered on an individual dwelling basis. No particular constraints have been identified for any of these technologies at this stage. Sites with increased opportunity for solar technologies have been identified in the Energy Opportunities Map.

Finally, **district heating** and biomass-/ gas-fired CHP are technically feasible and development densities should be encouraged to ensure maximum cost-efficiency in their deployment.

5.3.4 Energy Strategies for Code Levels

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

Phase 1: 2010 – 2013

The table below presents scenarios for meeting the CO_2 reduction target required for the 150 dwellings under **Code Level 3** and 1,368 m^2 of non-residential floorspace of **25% improvement over Building Regulations 2006**. The three scenarios look at combining energy efficiency with microgeneration.

2010 – 2013 **Domestic: Code 3 – 25% reduction in regulated CO_2 emissions** **Non-domestic: Building Regulations 2010 – 2013 (25% reduction in regulated CO_2 emissions)**		
Scenario	**Options**	**Description**
A	Energy efficiency	Improved building fabric and optimal orientation.
	Solar Hot Water	275 m^2 of SHW panels installed on suitable roofspace, i.e., about 2 m^2 installed on each of the expected new dwellings or every $70m^2$ of non-residential floorspace.
	Air Source Heat Pumps	A capacity of 220 MW_{th}, equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
B	Energy efficiency	As above.
	Photovoltaics	485 m^2 of PV panels installed on suitable roofspace, i.e., less than 3 m^2 installed on each of the expected new dwellings or every $70m^2$ of non-residential floorspace.
	Ground Source Heat Pumps	A capacity of 92 MW_{th} for the whole development, equivalent in output to meeting about a third of the space heating requirement of each new dwelling. Installed in larger, ground floor dwellings without solar technologies.
C	Energy efficiency	As above.
	Biomass boiler	Boiler efficiency of 90% to generate 45 kW_{th} per year.

The above preliminary calculations show that both Code level 3 and an improvement of 25% over Part L2 Building Regulations 2006 can be met through energy efficiency and different combinations of microgeneration technologies or a centralised biomass system.

5.3.4.1 Energy Efficiency

Please refer to Section 5.2.4.1above.

Phase 2: 2013 – 2016

The table below presents scenarios for meeting the CO_2 reduction target required for the 550 dwellings under **Code Level 4** combined with the 4,104 m^2 of non-residential floorspace that requires a **44% improvement of the Building Regulations compared to 2006 levels**. The three scenarios look at combining energy efficiency with microgeneration and medium/ large scale technologies.

2013 – 2016 **Domestic: Code 4 – 44% reduction in regulated CO_2 emissions** **Non-domestic: Building Regulations 2013 – 2016 (44% reduction in regulated CO_2 emissions)**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Photovoltaics	2,130 m^2 of PV panels installed on suitable roofspace, i.e., 3.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
	Solar Hot Water	605 m^2 of SHW panels installed on suitable roofspace, i.e., about 1 m^2 installed on each of the expected new dwellings (or about 2 m^2 on each, if only half the dwellings are suitable).
	Ground Source Heat Pumps	A capacity of 553 MW_{th}, equivalent in output to meeting almost all of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
	Biomass boiler	Boiler efficiency of 90% to generate 27 kW_{th}.
B	Energy efficiency	Improved building fabric and optimal orientation.
	Biomass boiler	Boiler efficiency of 90% to generate 440 kW_{th}.
C	Energy efficiency	As above.
	Photovoltaics	890 m^2 of PV panels installed on suitable roofspaces, i.e., 1.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
	Gas-fired CHP	An output of 192 kW_e.

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

5.3.4.2 Combined Heat and Power (Gas-fired)

While a gas-fired CHP unit of 192 kWe would meet the requirements for this phase, in order to ensure that the energy requirements can be met in the most cost-effective way during the later phases of development, it is suggested that the CHP unit be oversized for the requirements of the early phases. Therefore, in order to meet total requirements from 2013 to 2019+, it is suggested that plant with an output of **1,645 kW_e** should be installed.

Phase 3: 2016 – 2019

The table below presents scenarios for meeting **Code Level 6** energy requirements for the 600 dwellings expected to be built from 2016 until the end of the plan period and an improvement of **49% over Building Regulations 2006** for the 6,152 m^2 of non-residential development. Code 6 includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 150% improvement over Building Regulations 2006.

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

2016 – 2019 Domestic: Code 6 – 150% reduction in regulated CO_2 emissions (includes unregulated emissions) Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO_2 emissions)		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Gas-fired CHP	An output of 606 kW_e. See note on sizing the gas-fired CHP above (Section 5.2.4.3).
	Ground Source Heat Pumps	A capacity of 755 MW_{th}, equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
	Photovoltaics	5,804 m^2 of PV panels installed on suitable roofspace, i.e., 8.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
B	Advanced energy efficiency	As above.
	Biomass CHP	Biomass CHP to generate 280 kW_e per year.
	Biomass boiler	Boiler efficiency of 90% to generate 190 kW_{th} (potentially for dwellings that cannot be connected to the biomass CHP unit).

5.3.4.3 Biomass CHP

Biomass CHP combines the efficiency in fuel conversion of CHP with the low carbon intensity of biomass to enable significant CO_2 savings to be delivered. Similarly to gas-fired CHP, it should be considered at the earliest opportunity whether this technology should be oversized to meet the requirements of several phases, in order to meet the requirements of future phases cost-effectively. While for the needs of this particular phase a biomass CHP unit of 280 kWe would be adequate, it is recommended that a unit of total output of **630 kW_e** for Rochester Riverside be specified. This would meet the requirements for all development between 2016 and the end of the plan period.

5.3.4.4 Phase 4: 2019+

The table below presents scenarios for meeting the **zero carbon** requirements for the remaining 700 dwellings and 8,176 m^2 of non-residential development expected from 2019 and until the end of the plan period. This includes all regulated energy and occupant electricity, resulting in an estimated average overall percentage requirement of 150% and 120% improvement over Building Regulations Part L 2006 for domestic and non-domestic buildings respectively. Similarly to 2016-2019, while microgeneration could contribute towards meeting the overall target, most of the emissions reductions will need to be met through efficient, large scale technologies.

2019+ **Non-domestic: Building Regulations 2019+ (54% reduction in regulated CO_2 emissions plus allowable solutions for zero carbon non-domestic buildings, i.e., 120% reduction)**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Gas-fired CHP	An output of 845 kW_e. See note on sizing the gas-fired CHP above (Section 5.2.4.3).
	Ground Source Heat Pumps	A capacity of 257 MW_{th}, equivalent in output to meeting almost all of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
	Photovoltaics	6,770 m^2 of PV panels installed on roofspace, i.e., 8.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
B	Advanced energy efficiency	As above.
	Biomass CHP	Biomass CHP to generate 350 kW_e per year.

5.3.5 Conclusions for Rochester Riverside

Rochester Riverside is more constrained than Lodge Hill in terms of microgeneration, however development density is likely to be higher, increasing the cost-effectiveness for district heating infrastructure. In order to meet carbon reduction targets for the later phases of development, a biomass CHP unit of 630 kW_{th} capacity or a gas-fired CHP unit of 1,645 kW_{th} could be installed. In order to maximise technical efficiency it would be recommended that infrastructure compatible with wider site systems are installed during the early phases.

5.4 Chatham Centre and Waterfront

5.4.1 Introduction

The Chatham Centre and Waterfront site is to be developed over the next two decades to include domestic, retail, offices, cultural and other buildings. It is located near Chatham centre, towards its north and covers a total area of 30 hectares (about 0.3 km^2).

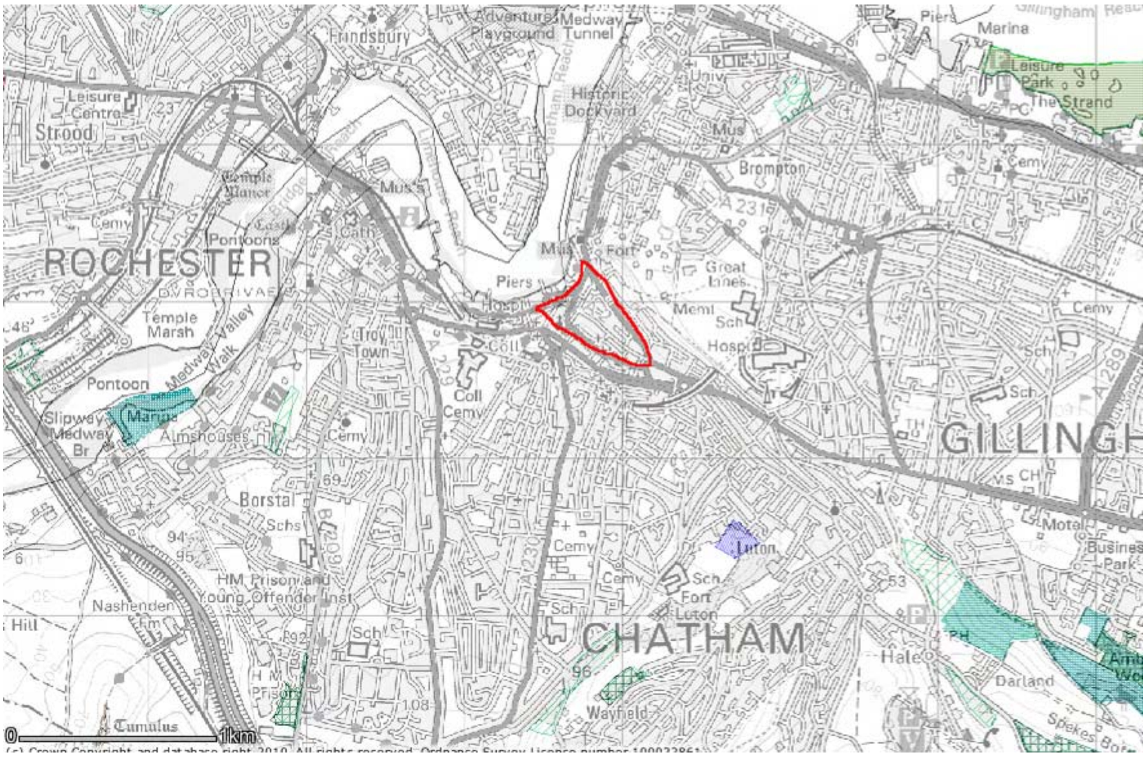


Figure 5.3: Chatham Centre and Waterfront

5.4.2 Site Development Context

Development at Chatham Centre and Waterfront is expected to start in 2010 and by the end of the Plan period 2,000 dwellings are expected to have been built. An area of 13,228 m^2 of non-residential floorspace has been assumed. Total CO_2 emissions for the site at completion under current benchmarks representing Part L 2006 compliance amount to 8,223 tCO_2/year and the total energy demand to 28,545 MWh/year.

The table below summarises the phasing and the implications the Code for Sustainable Homes and anticipated Building Regulations will have on Chatham Centre and Waterfront in terms of emissions reductions.

Number of dwellings	Phasing	Code level	Regulated CO_2 emissions if built to Part L 2006 compliant standards ($kgCO_2$/year)	Emissions to be displaced to meet anticipated regulatory standards (including emissions to be displaced through allowable solutions) ($kgCO_2$/year)
125*	2010/13	3	229,289	57,322
425	2013/16	4	779,582	343,016
325	2016/18	6	596,151	894,227
1,012	2019+	6	1,856,323	2,784,485

* And an additional 113 units that have already been completed.

Table 5.5: Breakdown of residential development at Chatham Centre and Waterfront by phasing, Code levels and regulated CO_2 emissions.

Floorspace (m^2)	Phasing	Building Regulations improvement over BR 2006	Regulated CO_2 emissions if built to Part L 2006 compliant standards ($kgCO_2$/year)	Emissions to be displaced to meet anticipated regulatory standards (including emissions to be displaced through allowable solutions) ($kgCO_2$/year)
0	2010/13	25%	0	0
0	2013/16	44%	0	0
5,291	2016/19	49%	509,073	249,446
7,937	2019+	120%	763,610	916,332

Table 5.6: Breakdown of non-residential development at Chatham Centre and Waterfront by phasing, Building Regulations percentage improvement and regulated CO2 emissions.

To summarise:

Phasing	Emissions to be displaced ($kgCO_2$/year)
2010/13	57,322
2013/16	343,016
2016/19	1,134,673

2019+	3,700,817

5.4.3 Technologies Feasibility

Chatham Centre and Waterfront is near the town centre, benefiting from higher densities, however lacking the space that Lodge Hill has.

While the wind speeds are high enough for large scale wind to be viable in Rochester Riverside, the site constraints analysis indicates that there is no opportunity for large wind. Wind speeds are below 4.5 m/s therefore stand-alone small-scale turbines are not an option either.

As discussed in Section 4.3.2 above, there is significant **biomass** resource in the South East, which would need appropriate supply chains to be set up for its full exploitation. Please note that, while currently there are very few Air Quality Management Areas in Medway, all of which are found around busy roads, air pollution may need to be taken into account as development progresses in Chatham Centre and Waterfront.

Other forms of **micro-generation**, including biomass boilers, heat pumps, solar hot water and PV, need to be considered on an individual dwelling basis. No particular constraints have been identified for any of these technologies at this stage. Sites with increased opportunity for solar technologies have been identified in the Energy Opportunities Map.

Finally, **district heating** and biomass-/ gas-fired CHP are technically feasible and development densities will need to be appropriately selected to ensure maximum cost-efficiency in their deployment.

5.4.4 Energy Strategies for Code Levels

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

Phase 1: 2010 – 2013

The table below presents scenarios for meeting the CO_2 reduction target required for the 125 dwellings under **Code Level 3** (no non-residential floorspace is expected before 2016). The three scenarios look at combining energy efficiency with microgeneration.

2010 – 2013 **Domestic: Code 3 – 25% reduction in regulated CO_2 emissions**		
Scenario	**Options**	**Description**
A	Energy efficiency	Improved building fabric and optimal orientation.
	Solar Hot Water	152 m^2 of SHW panels installed on suitable roofspace, i.e., about 1 m^2 installed on each of the expected new dwellings or every 70m^2 of non-residential floorspace.
	Air Source Heat Pumps	A total of just over 245 MW_{th} output capacity to meet almost all of the space heating needs of the residential element of the development.
B	Energy efficiency	As above.
	Photovoltaics	202 m^2 of PV panels installed on suitable roofspace, i.e., less than 2 m^2 installed on each of the expected new dwellings or every 70m^2 of non-residential floorspace.
	Ground Source Heat Pumps	A capacity of 77 MW_{th} for the whole development, equivalent in output to meeting about a third of the space heating requirement of each new dwelling. Installed in larger, ground floor dwellings without solar technologies.
C	Energy efficiency	As above.
	Biomass boiler	Boiler efficiency of 90% to generate 24 kW_{th} per year.

The above preliminary calculations show that Code level 3 can be met through energy efficiency and different combinations of microgeneration technologies or a centralised biomass system.

5.4.4.1 Energy Efficiency

Please refer to Section 5.4.2.1 above.

Phase 2: 2013 – 2016

The table below presents scenarios for meeting the CO_2 reduction target required for the 425 dwellings under **Code Level 4** (no non-residential floorspace is expected to be developed before 2016). The three scenarios look at combining energy efficiency with microgeneration and medium/ large scale technologies.

2013 – 2016 **Domestic: Code 4 – 44% reduction in regulated CO_2 emissions**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Photovoltaics	1,373 m^2 of PV panels installed on suitable roofspace, i.e., 3.5 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
	Ground Source Heat Pumps	A capacity of 625 MW_{th}, equivalent in output to meeting almost all of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
B	Energy efficiency	Improved building fabric and optimal orientation.
	Biomass boiler	Boiler efficiency of 90% to generate 241 kW_{th}.
C	Energy efficiency	As above.
	Photovoltaics	690 m^2 of PV panels installed on suitable roofspaces, i.e., 2 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
	Gas-fired CHP	An output of 173 kW_e.

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

Combined Heat and Power (Gas-fired)

While a gas-fired CHP unit of 173 kWe would be adequate to meet the requirements of this phase, in order to ensure that the energy requirements can be met in the most cost-effective way during the later phases of development, it is suggested that the CHP unit be oversized for the requirements of the early phases. In order to meet total requirements from 2013 to 2019+ (i.e. including requirements for Phases 3 and 4), it is suggested that plant with an output of **2,905 kW_e** should be installed.

Phase 3: 2016 – 2019

The table below presents scenarios for meeting **Code Level 6** energy requirements for the 325 dwellings expected to be built from 2016 until the end of the plan period and an improvement of **49% over Building Regulations 2006** for the 5,291 m^2 of non-residential development. Code 6 includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 150% improvement over Building Regulations 2006.

While microgeneration could contribute towards meeting the overall target, most of the reductions will need to be met through efficient, large scale technologies or the allowable Solutions mechanism. The scenarios below assume that all emissions are displaced by onsite technologies.

