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Renewable energy and sustainable construction study

Final report for West Oxfordshire

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Cherwell District Council and West Oxfordshire District Council
Renewable energy and sustainable construction study

A report by **CAG Consultants**
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Executive Summary

This joint study, commissioned by West Oxfordshire and Cherwell District Councils, is intended to provide an evidence-based understanding of the local feasibility and potential for decentralised, renewable and low carbon technologies; local targets for decentralised and renewable or low carbon energy; and local requirements for sustainable construction. The study will inform the policies contained within the two local authorities' Core Strategy Development Plan Documents as part of the Local Development Framework. (See chapter 1).

A review of national and regional policy indicates that the Government requires that Core Strategies give sustainable energy a higher profile and provide guidance on renewable energy targets, spatial guidance, including identifying any suitable areas for development, criteria policy and development-specific targets. Where appropriate, local planning authorities are encouraged to add to Regional Spatial Strategy (RSS) polices and proposals in the furtherance of action on climate change. The UK Renewable Energy Strategy 2009 has significantly raised the target for renewable electricity to 30% and introduced a 12% renewable heat target, both to be achieved by 2020. These targets have yet to be reflected in RSS policy and will be very challenging to achieve. (See chapter 2).

The South East Plan, RSS for the region, is relatively up to date (2008) and while it covers most of the ground set out above there are some significant gaps in relation to current national policy and guidance. In particular it does not include a renewable heat target or district-specific renewable energy targets, its criteria policy for renewables development is limited in scope, and it does not provide any spatial guidance for the development of renewable and low carbon energy. It does however include a clear definition of the scale of wind development that may be considered within the region's designated landscape areas. (See chapter 2).

A review of progress in delivering renewable energy in the Thames Valley and Surrey sub-region, using statistics compiled for RSS monitoring purposes (as at 2007), indicates that the majority of installed capacity is located at two large scale electricity from biomass plants. There has been a slow rate of progress in installing renewables, and planned capacity almost exclusively comprises smaller wind schemes. No monitoring information is available at a district level. (See chapter 3).

There are significant constraints on the development of large-scale renewable energy schemes, particularly for wind turbines in West Oxfordshire due to its highly-valued landscape, including the Cotswolds Area of Outstanding Natural Beauty (AONB), and its historic environment, which are subject to significant protective safeguards. In addition, the dispersed settlement pattern in the district means that large-scale wind turbines on most sites will generate some amenity impacts and this development pattern will also limit the opportunities for district heating schemes. The district is also used extensively for aviation activities, and this is likely to act as a further significant constraint on large-scale wind turbine development over extensive areas, although the specific impacts on aviation activities will need to be assessed on a site-by-site basis in consultation with airfield operators. (See chapter 3)

The appropriateness and potential of renewable and low carbon technologies for use in new developments has been considered, taking into account scale-related issues. In the case of small scale renewables (photovoltaics, solar hot water, ground and air sourced heat pumps, micro hydro, biomass heating systems and small scale wind), provided that the basic operational requirements are in place these technologies can play a useful role, although viability and feasibility will vary from site to site. The review of larger scale technologies includes Combined Heat and Power (CHP)/district heating, and wind. (See chapter 4)

In respect of larger scale CHP/district heating, the potential benefits include very efficient use of fuel, which can be renewable. Constraints include the high initial cost of infrastructure, a requirement for high density and preferably mixed development, and a conflict with UK energy policy which is built on choice. The potential for large scale CHP/district heating in West Oxfordshire has been examined in some detail in respect of each of the site options for major development in Witney, Carterton, Chipping Norton, Eynsham and Woodstock. The most promising sites have been identified and it is recommended that the Council should aim to include CHP/district heating in developments with at least 200 medium density dwellings where there is some potential complementary heat load within 1km provided by non-housing land uses and activity – schools, hospitals, leisure centres, business and industry. It is also concluded that by requiring Code for Sustainable Homes level 4, or higher, housing developments are more likely to incorporate CHP or district heating. (See chapter 4).

In respect of larger scale wind developments, a review of key constraints including wind speed, the Cotswolds AONB, ecological designations and air traffic operational requirements using GIS mapping has identified a number of areas that warrant further investigation. The opportunities identified are relatively scattered and located in the north and west of the district, most of which is included within the AONB. There is no obvious pattern of clusters or groupings that would lend themselves to identification in the Core Strategy descriptive text or by symbol in the Key Diagram. It is suggested therefore that the Core Strategy text be limited to pointing out that while there is some potential for larger commercial wind turbines, the pattern of development is likely to be one of single turbines or small clusters, scattered rather than being grouped in a particular part of the district. Some of the areas identified may lend themselves to the development of community-owned single turbines or small wind farms with some level of community ownership. The list of areas identified is not exhaustive and developers may bring forward other sites for consideration. (See chapter 4)

The findings of the study have been used to provide a commentary on the development sites identified in the West Oxfordshire 2009 *Core Strategy So Far: Interim Position*

Statement and the 2008 Core Strategy Issues and Options Consultation. In respect of the larger development sites in Witney, Carterton and Chipping Norton the study notes their potential for the use of CHP/district heating, particularly with regard to the overall size of the site, the possibility of achieving higher densities of housing development, and the proximity of other development that could help to diversify heat load. (See chapter 5).