2016 – 2019 **Domestic: Code 6 – 150% reduction in regulated CO_2 emissions (includes unregulated emissions)** **Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO_2 emissions)**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Gas-fired CHP	An output of 545 kW_e. See note on sizing the gas-fired CHP above (Section 5.2.4.3).
	Ground Source Heat Pumps	A capacity of 1,035 MW_{th}, equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies.
	Photovoltaics	3,150 m^2 of PV panels installed on suitable roofspace, i.e., 8 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
B	Advanced energy efficiency	As above.
	Biomass CHP	Biomass CHP to generate 151 kW_e per year.
	Biomass boiler	Boiler efficiency of 90% to generate 160 kW_{th}(potentially for dwellings that cannot be connected to the biomass CHP unit).

5.4.4.2 Biomass CHP

Biomass CHP combines the efficiency in fuel conversion of CHP with the low carbon intensity of biomass to enable significant CO_2 savings to be delivered. Similarly to gas-fired CHP, it should be considered at the earliest opportunity whether this technology should be oversized to meet the requirements of several phases, in order to meet the requirements of future phases cost-effectively. While for the needs of this particular phase a biomass CHP unit of 151 kW_e would be adequate, it is recommended that a unit of total output of **770 kW_e** be installed. This would meet the needs in Chatham Centre and Waterfront for all development between 2016 and the end of the plan period.

Phase 4: 2019+

The table below presents scenarios for meeting the **zero carbon** requirements for the remaining 1,012 dwellings and 7,937 m^2 of non-residential development expected from 2019 and until the end of the plan period. This includes all regulated energy and occupant electricity, resulting in an estimated average overall percentage requirement of 150% and 120% improvement over Building Regulations Part L 2006 for domestic and non-domestic buildings respectively. Similarly to 2016-2019, while microgeneration could contribute towards meeting the overall target, most of the emissions reductions will need to be met through efficient, large scale technologies.

2019+ **Non-domestic: Building Regulations 2019+ (54% reduction in regulated CO_2 emissions plus allowable solutions for zero carbon non-domestic buildings, i.e., 120% reduction)**		
Scenario	**Options**	**Description**
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Gas-fired CHP	An output of 2,185 kW_e. See note on sizing the gas-fired CHP above (Section 5.2.4.3).
	Photovoltaics	9,805 m^2 of PV panels installed on suitable roofspace, i.e., 9 m^2 installed on each of the expected new dwellings or per 70 m^2 of non-residential floorspace.
B	Advanced energy efficiency	As above.
	Biomass CHP	Biomass CHP to generate 619 kW_e per year.

5.4.5 Conclusions for Chatham Centre and Waterfront

Similarly to Rochester Riverside, Chatham Centre and Waterfront is more constrained than Lodge Hill in terms of microgeneration, however development density is likely to be higher, rendering district heating more cost-effective. In order to meet carbon reduction targets for the later phases of development, a biomass CHP unit of 770 kWe capacity or a large gas-fired CHP of 2,905 kW_e capacity could be adopted. For a site of this nature, however, it would be recommended that compatible DH infrastructure is installed throughout the development life of the site, and that thereby economies of scale are realised and efficiency is maximised.

6 Development Viability

Evidently energy targets which set out a step change to zero carbon will have a cost implication. The following section sets out to test development viability as applied to Medway.

Figure 9: Effect of changing Part L on E/O cost of building to the Code for Code levels 4 to 6 (large urban development)

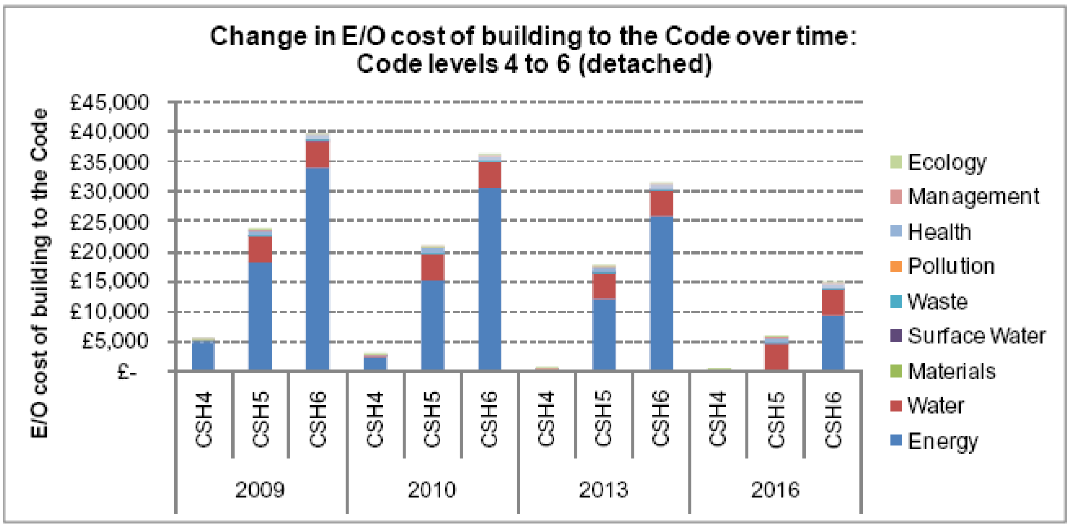


Figure 6.1: Extra Over costs of the Code for Sustainable Homes

The above table from DCLG[38] outlines the energy extra over costs compared to the other elements of the Code and demonstrates a reduction in extra over cost over time. However, it must be noted that over the same time period, the forecast cost of Building Regulation compliance increases.

Our project partner Cyril Sweett has also generated a strategic site-specific cost analysis of the different Code Levels of the CSH (in energy compliance terms), expressed as an uplift over 2006 Building Regulation compliance construction costs. Graphs of these average costs are shown below:

[38] The Code for Sustainable Homes Impact Assessment, Dec 2009

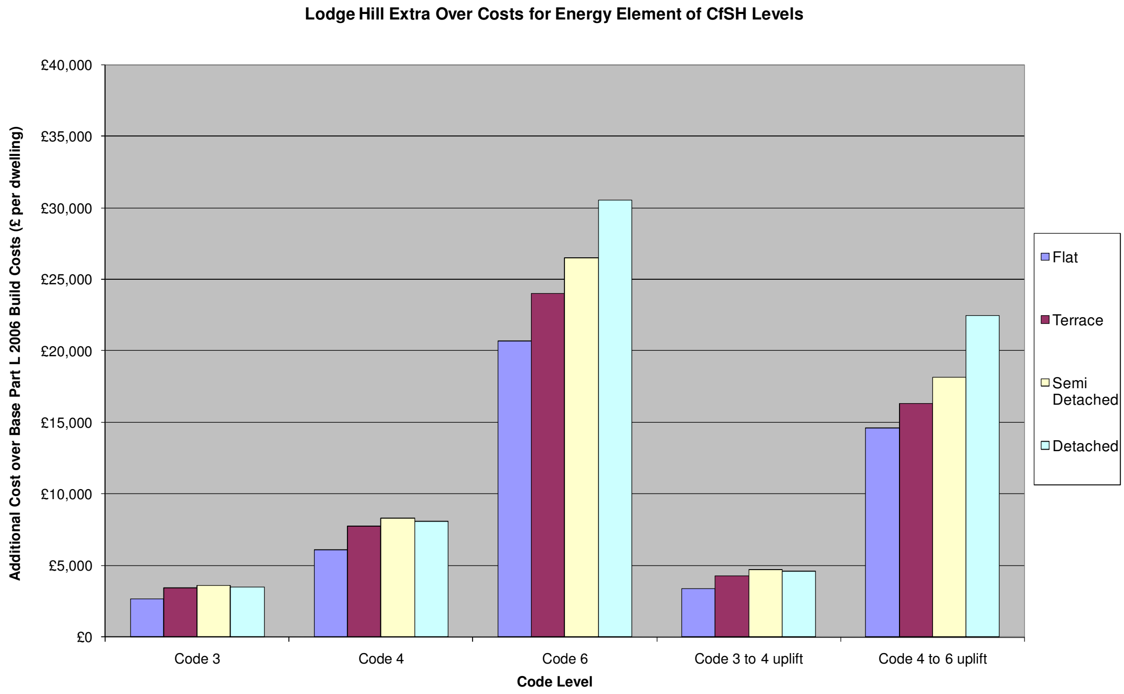


Figure 6.2: Lodge Hill Costs for Code for Sustainable Homes Energy Compliance

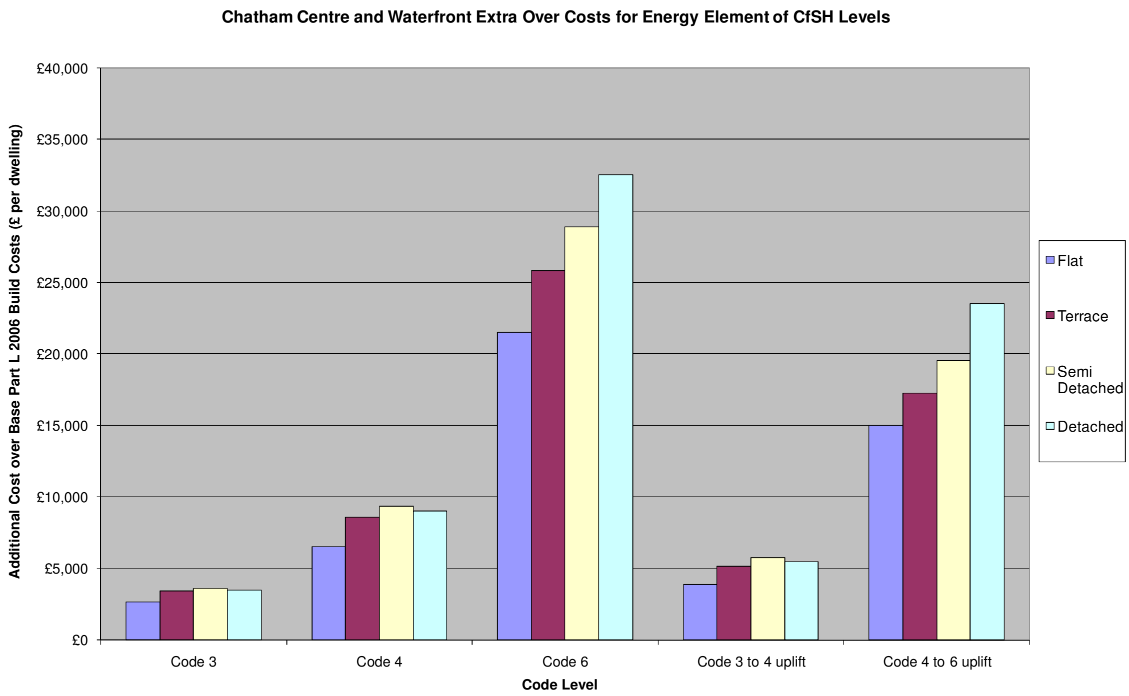


Figure 6.3: Chatham Centre and Waterfront Costs for Code for Sustainable Homes Energy Compliance

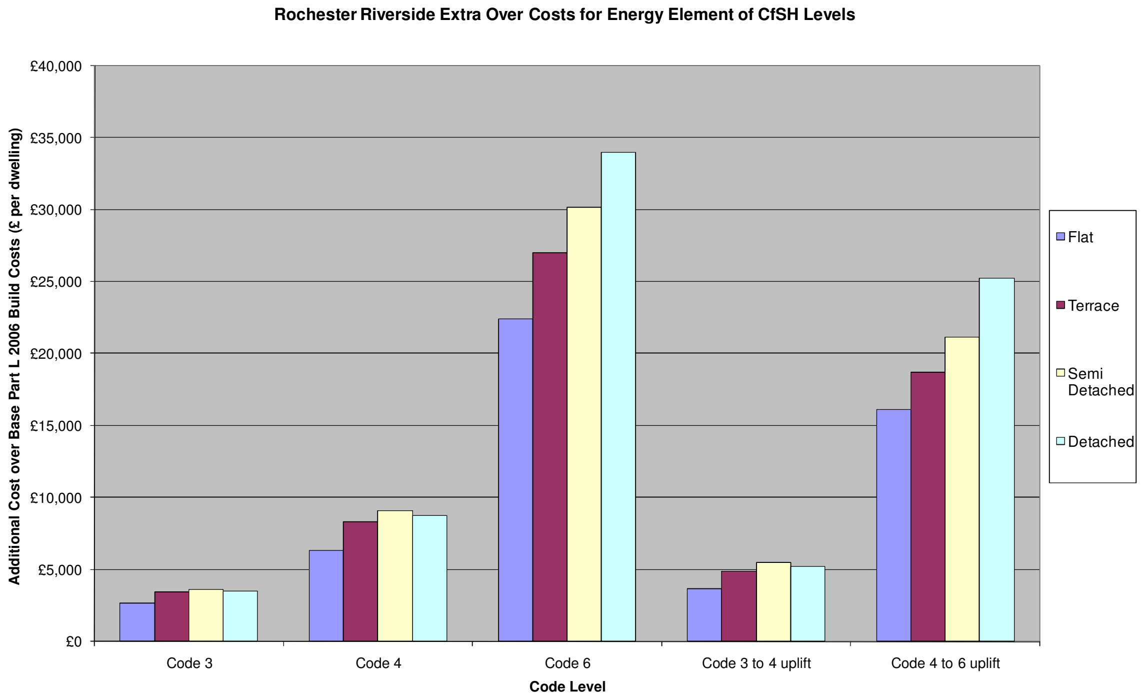


Figure 6.4: Rochester Riverside Costs for Code for Sustainable Homes Energy Compliance

These graphs reflect the mix of technologies that were considered available at the strategic sites evaluated within this study. The graphs also illustrate the projected cost uplifts anticipated between each policy level commonly adopted of the Code for Sustainable Homes – e.g. the cost uplift from Code 3 to Code 4, and the uplift between Code 4 and Code 6.

It can clearly be seen that Code 6 compliance is several times more costly than Code 4 compliance.

Two broad approaches to viability have been adopted in this report, an 'elemental approach' and a 'land value comparison approach'. These are outlined below.

6.1 Elemental Approach to Viability

The elemental approach adopted for viability testing is illustrated by the flow chart below. In essence this takes the methodology outlined by the document 'Renewable and Low-carbon Energy Capacity Methodology' in order to help identify technologies suitable for each site, and then conducts land-value based viability test on the basis of market sales values. Assessing viability is complex and can only be estimated indicatively as it involves many factors which will differ significantly under each specific circumstance.

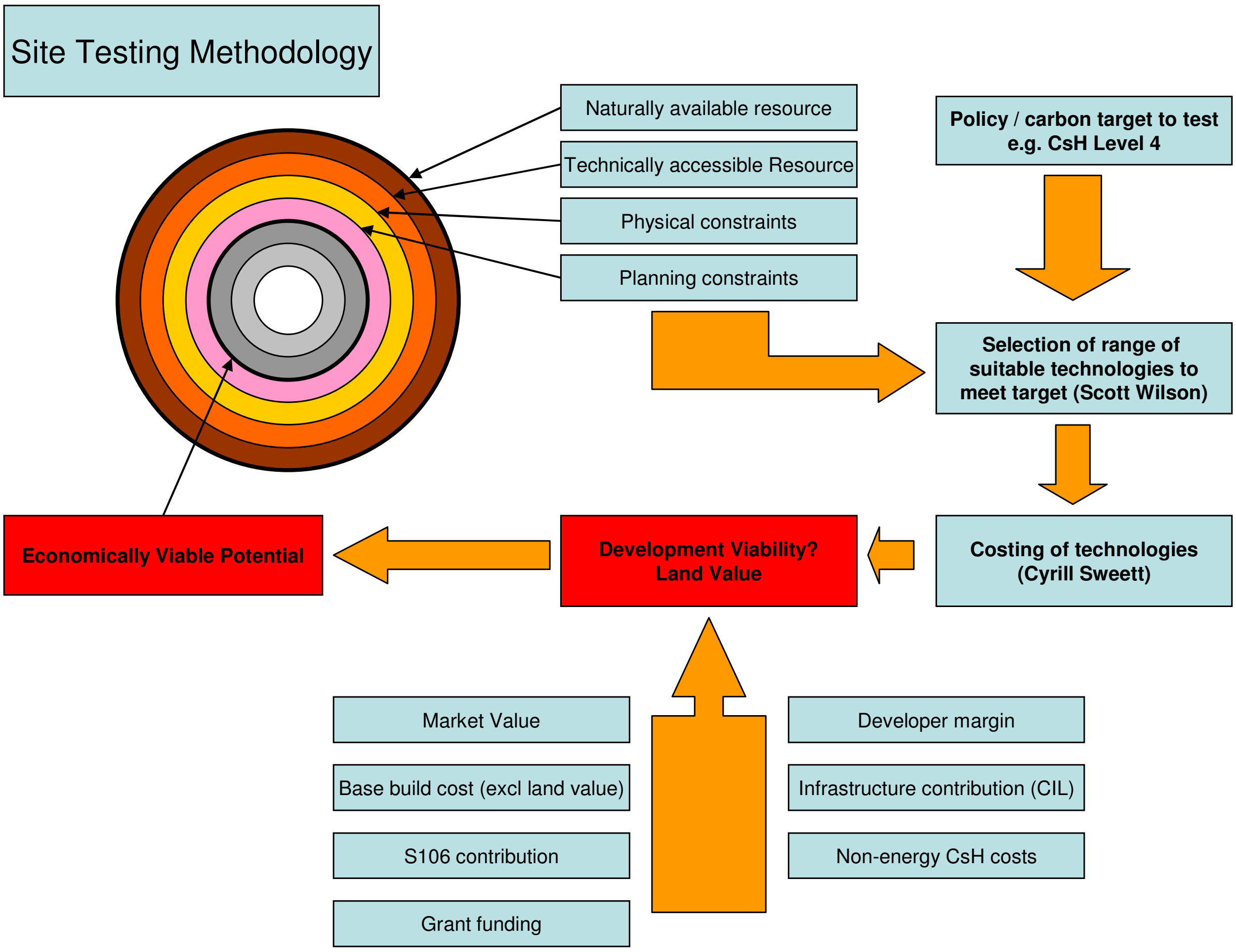


Figure 6.5: Viability testing methodology flow chart

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

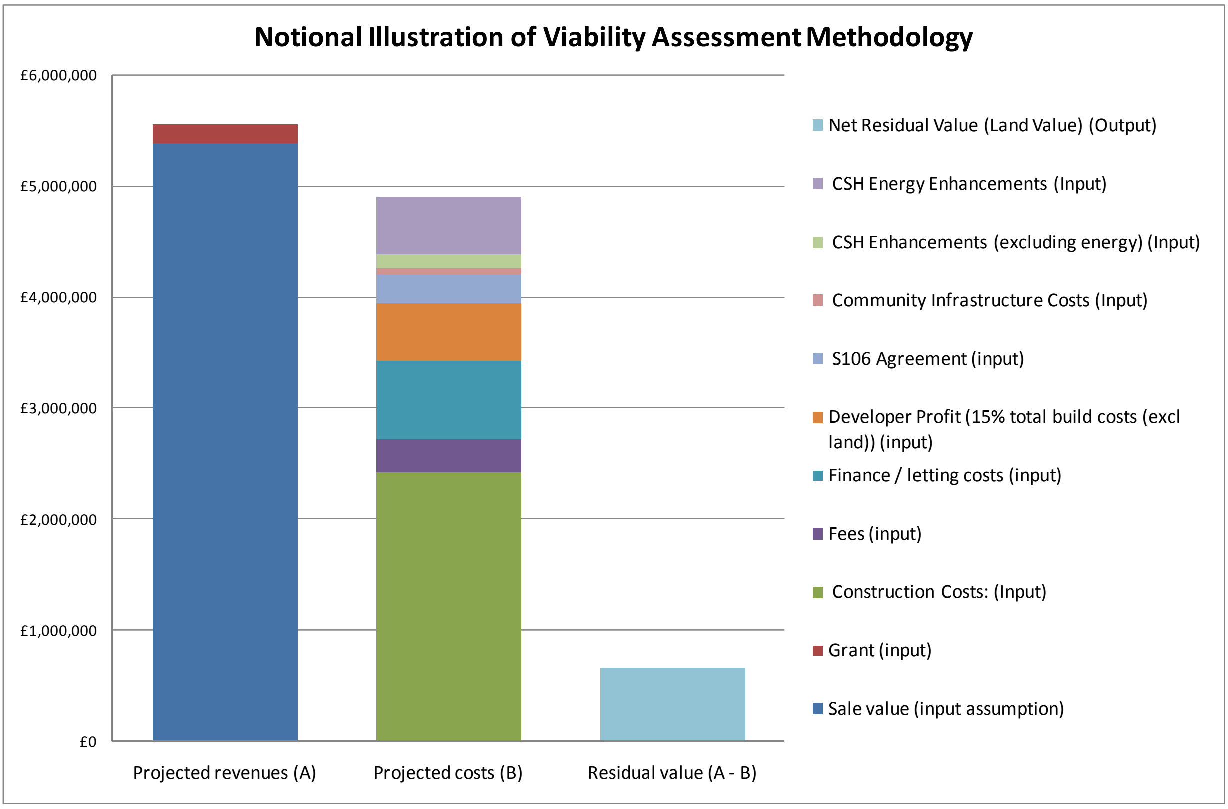


Figure 6.6: Notional land value / residual value methodology illustration

It can be seen from the flow diagram and residual value illustrations above that there are a large number of variables that form part of this model. Wherever possible, Scott Wilson has adopted figures from 'Medway Council - Affordable Housing Viability Study, October 2009'. Additionally, Scott Wilson has integrated the headline figures from the 'Guide to Developer Contributions SPD', and added the Code for Sustainable Homes cost figures generated by Cyril Sweett.

How to interpret these results and their limitations:

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

a) Retaining the existing use;

b) Alternative uses to which the land might be put;

c) The present value of some future use / value that might be realised.

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

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

These additional items are potentially very significant in cost terms when extrapolated to the sizes of developments under consideration here. The highly variable nature of these items has led to the decision not to attempt to cost them on a generalised basis, however, their omission effectively means that a viability threshold should be considered to be at a point above zero land value (as discussed above). These uncertainties have also lead to the decision to present the land value results on a notional scale, rather than as concrete values, as the use of concrete values has the tendency to give the illusion of accuracy (which is not possible on this scale), and as relative figures are also of interest at this policy level study.

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

The geographic zones currently selected for viability testing follow the model set out in the Affordable Housing Viability Study – e.g. as follows:

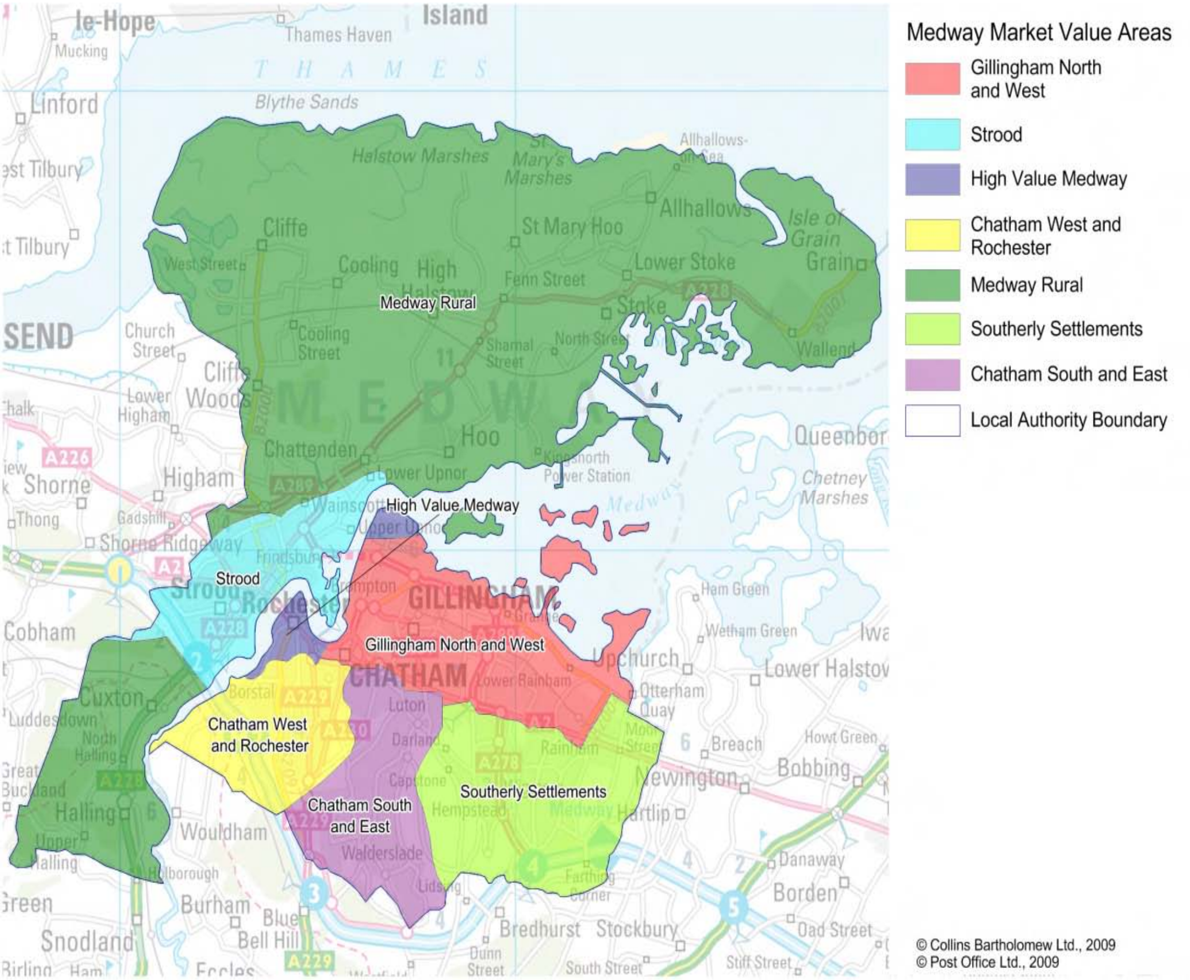


Figure 6.7: Viability Testing Areas

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

6.1.1 Elemental Approach Viability Testing Results

Acceleration of Code 4 to implementation in 2010

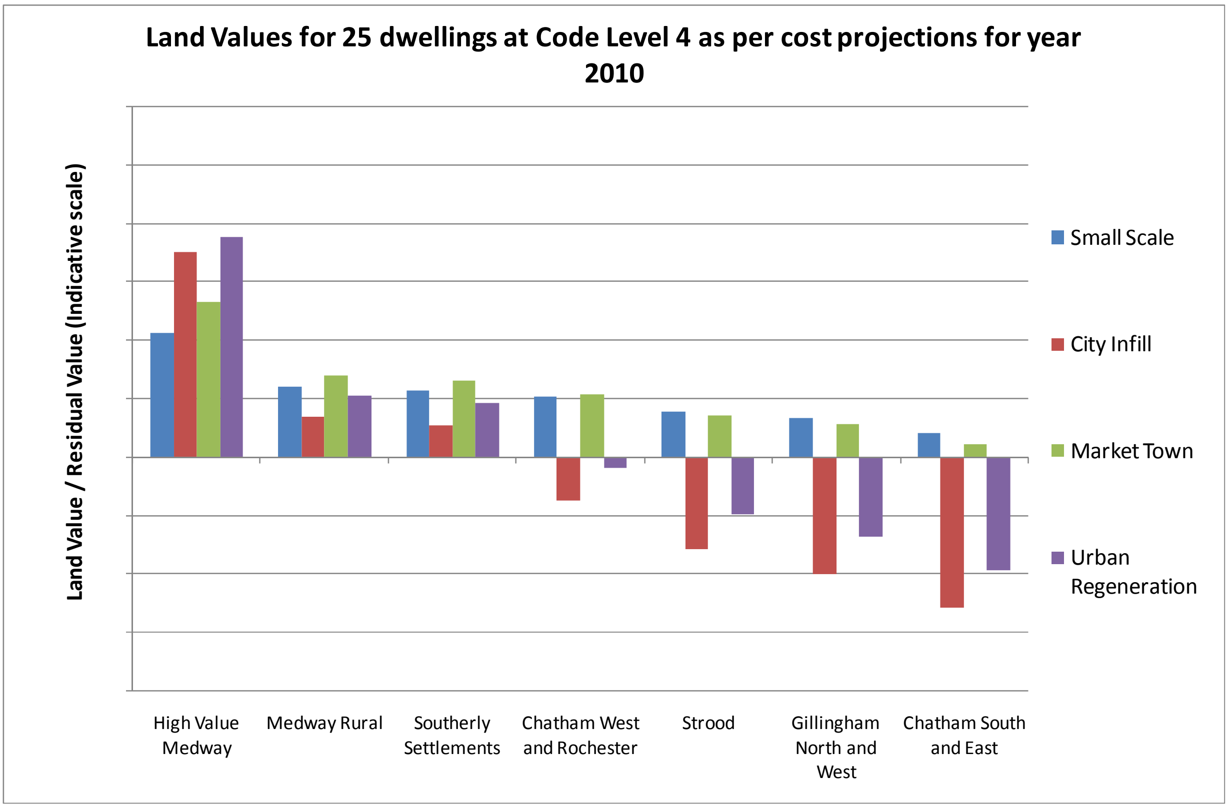


Figure 6.8: Land value as per cost projections for Code Level 4 in 2010

This distribution of land values across the Unitary Authority reflects the spread of market values that have been derived from the Affordable Housing Viability Report (e.g. decreasing land values from High Value Medway to Chatham South and East), with the additional point to note that in all areas except High Value Medway, the development mixes of 'Small Scale' and 'Market Town' are more profitable than the flat-dominated 'City Infill' and 'Urban Regeneration' modes of development. This possibly reflects a local desire to live in houses rather than flats that is translated in market sales values.

In terms of policy orientation for Medway, it can be seen that for 'Small Scale' and 'Market Town' development, land values remain positive throughout the region even under the imposition of CSH Level 4 in 2010. This analysis would suggest that a policy target that requires immediate conformity with CSH Level 4 may be appropriate without hindering development viability. However, this analysis is, of course, generic, and does not make allowance for site-specific factors impacting build cost nor reflect site specific variation in market values. Hence within this notionally 'average' land value analysis, there would no doubt be sites in the lower value areas of Medway that would in fact be pushed beyond viability with the imposition of the higher Code Requirements, leading to the question of whether policy should be developed not to hinder all development in the region, or whether a smaller volume of lower impact development (in carbon emissions terms) is more desirable.

Acceleration of Code 6 to implementation in 2013

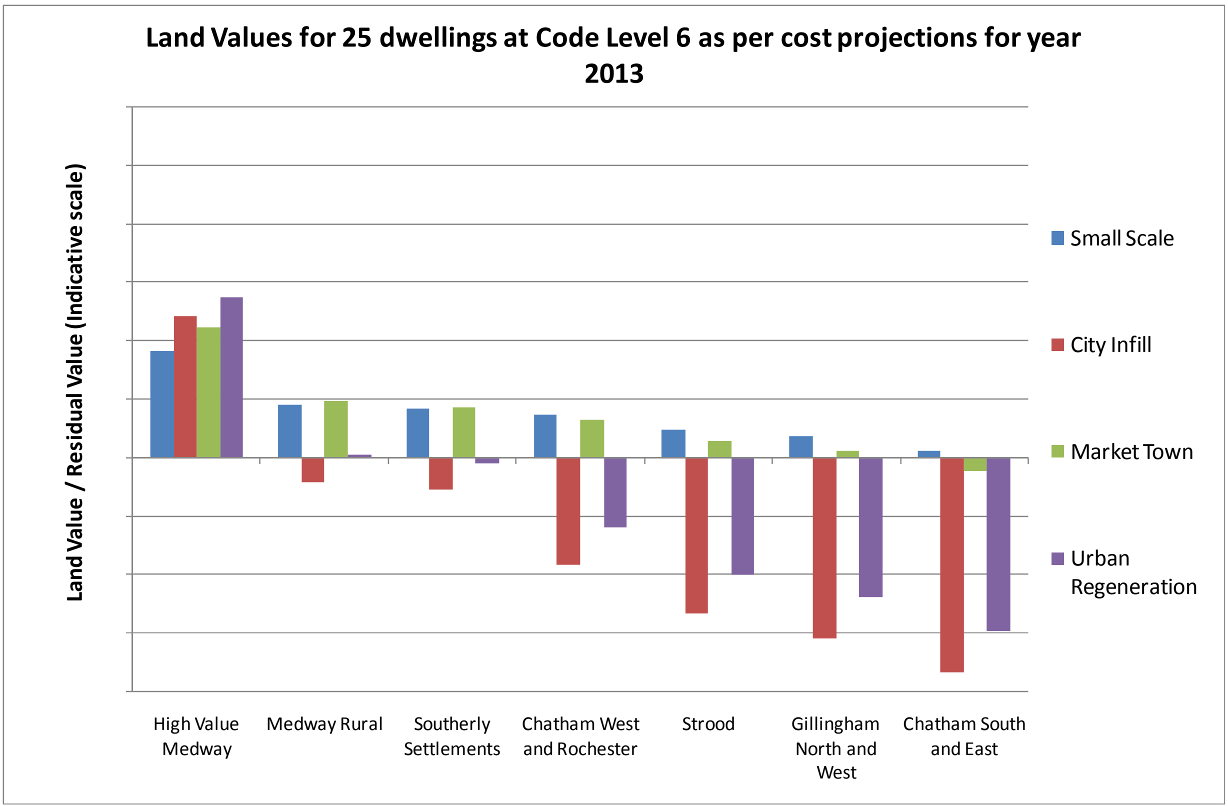


Figure 6.9: Land Values for 25 dwellings at CSH Level 6 in 2013

This chart also illustrates that development would appear viable even at Code Level 6 within High Value Medway in 2013. Viability in other areas depends on development type, and as noted above, the assessment here appears to illustrate that house-based developments (as opposed to flats or apartments) are more viable.

6.1.1.1 Sensitivity Analysis

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

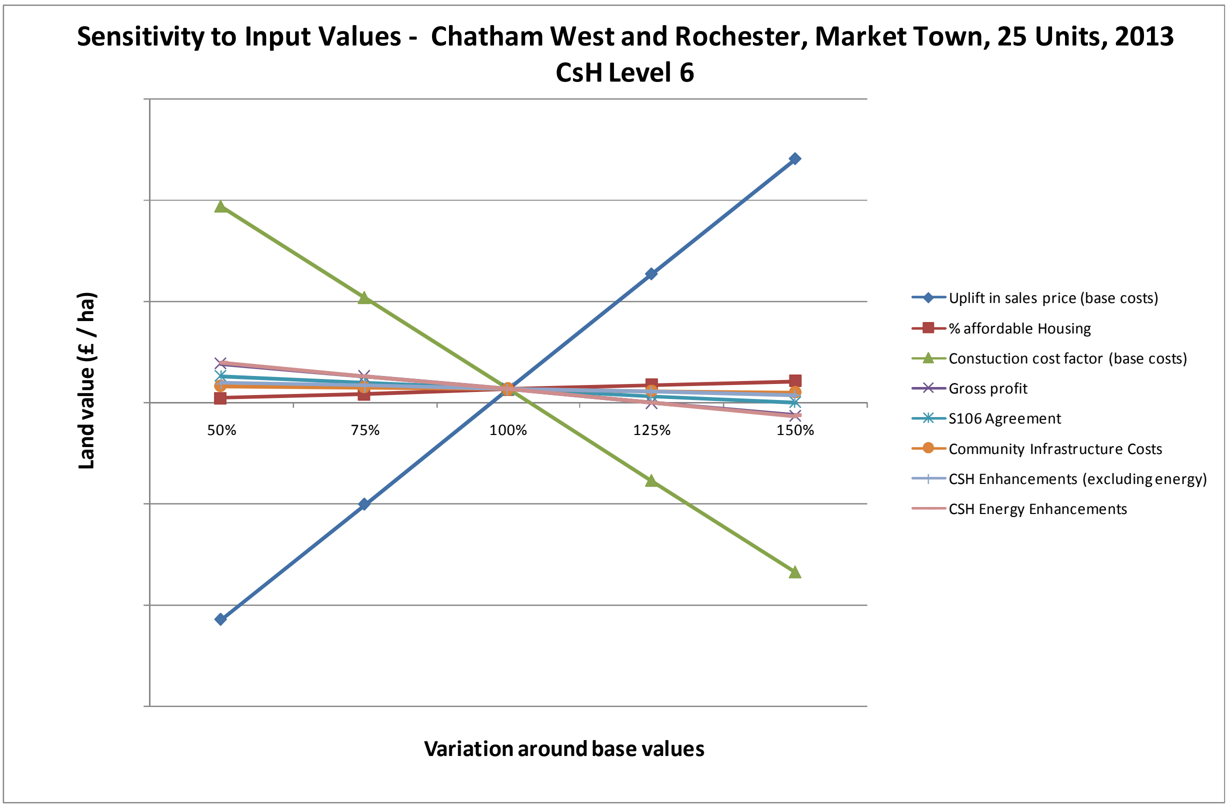


Figure 6.10: Sensitivity chart for viability testing

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

This analysis suggests that from a policy development perspective, it would be appropriate to impose higher standards on development in the knowledge that market conditions and site specific constraints can radically impact viability in directions that policy cannot predict. The implementation and deliverability of higher levels of energy performance should then be assessed on a site-by-site basis as development comes forward, and the onus of evidence of viability should be placed on the developers for schemes above a certain scale.

6.2 Energy Extra-Over Costs to Land Value Approach

This section adopts a second approach to viability testing. Using published land values for the Medway area as a starting point, it compares Land Values with the additional costs that are likely to be borne by developers with the introduction of both the Code for Sustainable Homes and the Community Infrastructure Levy. This test effectively assumes that market values, build costs and other values remain constant over time, whilst the additional costs related to energy (and non-energy matters) of different Code levels will erode land values. At the point where existing land values are equal to the additional costs projected for energy and non-energy related Code for Sustainable Homes elements, development would not be viable, as developers would not be able to offer land-owners sufficient incentive to release their land for sale.

This analysis focuses on different development types and densities. We do not propose a particular threshold for 'viability' due to difficulties associated with valuing alternative uses, site-specific variations in cost estimates and the potential for 'viability' thresholds to change over time. However, the comparison between land-values and energy-related costs will illustrate the comparative contribution that this element of overall construction / development costs to overall financial viability, and will hopefully enable meaningful points to emerge in terms of policy implications.

Three policy options are evaluated here:

- **Policy Option 1 – Government Timescale**

(Code 3 and 25% CO_2 reduction in non-residential in 2010, Code 4 and 44% CO_2 reduction in non-residential in 2013, Code 6 and 49% CO_2 reduction in non-residential in 2016 and zero carbon non-domestic in 2019)

- **Policy Option 2 – Accelerated Timescale**

(Code 4 and 44% CO_2 reduction in non-residential in 2010, Code 6 and 49% CO_2 reduction in non-residential in 2013 and zero carbon non-domestic in 2016)

- **Policy Option 3 – Aspirational Timescale**

(Zero carbon domestic and non-domestic in 2010)

6.2.1 Domestic Buildings' Analysis

These policy options are evaluated against development scenarios as posited by Cyril Sweett in their analysis of the costs of the Code for Sustainable Homes. The various scenarios of development are illustrated below.

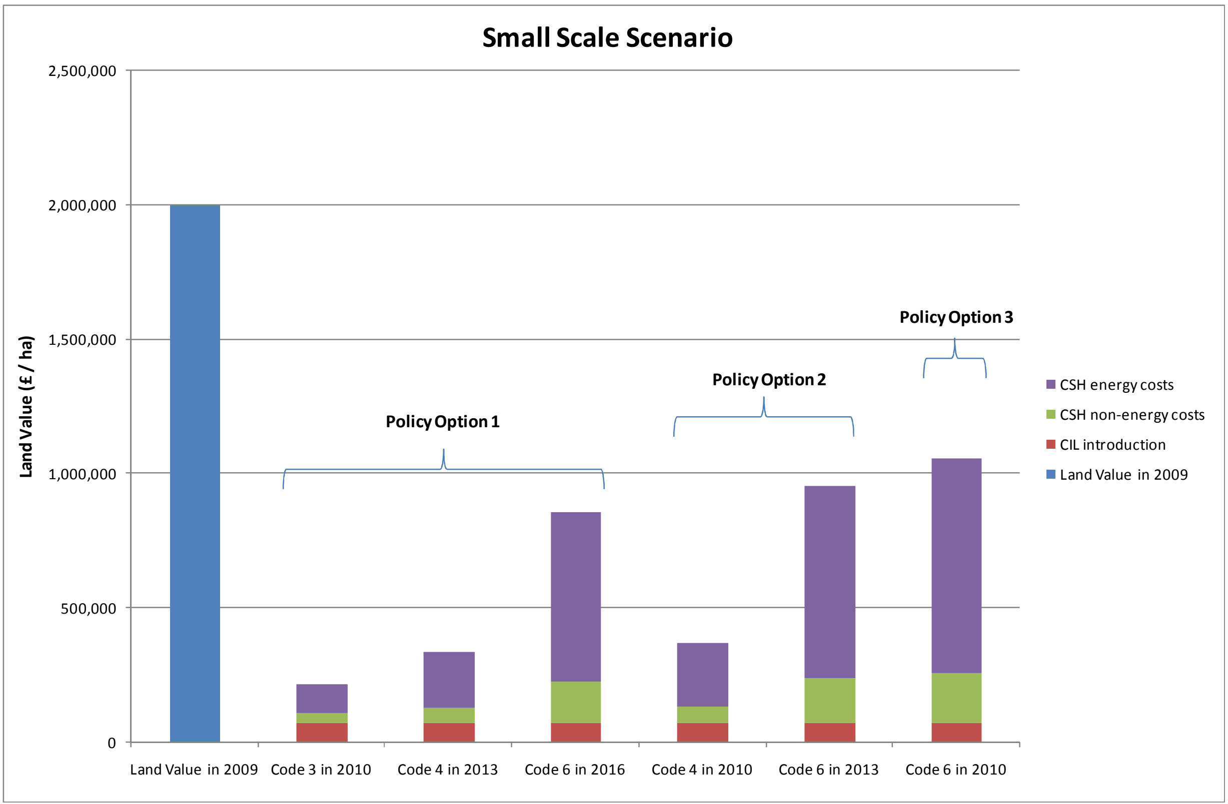


Figure 6.11: Small-Scale Development, Extra-Over Costs Approach

This graph illustrates the projected energy and non-energy related cost of the CSH for small scale development, which contains a large proportion of detached and semi-detached houses.

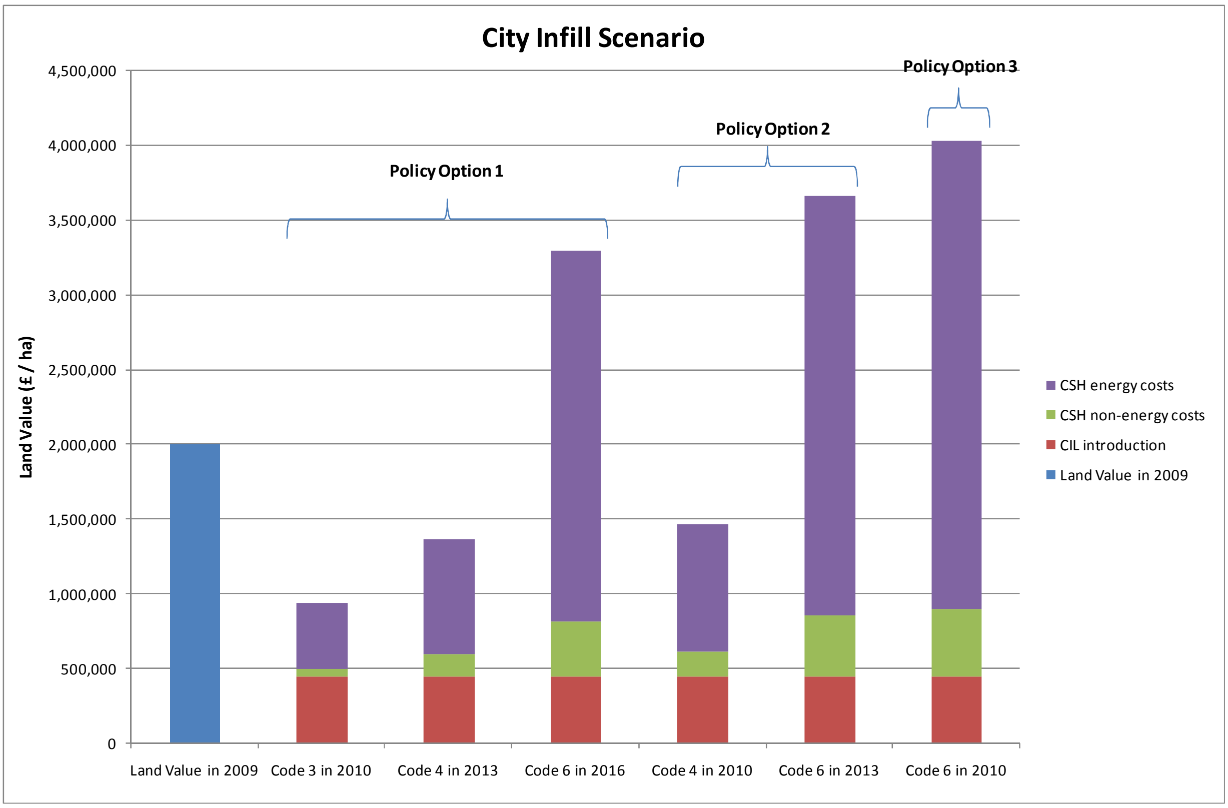


Figure 6.12: City Infill Development, Extra-Over Costs Approach

This graph illustrates the city infill scenario, where a high density of flats is modelled.

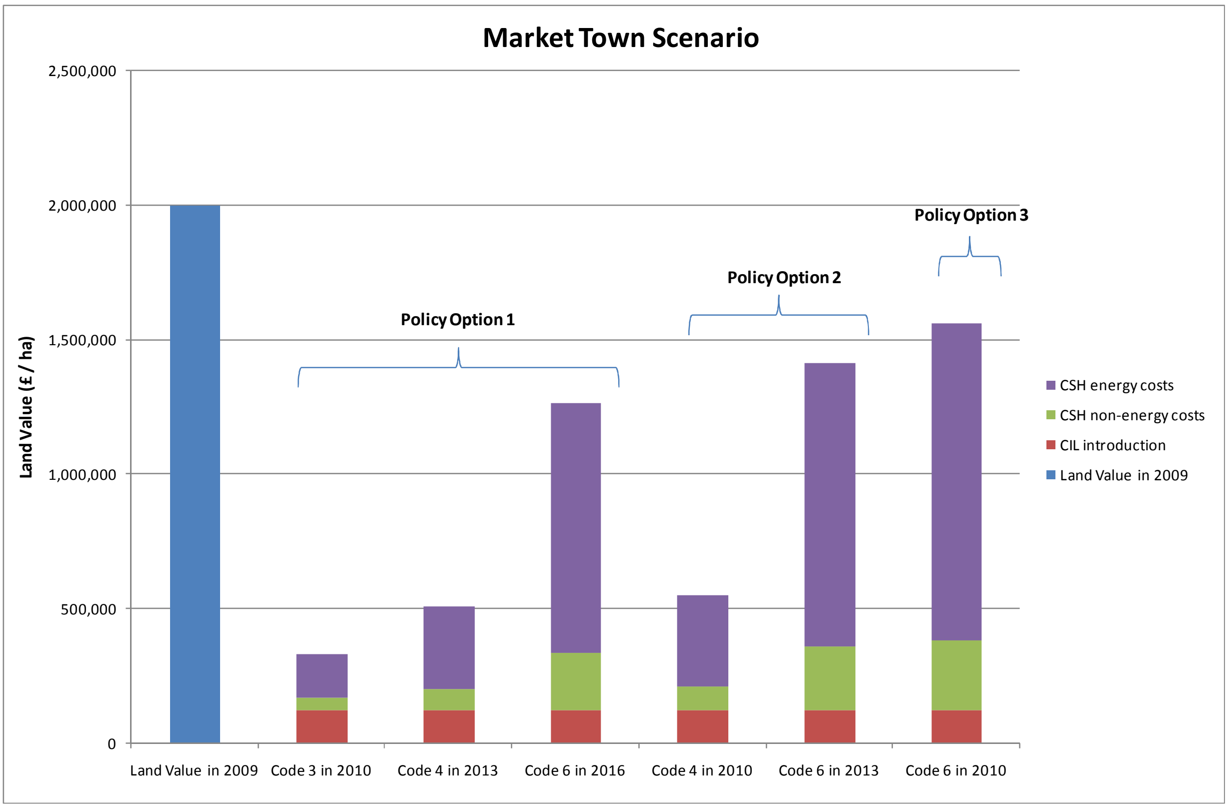


Figure 6.13: Market Town Development, Extra-Over Costs Approach

The market town scenario contains a mix of flats, semi-detached, terraced and detached properties.

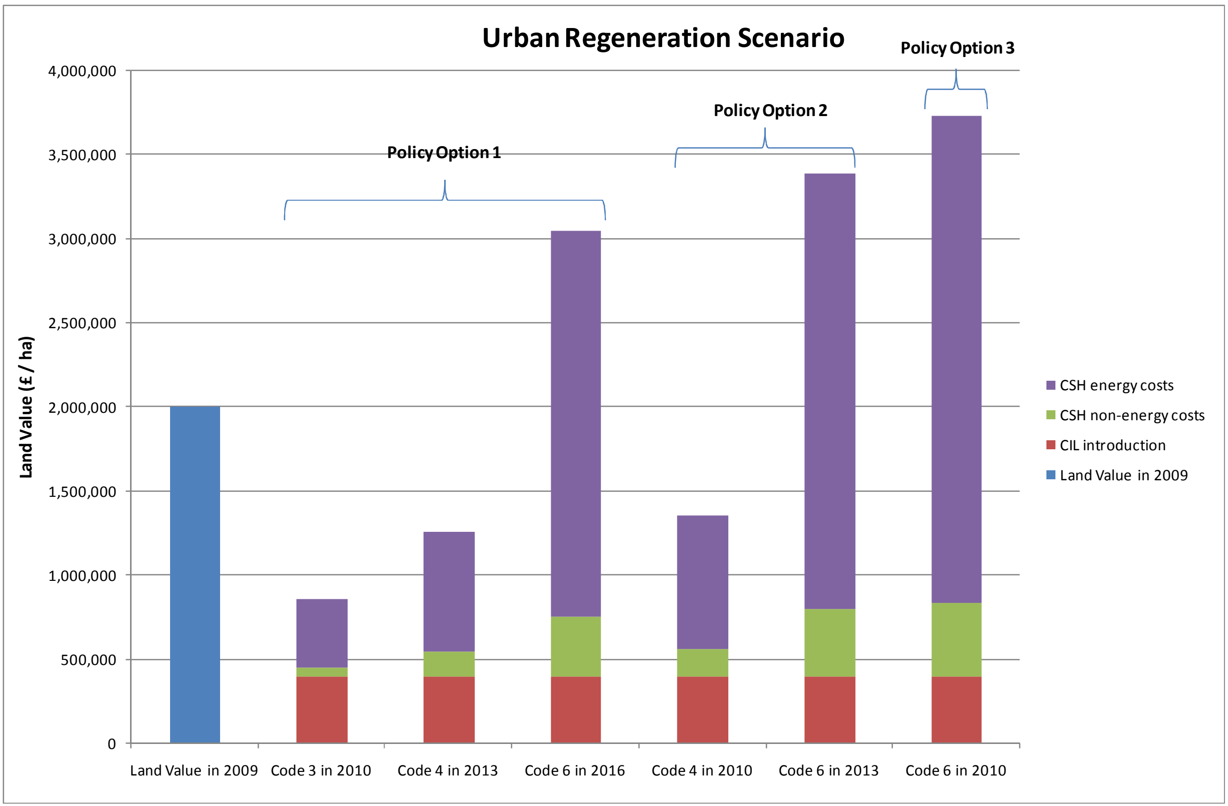


Figure 6.14: Urban Regeneration Scenario, Extra-Over Costs Approach

The urban regeneration scenario represents a high density build scenario where there is a high proportion of flats and a smaller proportion of terraced houses.

The comparison of these graphs above illustrates that where there are higher densities of development, the costs per hectare of the sustainability standards increases.

Scott Wilson does not have detailed and robust land-value data for different development scenarios (or the strategic sites), and hence in this analysis a single value from the VOA has been adopted. However, it may be expected that land value would also increase with development density, and hence that the impact on viability would not be so significant as illustrated, particularly under the higher density scenarios of Urban Regeneration and Urban Infill.

6.2.2 Non-domestic Buildings Analysis

Land value figures for non-domestic use are also published by the Valuation Office Agency[39], and these have formed the basis of analysis of the viability of the non-domestic element of development. The comparative costs of emissions reductions here have been based upon an analysis of the calculation of required emissions reductions for each phase of government

[39] Valuation Office Agency Property Market Report, July 2009, http://www.voa.gov.uk/publications/property_market_report/pmr-jul-09/industrial_land.htm#south_east, accessed 17th May 2010.

policy, multiplied by a flat rate of assumed cost of carbon reduction at the figure posited in the recent Government Impact Assessment analysis on the move towards zero-carbon non-domestic buildings[40].

On this basis, the following results for anticipated Government Regulatory compliance have been calculated.

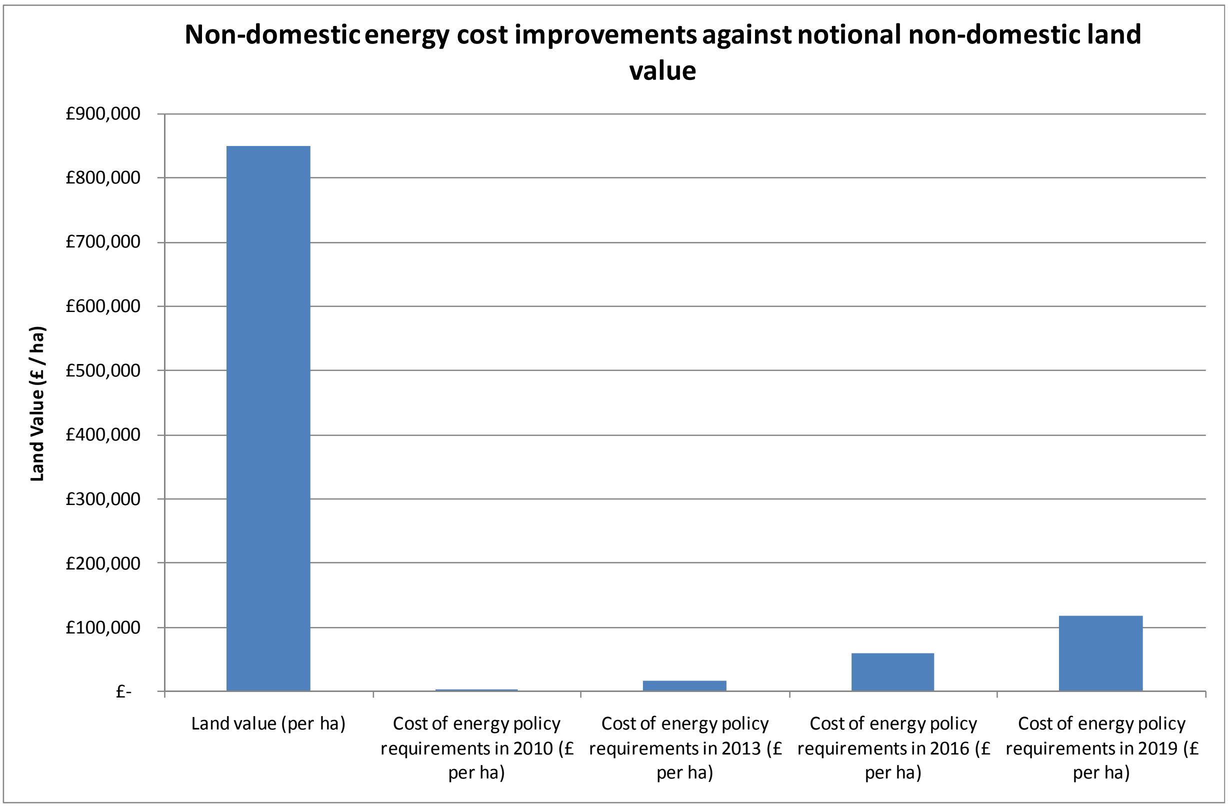


Figure 6.15: Non-domestic viability impact results

This graph only takes account of the notional energy-related compliance costs at different points in time, and is therefore only a partial snapshot of overall land-development viability. However, it can be seen through comparison with the domestic graphs above, that energy-related costs appear to represent only a smaller element of land value. This can perhaps be attributed to the fact that non-domestic land value relates more to the operational income levels that might be expected from a site, rather than the value of assets built upon it.

On this basis, it would appear that there is potential to accelerate standards beyond existing government requirements, particularly as improved energy standards should lead to reduced operational costs. However, Scott Wilson does not consider this evidence sufficiently robust to recommend this policy orientation in this case.

[40] DCLG - http://www.communities.gov.uk/documents/planningandbuilding/pdf/1284609.pdf, accessed 17th May 2010

6.3 Further Development Viability Considerations

6.3.1 Implication of Feed-in Tariff / Renewable Heat Incentive

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

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

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

6.3.2 Implication of ESCos & District Heating

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

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

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

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

installation cost and the energy centre plant. Another party, e.g. the developer therefore has to fund the remainder of the DH installation cost.

The regulatory context in which ESCos are operating is changing with the introduction of the Renewable Heat Incentive, and for renewable fuelled installations this may change the balance of contribution that ESCos are willing to make. It is beyond the scope and resource of this project to identify the impact of the RHI in a DH / ESCo context, and the knock-on effects in terms of costs of more stringent environmental standards. The approach adopted here assumes a standard cost for DH installations that is then examined in sensitivity analysis.

6.3.3 Interpretation of Viability Testing Results and Policy Implications

Estimating viability is challenging as the proceeding sections have identified, predominantly due to the complexity of factors and variation to be considered on a site specific basis. The challenge of this policy-level study is arguably many-fold more complicated, as a range of development sizes, a range of geographic areas, and a range of development periods need to be tested. With both limited sources of information and resources, there are necessarily limitations to the outputs of the testing carried out in this study.

The regulatory landscape for carbon emissions and energy reduction is complicated and still developing. The changing national policy background against which this study is being undertaken means that almost all cost estimations are projections and forecasts. Nevertheless, given these difficulties and limitations in viability projections there is still value and interest in the results of the testing carried out in this project.

The 'elemental approach' illustrates that whilst many factors affect viability, nearly all of these pale in comparison with wider market fluctuations. This means that whilst in the current depressed market some of the increase in costs implicit in higher environmental standards would appear to burden developers in areas where there is already very little or no margin available; in uplifted market conditions, the same measures would arguably only have a minor impact on land value. How should this be addressed in Policy? It is Scott Wilson's view that policy should be sufficiently flexible to deal with changing market conditions and hence, to allow for a more favourable market for development, any policy demands should be accompanied by the onus of evidence of non-viability being provided by developers (above a certain threshold of development).

The elemental approach also shows that there are large variations in viability between geographic areas of Medway. Again, rather than try to develop a complicated 'map' of areas of market value, it is suggested that the most appropriate policy solution to reflect this is to place the onus of evidence of viability or non-viability on developers. In this context, this could take the form of localised market research evidence that demonstrates sales values / land values. This would then inform the implementation of policy approach to particular sites.

The 'Extra-over Cost' approach to viability highlights different aspects of the imposition of accelerated policy standards. First, in terms of land value per hectare, it shows that there is a lower uplift in energy costs for less dense, low rise development in comparison with high-density city-infill type schemes. The analysis shown here suggests that for all types of high-density schemes Code 6 appears to be cost prohibitive at current estimations of market conditions. This analysis is not definitive, however, and does not reflect the potential for higher land values to be seen than have been adopted here (derived from the Valuation Office Agency). In terms of the three strategic sites, this suggests that Lodge Hill may be the most suitable arena for the imposition of higher standards in terms of energy – however, it must be noted in this context that there are other wider considerations (e.g. cost of infrastructure and potential remediation costs) for this more diffuse site that may offset the comparatively low cost for higher carbon performance standards.

7 Policy and Implementation Options

7.1 General Core Strategy Policies

7.1.1 Defining Criteria-Based Policies

Planning Policy Statement 22 (Renewable Energy) advises that planning applications for stand-alone renewable energy installations should be assessed against specific criteria that are set out in local development documents (see Paragraph 6). Criteria-based policies should be drafted to reflect local circumstances, focusing on the key criteria that will be used to judge applications, with more detailed issues set out in Supplementary Planning Documents (see Paragraph 7). In areas that are nationally designated (such as the High Weald Area of Outstanding Natural Beauty), there is a presumption that small-scale developments should be permitted, provided that there is no significant environmental detriment to the area concerned.

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

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

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

7.1.2 Consequential Improvements

In common with many other Local Planning Authorities, the majority of planning applications relate to proposals for small extensions to private dwellings ('Householder Applications'). In 2008, these accounted for nearly two thirds of all applications determined by the Council. Whilst individually they have very limited impact in terms of increased energy demand and carbon emissions, the cumulative impact of these proposals is significant, even compared with many major schemes proposing new development. As a result, a number of Councils have considered the introduction of planning policies that seek to address the impact of extensions to existing dwellings. This also provides the opportunity for Planning Authorities to bring about measures that will contribute to National Indicator 186 (per capita reduction in CO_2 emissions).

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

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

Uttlesford Council's Building Control team is responsible for agreeing with the householder which measures are to be implemented to the rest of the building fabric as part of the condition. Householders are asked to implement as many of the eight measures as are practical and cost effective (defined by a payback period of less than 7 years), limited to no more than 10% of the total cost of the extension. In the first two years of implementation of these measures, Uttlesford believes it has achieved a reduction in energy consumption in the District's dwellings of nearly 2,000 MWh, equivalent to over 400tonnes of CO_2 emissions per annum.

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

7.2 Applying the Standards of the South East Plan

The South East Plan (May 2009) includes a number of policies relating to sustainable development, energy and water infrastructure and reducing carbon emissions, as previously summarised (see Section 1.6). Policy NRM 11is set out in full below:

POLICY NRM11: DEVELOPMENT DESIGN FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY

Local authorities should:

i. **promote and secure greater use of decentralised and renewable or low-carbon energy in new development, including through setting ambitious but viable proportions of the energy supply for new development to be required to come from such sources. In advance of local targets being set in development plan documents, new developments of more than 10 dwellings or 1000m² of non-residential floorspace should secure at least 10% of their energy from decentralised and renewable or low-carbon sources unless, having regard to the type of development involved and its design, this is not feasible or viable**

ii. **use design briefs and/or supplementary planning documents to promote development design for energy efficiency, low carbon and renewable energy**

iii. **work towards incorporation of renewable energy sources including, in particular, passive solar design, solar water heating, photovoltaics, ground source heat pumps and in larger scale development, wind and biomass generated energy**

iv. **actively promote energy efficiency and use of renewable and low carbon energy sources where opportunities arise by virtue of the scale of new development including regional growth areas, growth points and eco-towns.**

Local authorities and other public bodies, as property owners and managers, should seek to achieve high levels of energy efficiency when refurbishing their existing stock.

Section (i) of Policy NRM11 defines a target for on-site generation of decentralised and renewable or low carbon energy as a minimum requirement for development proposals exceeding a specified size (greater than 10 dwellings or 1,000m² of non-residential floorspace). The policy proposes this target be adopted by local planning authorities as an interim measure in advance of setting their own targets and thresholds through their DPDs. The supporting text that follows the policy in the South East Plan gives no direction on how Local Planning Authorities should implement the policy.

Medway Council has not yet sought to implement SEP Policy NRM11 in any planning decisions that we are aware of since publication of the South East Plan, although are expecting to do so shortly on Rochester Riverside. However, NRM11 presents the opportunity to the Council to bring forward a policy framework that can be designed to reflect the specific circumstances within Medway as outlined in the following sections.

7.2.1 Defining Parameters of Energy Policy

7.2.1.1 Defining which elements of building energy use should be included within the policy.

Policy NRM11 makes no distinction between ‘regulated’ and ‘unregulated’ energy use. The term ‘regulated’ energy relates to all energy consumed within a building for purposes that are included in assessment of compliance with Part L of the Building Regulations. For example, within a house, regulated energy relates only to comfort heating and hot water (including heating system pumps and fans), and fixed lighting (i.e. ceiling and wall-mounted lights). All other energy uses such as cooking and electrical appliances are excluded, and together comprise ‘unregulated’ energy use. The proportion of total energy demand (i.e. the sum of regulated and unregulated energy) arising through unregulated energy uses can be significant, as shown below.

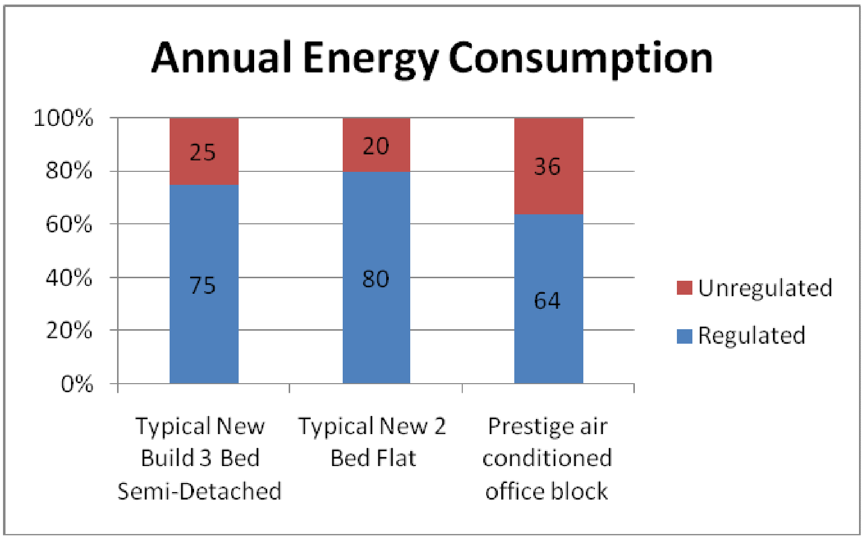


Figure 7.1: Energy Consumption of Dwellings against Offices

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

7.2.2 Policy Targets Based on Carbon Emissions

7.2.2.1 Expressing the policy targets in terms of carbon emissions.

Policy NRM 11 sets a minimum requirement for decentralised renewable or low carbon (LZC) energy production, expressed as a percentage of energy consumption. The purpose of this policy is to address the objectives of reducing carbon emissions arising from energy use in new buildings. However, the mechanism by which this policy is to be assessed is the amount of low or zero carbon energy generation. The consequence of this is that the policy focuses on the means (LZC energy generation), rather the objective (reduced carbon emissions).

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

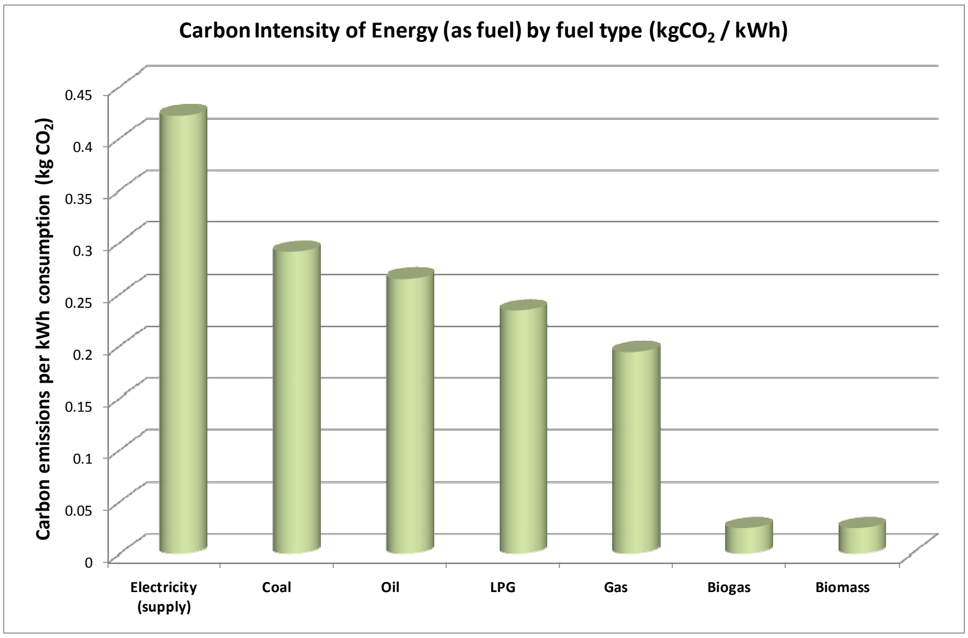
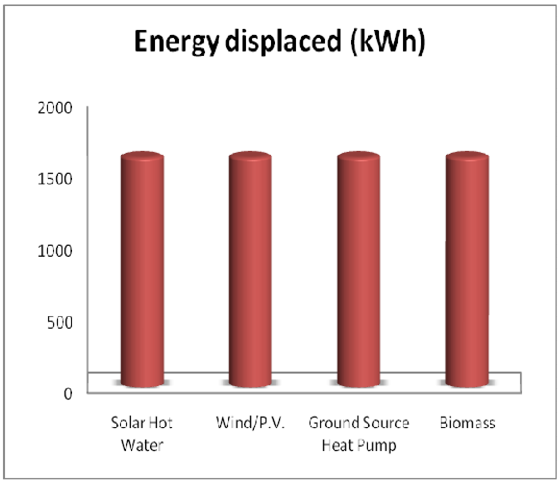


Figure 7.2: Carbon Intensity of Fuel Types

Therefore, the reduction in carbon emissions arising from different types of LZC technology is dependent on the type of conventional energy that they are replacing. As a general rule, renewable electricity generation (for example from a photovoltaic panel) provides a greater saving in carbon emissions than an equivalent amount of energy generated by a renewable heat source (such as a solar hot water panel). Furthermore, heat-producing LZC technologies that require an input of electricity to operate (such as ground source heat pumps) make the smallest contribution to reducing carbon emissions. As a result, some proposals may meet the target defined in NRM 11 by generating at least 10% of energy on site through LZC means, but achieve a significantly more modest reduction in carbon emissions. The figure below illustrates this.



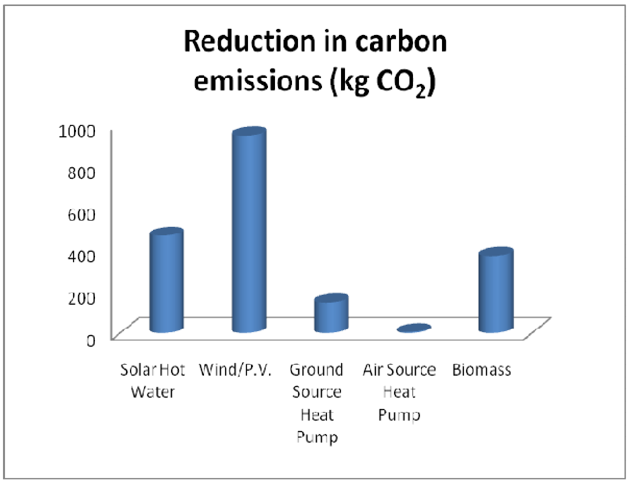


Figure 7.3 & Figure 7.4: Energy Displaced and Reduction in Carbon Emissions

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

7.2.3 Setting a Policy Based on Betterment over the Building Regulations

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

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

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

7.2.4 Removing the Size Threshold

SEP NRM 11 does not include minor planning applications for development proposals of 10 houses or less, or less than 1,000 m^2 non-residential floorspace. In Medway, 333 minor applications were determined in the year ending June 2009. These schemes comprise a significant proportion of all development proposals within the Borough.

Adopting a policy that removes the size threshold currently set within SEP NRM11 would enable the Council to secure significant reductions in energy consumption and carbon emissions in smaller developments.

A further option is to consider applying the targets set out in the SEP policy on a phased basis, with an initial requirement for at least 10% of energy to be on-site generated LZC energy, to be replaced through the phased introduction of higher standards over time. This would enable the Council to bring development in line with the Government's planned introduction of milestones towards achievement of zero carbon homes by 2016 (and other buildings by 2019) as set out in Section 2.3.

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

Merton was the first council in the UK to adopt a prescriptive planning policy requiring new commercial buildings to generate at least 10% of their energy needs from on-site renewable technology. It was adopted in 2003 and influential to the point where many other local authorities adopted it, or similar policies. The policy has been challenged, and successfully defended albeit the national policy backdrop to its introduction has now considerably changed. It is important to note that the 'Merton Rule' was introduced requiring a percentage contribution in *energy* terms, whereas the policy has now been updated to require a percentage contribution to *carbon emissions*. As noted above in Section 7.2.2, the use of carbon emissions targets is considered more appropriate in the wider context of both current legislation and given the use of technologies such as CHP (which increase on-site energy consumption, whilst decreasing overall site emissions).

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

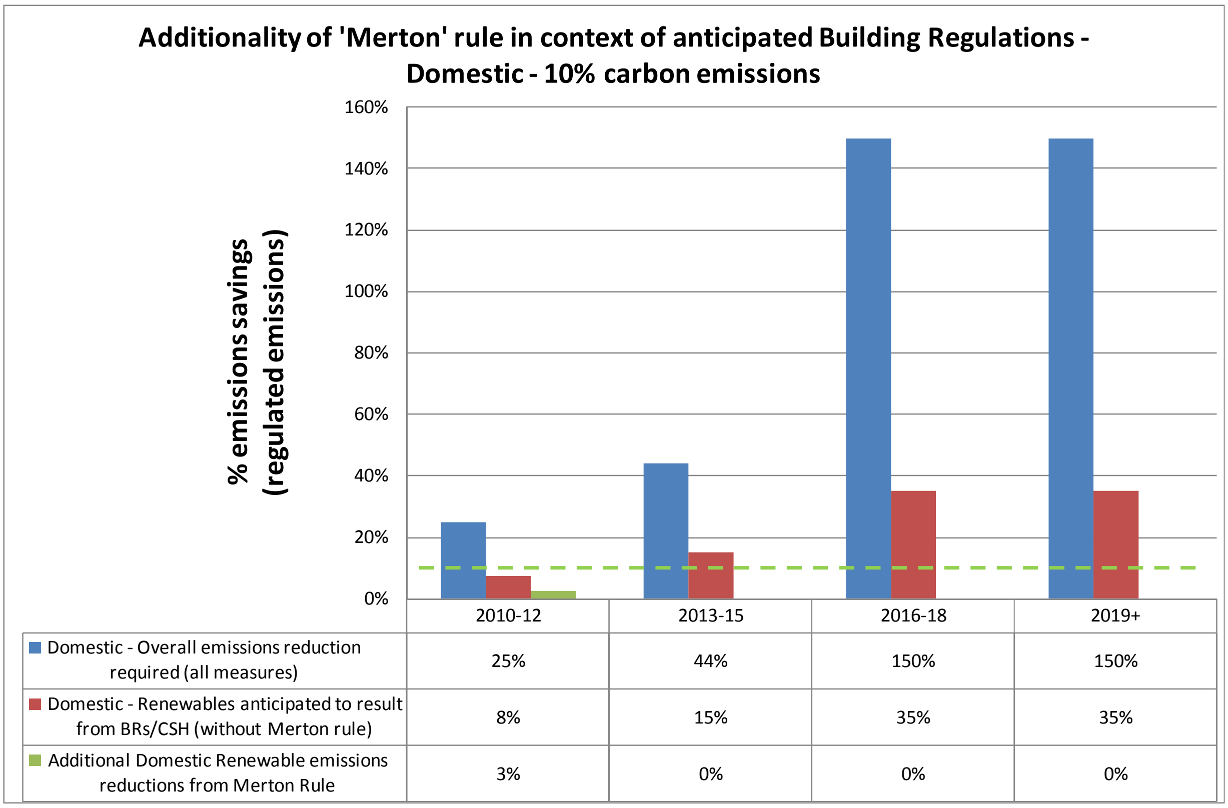
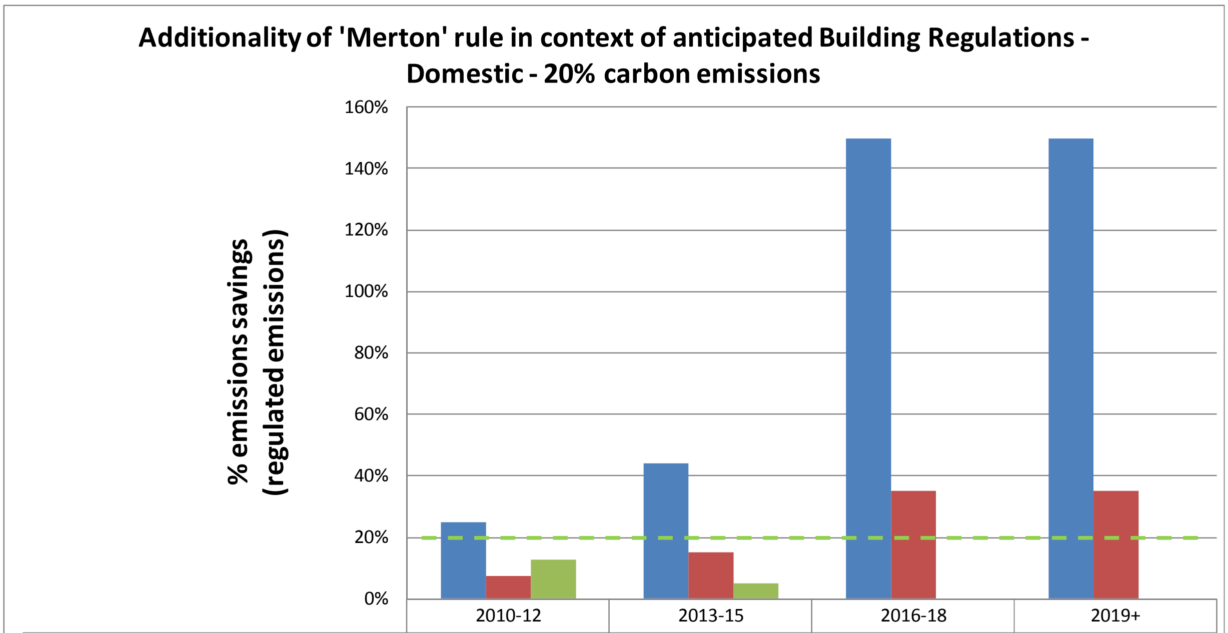


Figure 7.5: Additionality of Merton Rule at 10%

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

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

Further levels of Merton-style rule are shown below:

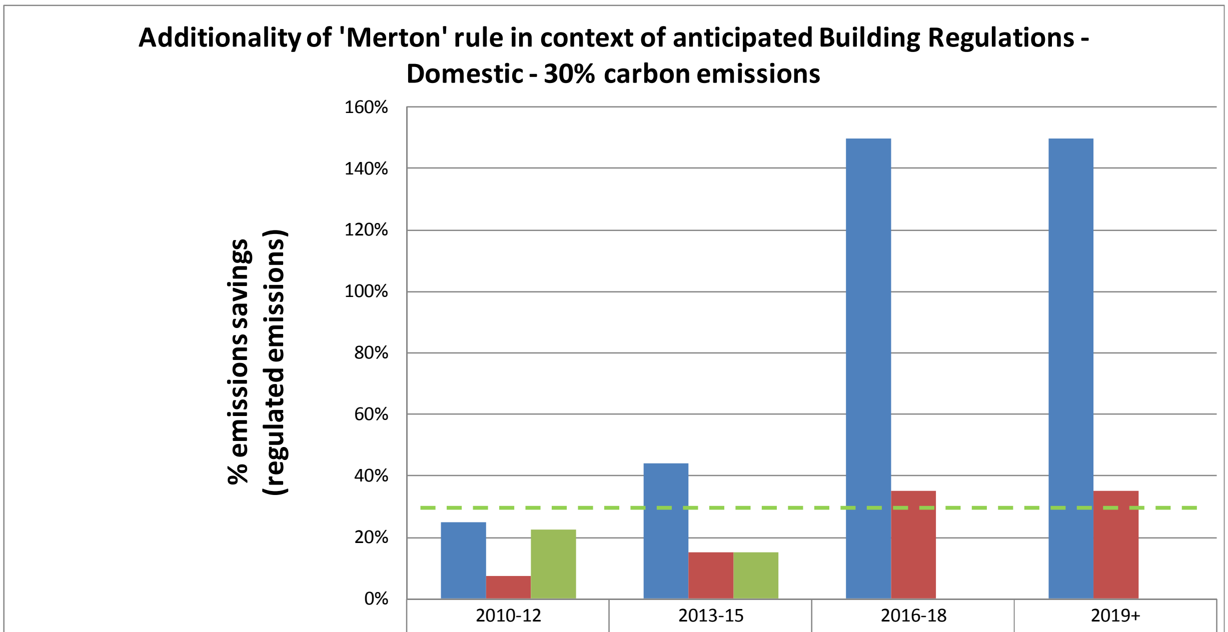


	2010-12	2013-15	2016-18	2019+
Domestic - Overall emissions reduction required (all measures)	25%	44%	150%	150%
Domestic - Renewables anticipated to result from BRs/CSH (without Merton rule)	8%	15%	35%	35%
Additional Domestic Renewable emissions reductions from Merton Rule	13%	5%	0%	0%

Figure 7.6: Additionality of Merton rule at 20%

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

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



	2010-12	2013-15	2016-18	2019+
Domestic - Overall emissions reduction required (all measures)	25%	44%	150%	150%
Domestic - Renewables anticipated to result from BRs/CSH (without Merton rule)	8%	15%	35%	35%
Additional Domestic Renewable emissions reductions from Merton Rule	23%	15%	0%	0%

Figure 7.7: Additionality of 'Merton Rule' at 30%

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

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

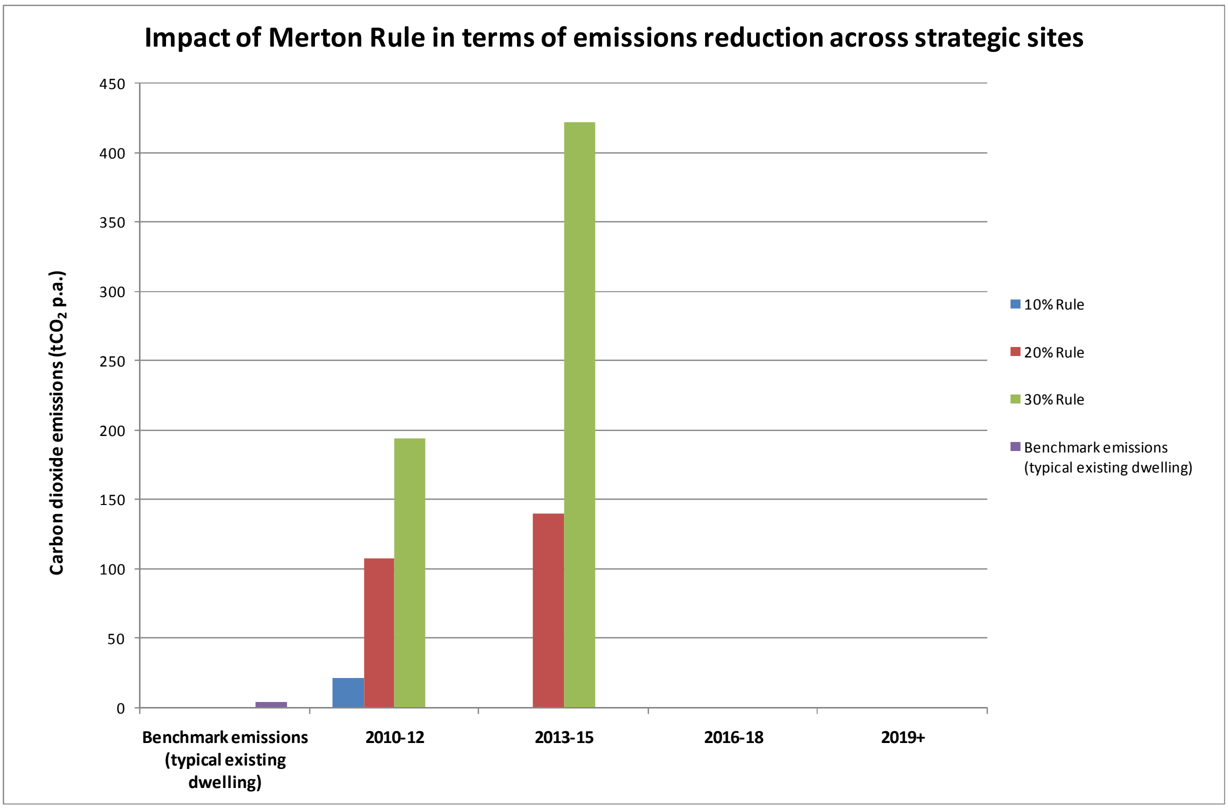


Figure 7.8: Carbon emissions impact of Merton rule at different levels across strategic sites

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

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

7.2.6 Establishing a 'Carbon Fund' – Policies Seeking Aspirational Levels of Carbon Reduction

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

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

This approach offers a number of benefits for Medway:

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

The mechanism for contributing to a carbon fund could take a number of forms. For example, Milton Keynes Borough Council in its Local Plan policy D4 (adopted 2005), has set a levy based on a single one-off payment set at £200 per tonne of carbon. The levy is calculated on the basis of an aspirational target for all residential developments of more than 5 units (or over 1000m2 commercial floorspace) should be carbon neutral. This permits new developments to have net emissions as long as they pay into the fund to enable these emissions to be off-set elsewhere within the borough. The payment is based on estimated annual emissions from the new development and recognises the cost-effectiveness of offsetting carbon emissions through low-cost measures to reduce energy use within existing stock. Milton Keynes set the levy on the basis of an offset feasibility study it commissioned in 2004.

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

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

Ashford sets out how this policy is to be implemented through an SPD. In common with Milton Keynes, Ashford requires developments to pay a levy based on the predicted emissions arising from energy use in a development over the course of year. A one-off payment is made into the fund, the sum being based on the 'Shadow Price of Carbon', currently set at £27/tCO_2 or

£99/tC.[41] This has the advantage of using the monetary value set by Defra, and avoids detailed justification of the cost per tonne of emissions by the council. However, the cost of carbon emissions defined within the Shadow Price is considerably lower than the figure set by Milton Keynes and significantly lower than the assumed abatement cost of £95/tCO_2 by the Government under Scenario 2 – Balancing on-site and off-site. Significantly, Ashford states that it will use the sums paid into the carbon fund for reducing energy consumption within existing buildings and tree planting.

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

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

By providing the opportunity to relax the requirement to meet the more demanding standards for water and energy on-site, the policies that have been adopted recognise the high costs that can be encountered in achieving these standards within new developments (especially as these developments are likely to achieve significant improvements in energy and water efficiency over existing stock), and the potential to achieve equivalent levels of energy and water efficiency at a lower cost through measures to improve the performance of existing stock. Therefore, this can be an effective mechanism for stabilising the growth in emissions through new development where the additional costs of achieving high standards of energy efficiency and/or carbon reduction threaten to exceed the economic viability of a scheme.

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

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

council responded by submitting a re-structured policy and further evidence that sought to address the Inspector's comments. However, following further concerns expressed during and following the examination in respect of a number of other substantive issues in the Cotes Strategy (in addition to the Sustainable Construction policy), the Council withdrew its Core Strategy.

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

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

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

- A clear explanation of the circumstances in which a development proposal may mitigate its impact through off-site measures
- The minimum standards that are to be achieved on-site
- The funding levels to be applied to calculate the value of contributions to a carbon fund
- The mechanism to be applied to enable developers to contribute to the fund
- Whether such measures can be carried out directly by the developer
- An indication of the programme of off-site measures that will be targeted for implementation through a carbon fund
- Evidence of the ability of the council to deliver to this programme

7.3 Existing Initiatives in Medway

The following describes two of the main sustainability initiatives already in place within Medway; Making an "Eco-Advantage"; and LoCUS.

7.3.1 Making a real "Eco-Advantage"

The Eco-Advantage project is a unique partnership of three Local Authorities (Medway Council (Lead Partner), Reading Borough Council, Basingstoke and Deane Council) together with the social enterprise Cementaprise Training, who are developing and delivering an ESF Innovation, Transnational and Mainstreaming project to raise climate change awareness and skills. The partnership is focusing on four of the South East England Development Agency's 'Diamonds for Growth', Medway being the lead partner, Reading, Basingstoke and Milton Keynes. These Diamonds are 'centres of economic activity which can act as catalysts to stimulate prosperity' in South East England.

Eco-Advantage is developing and piloting a range of bite sized courses, to help low skilled workers and unemployed people develop a practical understanding of the issues around climate change and give them some practical skills to take into the workplace. It is about giving people a real "Eco Advantage" in the labour market.

The training courses are covering a general introduction to climate change issues, and a range of modules which are sector specific focusing on: construction, hospitality and retail. The training is targeted at entry level, levels 1 / 2 and is delivered with holistic Social Incubation support, which is designed to empower individuals who face multi barriers to engagement in the labour market and as active citizens.

Supporting engagement into the workplace is the testing and development of a Work Ability model and tools, together with the creation and access to a job-ready database of candidates with "Eco- Advantage" Skills, thus matching the needs of local employers to the green skills of local people.

Participants in the Eco-Advantage project will be encouraged to become volunteer ambassadors in their local communities to help develop eco awareness. For many this will be a useful stepping stone into paid employment as well as having a real local impact.

The project is developing, piloting and mainstreaming Eco Advantage short training programmes aimed at lower skills front line staff, in addition to helping businesses gain eco-competitive benefits and is also helping to support the start up and development of local third sector environmental businesses.

Pilot work has already been undertaken with prisoners nearing release, which has raise several issues around the high level of interest in the issues of climate change, but also the challenges of comprehension of such a vast and complex subject and resulting feelings of inability to make a difference.

The project will gain advantage from its transnational working with partners in Germany, Finland and Estonia, who have similar interests, new tools and methodologies for the engagement and empowerment of individuals and business into the issues of climate change. Currently Eco-Advantage is building the Eco-Sapiens website which will be an open online repository for all tools and methodologies developed.

7.3.2 LoCUS - Low Carbon Understanding SMEs

The project will aim to deliver meaningful reductions of CO_2 and other ecological footprint outcomes by bringing landlords and Small and Medium Enterprises (SMEs) together to action a plan for a low carbon future.

Clusters

The project focuses on developing 'clusters' of SMEs and Landlords and working with them to reduce carbon and ecological footprint. Landlords often find that energy use is managed by their tenants. Tenants often find that the building fabric is controlled by their landlord. This is a key point in considering how to move environmental improvement forward in the SME sector.

SME Carbon footprint

SMEs contribute almost one half of the carbon footprint of businesses in the UK. Local Authorities find this sector challenging to work with due to their sheer number and the complexity of networking.

The Partners

LoCUS is based on a partnership of Business Link, Local Authorities in Reading (Lead Partner), Medway, Oxford and Basingstoke and Deane with their Local Strategic Partnerships and leading research and technical organisations. It aims to build local clusters and access local network support and regional expertise. It utilises existing work and takes forward significant cohesive programme to establish activity in a growing network of clusters across the Southeast.

7.4 Measures to Support Implementation of Policies

7.4.1 Pre-application Discussions

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

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

Please refer to Section 7.1.4, which provides an example of how this may be implemented through Planning Performance Agreements (PPAs).

7.4.2 Skills and Training

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

A process for ensuring knowledge transfer and assimilation would be required both internally within the Council, the Local Strategic Partnership and Medway Renaissance. This would likely involve a training program for selected planning officers and a simple process to ensure knowledge and skills were not lost if staff moved on. Therefore, it would be essential to ensure more than one officer were adequately trained at any one time, enabling the continual monitoring and measurement of applications, in accordance with energy policy and standards, as outlined further in Section 7.1.6.

Skills and training are important both within the Council and also for occupants of existing stock and developers, in order to provide an insight into the options available for carbon reduction. Leaflets providing information and training days run buy the Council may be required to further educate and disseminate information within Medway UA and the Council. This may best be facilitated via cross-boarder initiatives, through reliance on the shared resources and knowledge of the Local Strategic Partnership.

7.4.3 Local Development Orders (LDOs)

The Planning and Climate Change Supplement to PPS1 encourages planning authorities to consider using LDOs as a means of helping secure low and zero carbon energy supplies. LDOs could form a suite of tools (including guidance and design codes) that can help stimulate investment in energy infrastructure. For example, by granting additional permitted development rights relating to the installation of community heat plant, some of the cost and uncertainty associated with new low carbon energy infrastructure may be reduced, hence deeming developers less resistant to funding its provision. Other potential applications of an LDO include: broadening the range of 'permitted development rights', in some or all of a Local Authority area, to cover a wider range of householder micro-renewable energy installations; or providing a 'framework permission' for a decentralised energy network to serve a development and/ or existing buildings.

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

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

7.4.4 Planning Performance Agreements (PPAs)

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

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

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

7.4.5 Supplementary Planning Documents (SPDs)

Whilst Planning Authorities are expected to set out their requirements relating to decentralised energy supply or the environmental performance of developments in their DPDs, the use of SPDs is an effective mechanism for guiding developers on the more detailed aspects of a proposal, including matters relating to implementation and phasing. An SPD has been developed for Chatham Centre and Waterfront and there is a Development Brief for Rochester Riverside. A further SPD is being developed for Lodge Hill, Chattenden.

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

A similar approach could be applied by Medway Council to a number of small- or medium-sized developments (for example below 50 house units) where the scale of development is inadequate, or their location inappropriate, for the use of community-scale renewable energy (such as a 0.25MW wind turbine). In such cases small- or medium-sized developments could pool their planning contributions to provide new renewable or low carbon energy infrastructure and hence meet a prescribed proportion of the developments' energy consumption or carbon emissions target, for example, through the use of a Carbon Fund as mentioned in Section 7.2.6 above.

7.4.6 Monitoring and Review of Policies

The Supplement to PPS1 emphasises the importance of effective monitoring of policies to ensure implementation is line with an Authority's strategy, and this should be incorporated into annual monitoring arrangements.[42] Monitoring should provide key data on outcomes to assess performance against a Council's policy objectives and Regional Spatial Strategy (RSS) targets.

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

[42] See Paragraph 34 of the Supplement to PPS1 for details.

8 Conclusions and Recommendations

Global and national policy has gone through a transition, having caught up with the scientific certainty associated with our changing climate and the impact associated with development, which requires a response to mitigate the effects of climate change and global warming through a reduction in building-related carbon emissions.

The study sets out a **clear evidence base** which reviews a balance between policy drivers, local constraints and opportunities, including the implications of cost on development viability, with the key aim of developing sustainable communities within Medway UA. These legally binding national policies require Medway to contribute to the UK's renewable energy target of 15% and take incremental steps to reducing total carbon by 80% by 2050 and ensure this is implemented in a way that reflects the local context and physical characteristics of the region.

The carbon footprint analysis of Medway UA confirmed **1,233 (0.28%)** tonnes of carbon per annum which can be compared to 432,727,000 for the UK. Based on an evaluation of this carbon footprint against the LDF energy policy options presented in the Core Strategy, Issues and Options Consultation, the figures for domestic and commercial emissions projections identify there is only a **limited level of impact on overall building stock emissions that new-build policy can make**. If the overall goal of policy design and implementation is to reduce global carbon emissions, then this analysis strongly points towards the need for **policy measures that target the emissions of existing buildings as well as new construction.**

Further analysis was undertaken to determine the overall capacity for the installation of Low and Zero Carbon technologies, which was estimated as **641 MW**. The results from this section were used to feed into the Strategic Sites analysis, which presents different scenarios for meeting the respective targets for domestic and non-domestic buildings at different phases across each site. If a strategic view is taken to addressing energy requirements throughout the lifetime of the development, **district heating** should be considered at an early stage, as it appears to be the most cost-effective option either through gas-fired (in Rochester Riverside and Chatham Centre and Waterfront) or biomass (on all three sites) Combined Heat and Power.

Further low and zero carbon technologies should be considered on a development site basis. It should be noted that wind resources are only viable in Lodge Hill. Microgeneration options have been identified in the Energy Opportunities Map across the whole of Medway.

In terms of **development viability**, the 'elemental approach' illustrates that whilst many factors affect viability, nearly all of these pale in comparison with wider market fluctuations. This means that whilst in the current depressed market some of the increase in costs implicit in higher environmental standards would appear to burden developers in areas where there is already very little or no margin available, in uplifted market conditions the same measures would arguably only have a minor impact on land value. Policy should be sufficiently flexible to address changing market conditions and hence, to allow for a more favourable market for development, any policy demands should be accompanied by the onus of evidence of non-viability being provided by developers (above a certain threshold of development).

8.1 Recommended Policy Orientation

This section summarises the main findings from this evidence base study to be considered by Medway Council to inform the development of policies for the Local Development Framework.

- From the analysis described in Chapter 3, it is clear that the impact of new development is relatively insignificant in terms of carbon dioxide emissions reductions compared to existing stock (refer to the "Straight Line graph"). Therefore, policy should also address existing stock emissions reductions.
- On an Authority-wide basis, the thresholds adopted in the South East Plan are reasonable for Medway. Nevertheless, it should also be considered that the vast majority of applications are for small developments, i.e., for less than 10 dwellings or 1,000 m^2 of non-residential floorspace. Consideration should, therefore, be given to policy specific to minor applications, i.e., less than 10 dwellings.
- While the Energy Opportunities Map presented in Chapter 4 provides guidance on which areas are more favourable for each technology evaluated, policy should not be technology-specific as such. The Energy Opportunities Map is should be used to inform the validity of applications, especially during potential negotiations between Medway Council and developers.
- Site-specific policy orientation should be provided for each of the Strategic Sites based on development typology and site characteristics. Because the time span of development extends after 2016 and -2019 where all new buildings will have to be zero carbon, District Heating, would be required by all sites, and consideration should be given to linkage with the early phases where targets could be met through other sources of renewable energy.
- To be more precise, the following examples have been identified in this study where specific sites within Medway demonstrate synergies for district heating or specific opportunities for deployment of renewable technology generation. These will need to be further explored if Medway is to achieve national targets in line with the step change to zero carbon:
    - Lodge Hill: There is a distinct opportunity for large wind and there are potentially District Heating opportunities through Kingsnorth power station, which may be supported by a leisure centre to the north-west of the development site. Please refer to Section 4.3 for details on the current limitations to linking Kingsnorth to Lodge Hill.
    - Rochester Riverside: There is significant opportunity on Rochester Riverside for District Heating through the University of Creative Arts on Interface Land and a number of schools, which could provide the necessary anchor loads.
    - Chatham Centre and Waterfront: This site benefits from having a hospital in close proximity and a number of schools and two leisure centres. The proposed development site at Gillingham Waterfront is also in close proximity to Chatham Centre and Waterfront and potential synergies may exist for a heat network.
    - Rochester Airfield: Further District Heating opportunities are identified around Rochester Airfield. The airport, prisons and clusters of schools are likely to provide the necessary anchor loads.

- It is evident that, due to the diversity in Medway, there are very different viability levels at different areas and policy should account for this. For details, refer to Chapter 6 on the Development Viability Analysis. Please note that the onus for supplying appropriate site- and development-specific evidence for viability should be imposed on developers.
- Recent and expected government incentives for low and zero carbon technologies, such as Feed-in Tariffs and the Renewable Heat Incentive or Enhanced Capital Allowances, significantly alter the economics of these technologies.
- In order to ensure consistency with government standards, any policy targets should be expressed in terms of carbon dioxide emissions reductions. The baseline should be Building Regulations Part L (2006) up to 2015 and 2018 for domestic and non-domestic buildings respectively (regulated emissions). Thereafter, the baseline should further include unregulated emissions from occupant electricity (lights, cooking and other appliances).
- Imposing higher levels of the Code for Sustainable Homes and BREEAM for strategic sites ahead of Government timescales have been considered specific to the opportunities and constraints identified in this study.
    - Lodge Hill: Large wind appears to be technically viable on Lodge Hill and development viability analysis suggests that the acceleration of sustainability standards in line with Policy Option 2 (Code Level 4 and 44% improvement over Building Regulations 2006 for non-domestic buildings in 2010 and Code Level 6 and 49% improvement over Building Regulations 2006 for non-domestic buildings in 2013) could be viable. However, this analysis has not been able to reflect all local site-specific parameters and, hence, this requires further testing. At this stage it is proposed that Medway should impose Policy Option 2 for developments at this site and also ensure that the renewable and low carbon decentralised energy target contained within the South East Plan (NRM11) is adhered to. Given the strategically important location of this site along potential district heating routes from Kingsnorth Power Station, it is also strongly encouraged that Medway impose a requirement that all development is this area is made compatible with the future installation of a DH network.
    - Rochester Riverside: This site is embedded within an urban environment with access to the River Medway and on this site it is not feasible to install large wind. As a result of the urban constraints and the nature of the development itself (e.g. predominantly flats) the achievement of Code Level 6 and significant on-site reduction in carbon emissions in non-domestic buildings is likely only to be achievable with the use of biofuel CHP. On this basis it is proposed that for this site potential delivery of fuels via the River Medway should be encouraged to minimise traffic impacts. This technology is also likely to be more viable on a whole-site basis, and hence it is recommended that district heating is encouraged for the whole site including the early phases of development. Viability testing shows that the imposition of Code 4 is likely to erode domestic land values significantly. On this basis it is recommended that Government standards are not accelerated for this site.
    - Chatham Centre and Waterfront: Embedded within the urban context, this area benefits from potential linkages to existing hospital, university and leisure complex sites. The viability of realising synergies between these nodes has not yet been fully explored, but should be encouraged both for local economies of scale, and also to

enable a future DH network from Kingsnorth Power Station to serve a wider selection of loads. Viability testing shows that the imposition of Code 4 is likely to erode domestic land values significantly. On this basis it is recommended that Government standards are not accelerated for this site.

- Renewable Target Setting: Outline analysis of a Merton-style rule has shown that a target of 20% or more would have some impact on carbon emissions in the Unitary Authority in the years prior to the introduction of zero-carbon standards. However, as viability outside the High Value Medway areas is demonstrated to be eroded by the imposition of CSH Levels 3 and 4 alone, the additional burden of further requirements is not considered appropriate within the wider Unitary Authority. Figure 7.2 demonstrates the additional contribution to emissions savings that a Merton-style rule of 20% would result in, therefore, in the period up to 2016, additionality (in terms of carbon savings) would result from policies that stipulated this in Higher Value areas within Medway, such as the Strategic Sites identified in this study. It should be noted, the imposition of a rule of this nature could lead to the undesirable reduction of energy efficiency measures in favour of renewable technologies. Therefore Medway may want to consider including a carbon reduction target from energy efficiency measures to support the deployment of a Merton-style rule.

APPENDIX A: UKCIP09 Projections

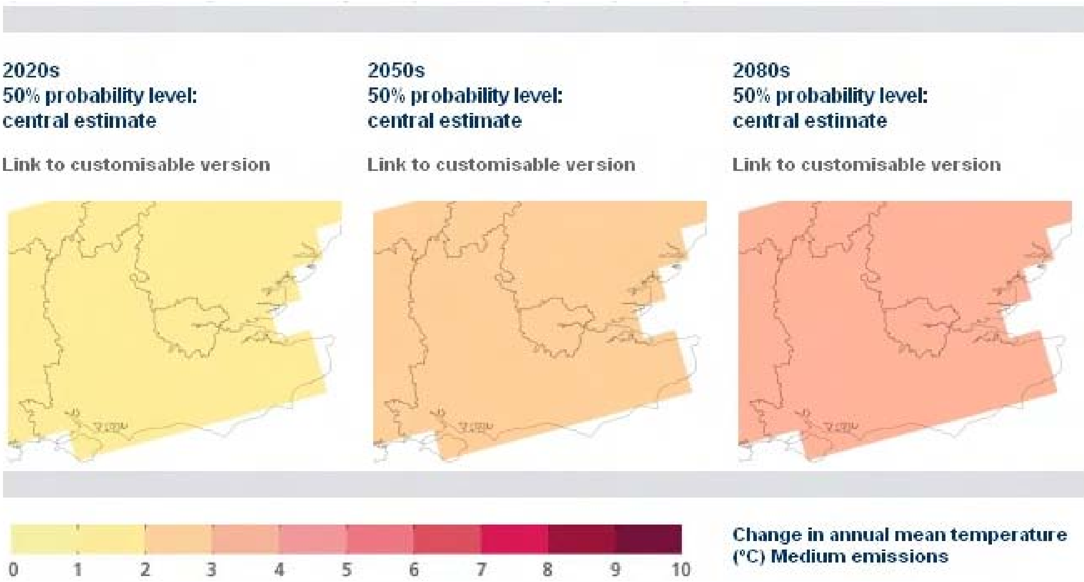


Figure E0.1: Annual mean temperature changes over differing time periods (50% probability level, medium emissions scenario)

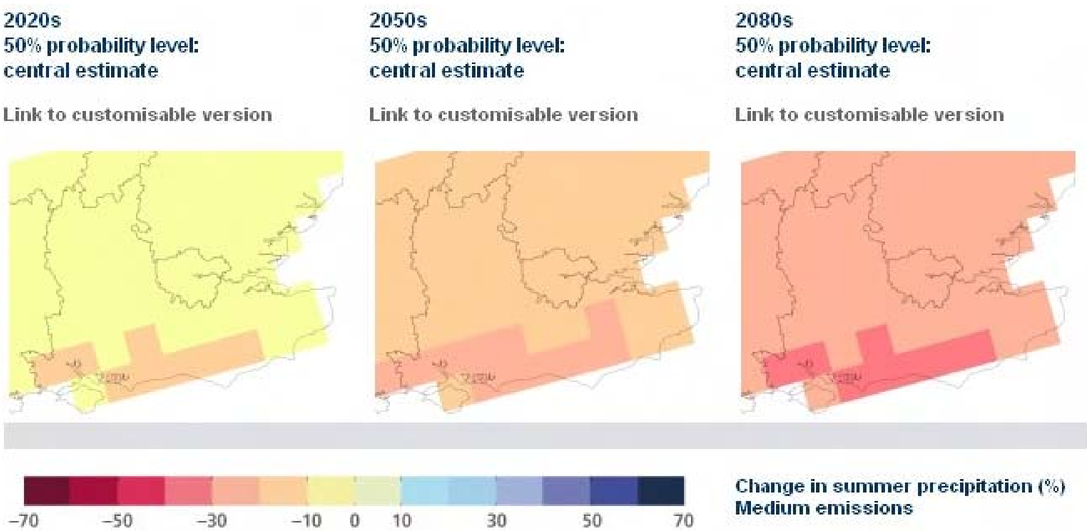


Figure E0.2: Summer precipitation changes over differing time periods (50% probability level, medium emissions scenario)

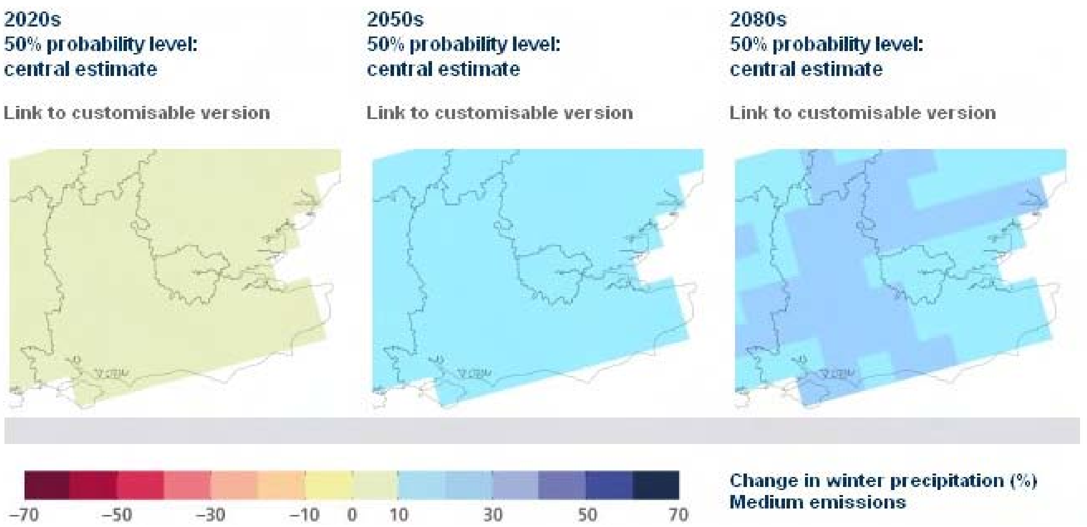


Figure E0.3: Winter precipitation changes over differing time periods (50% probability level, medium emissions scenario)

These maps highlight that under the medium emissions scenario, by 2080 Medway Council may see particularly sharp redistribution of current precipitation patterns, such that there is at least 10% more rainfall during the winter and, even more strikingly, at least 30% less rainfall during the summer. The 3 degree C temperature rise prediction appears to be evenly distributed across the region.

If global emissions levels are successfully reduced such that a low emissions scenario applies, then the following changes are predicted:

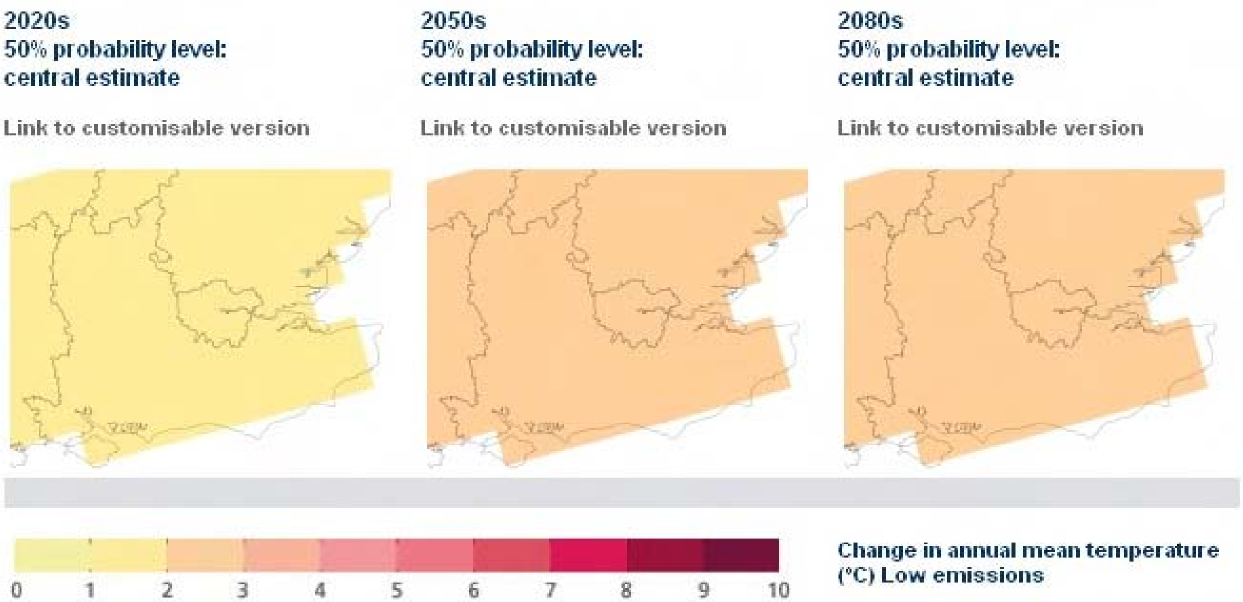


Figure E0.4: Annual mean temperature changes over differing time periods (50% probability level, low emissions scenario)

This illustrates that at this probability level, the estimated temperature rise by 2080 is reduced against the medium emissions scenario.

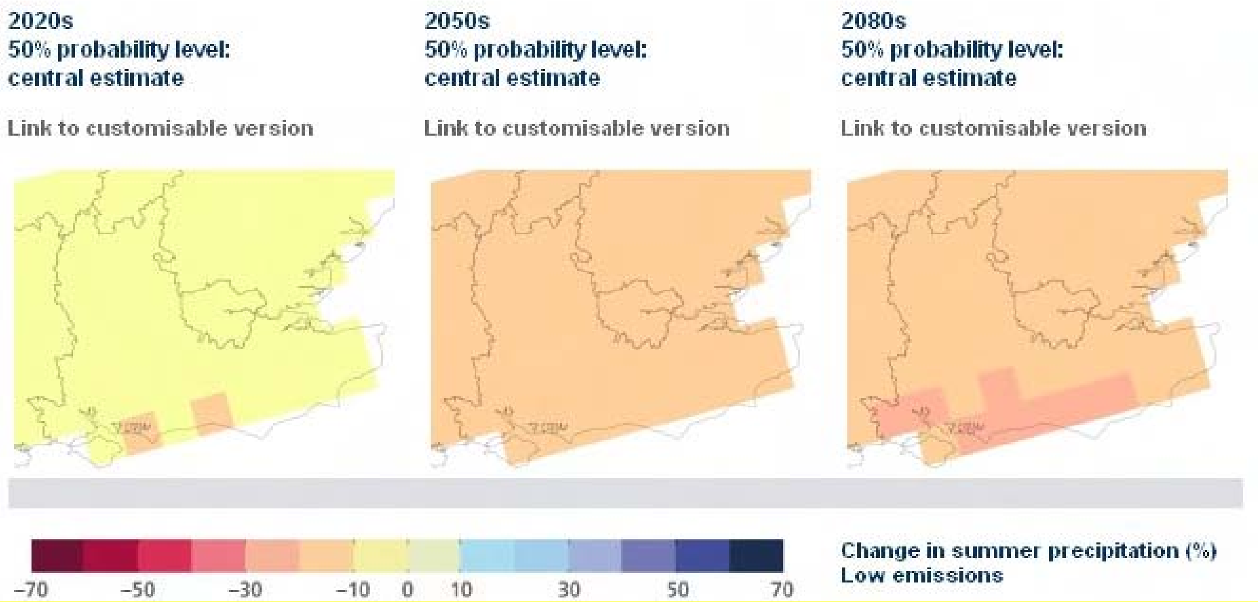


Figure E0.5: Summer precipitation changes over differing time periods (50% probability level, low emissions scenario)

At all projected time-periods, this figure illustrates that if a low emissions scenario is applied, the estimated level of change in summer precipitation is considerably reduced against a medium emission scenario.

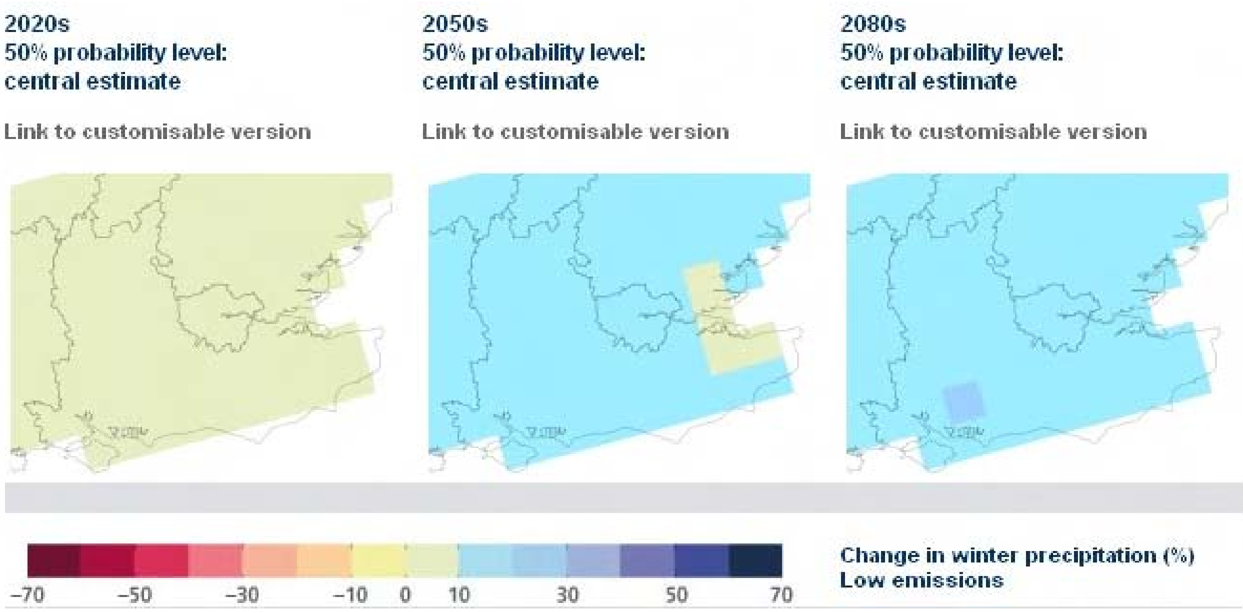


Figure E0.6: Winter precipitation changes over differing time periods (50% probability level, low emissions scenario)

This final figure, in comparison with the medium emissions scenario, shows that the expected level of change in winter rainfall would be slightly reduced under a low emissions scenario.

APPENDIX B: Electricity Distribution Infrastructure in Medway