Making an assessment of policy wording options for the West Oxfordshire Core Strategy is a key output of the study and is dealt with in detail in chapter 6. Drawing from the earlier review of national and regional policy, suggestions are put forward covering climate change mitigation and adaptation, energy hierarchy, district renewable energy targets, criteria for assessment of projects, spatial guidance, and for sustainable construction and embedded renewable energy. In respect of district renewable energy targets the study concludes that there is currently too much uncertainty about the number and scale of CHP/district heating schemes to specify a district renewable heat target. Similarly, while the study has identified areas possibly suitable for large scale wind turbines, considerable further work is required before a figure of potential installed capacity can be estimated. The study recommends that the use of district renewable energy targets should await a sub-regional study of renewable energy potential – possibly undertaken as an input into the preparation of a new Integrated Regional Strategy. (See chapter 6)

As regards policy for sustainable construction and embedded renewable energy, chapter 6 provides an exploration of alternatives focused on the introduction of the higher standards in the Code for Sustainable Homes and BREEAM, and the use of 'Merton' style policy for on-site renewables, as encouraged by the South East Plan. Three possible options are explored. The first involves including a 'Merton' style policy in the Core Strategy. This would have to be clear about its relationship with Code and BREEAM standards, and would have to include a very clear statement on energy hierarchy to ensure that the use of renewables is not put ahead of energy efficiency. One major disadvantage of this approach is the additional demands on planning officers' time and the expertise required to deliver it effectively. (See chapter 6)

The second option would be to express policy requirements in relation to Code and BREEAM standards. This has the difficulty of being out of conformity with RSS (although it would conform with more recent regional advice), and it would not guarantee the use of on-site renewables, although this is highly likely as higher standards are introduced. The advantage of this approach is that verification of conformity with the standards is carried out by external assessors, which significantly reduces the demands on planning officers.

A third option would be to express policy in terms of achieving specific Code credits for the use of local renewable or zero carbon technologies. However the study has not identified any other authorities taking this approach and it could be considered overly restrictive for developers. In examining the above options the cost implications of complying with the Code and BREEAM are set out along with consideration of viability and other matters. (See chapter 6).

In drawing conclusions on the options for sustainable construction and embedded renewable energy the study finds that the carbon reduction objectives of the 'Merton-style' policy for embedded renewable electricity in new developments, which are encouraged in the South East Plan, could be achieved more easily and effectively and with wider benefits through the adoption of Code for Sustainable Homes/BREEAM requirements. (See chapter 6)

There are sometimes concerns that renewable and low carbon equipment will not be installed properly and fully commissioned, or that it will not be maintained and periodically replaced to ensure that the required CO_2 savings and contribution to renewable energy targets are achieved in the longer term. There are technical ways of ensuring ongoing compliance by the use of data loggers, but these must be required at the outset or imposed by condition. In addition, the Council has access to a wide range of mechanisms that can be used to assist in delivery. These include Section 106 Agreements, and the Community Infrastructure Levy which may be particularly relevant to the development of CHP/ district heating networks. (See chapter 7).

Delivery will require not only funds but also new organisations, particularly to facilitate the creation of decentralised energy systems operating across the district. Energy Service Companies (ESCos) are a potential way forward and the study recommends that West Oxfordshire District Council considers taking this approach. While it is always important to achieve maximum energy efficiency and use of on-site renewables there will often be situations where the full requirements of policy cannot be achieved on site. Some local authorities already have policies in place to ensure that where required standards cannot be met on-site the developer pays into a local carbon offsetting scheme used to reduce carbon emissions elsewhere in the district, e.g. local energy efficiency and small scale renewable projects. (See chapter 7).

Contents

1. Introduction

This joint study, commissioned by West Oxfordshire and Cherwell District Councils, is intended to provide an evidence based understanding of:

- the local feasibility and potential for decentralised, renewable and low carbon technologies;

- local targets for decentralised and renewable or low carbon energy; and

- local requirements for sustainable construction.

The study will inform the policies contained within the two local authorities' Core Strategy Development Plan Documents as part of the Local Development Framework.

This final report presents the findings from the study in relation to West Oxfordshire. A separate report deals with Cherwell.

Section 2 presents a summary and analysis of EU, national, regional and local policy, drawing out the key issues which will need to be addressed in the two authorities' core strategies. Section 3 discusses the sub-regional targets which have been set for renewable electricity generation in the context of the progress being made currently in delivering renewable energy schemes in the district and at sub-regional level, and the evidence available on key constraints and opportunities. Section 4 explores the feasibility and potential of small scale and large scale renewable technologies in the district. In the light of this analysis, section 5 provides a broad commentary on the extent to which the various 'directions for growth' in the emerging Core Strategy could take advantage of the opportunities identified to generate renewable energy and reduce carbon emissions. Section 6 contains a detailed discussion of and recommendations for policy wording for the Core Strategy, whilst section 7 provides advice on key implementation issues.

2. Policy review

Planning policy for energy and sustainable construction is going through a period of rapid evolution. This section describes the current policy context for the study. The review:

- summarises the national and EU policy context for local planning policies on renewable energy and sustainable construction, including a more detailed summary of the Code for Sustainable Homes, which is becoming increasingly significant in planning policy;

- summarises the key aspects of the Regional Spatial Strategy (RSS), *The South East Plan*;

- summarises the current content of the district's local plan and the emerging LDF in respect of renewable energy and sustainable construction;

- identifies key gaps in policy coverage at the regional and district level; and

- highlights the key issues for policy development in the LDF.

2.1 National and EU policy and strategy

The key aspects of national and EU policy and strategy documents on energy and sustainable construction are summarised below.

2.1.1 Carbon dioxide (CO_2) / greenhouse gas reduction targets

The UK Climate Change Programme 2006:

- set national CO_2/GHG reduction targets; and

- created a requirement for annual reporting to parliament on progress against the targets.

The Climate Change Act 2008:

- increased the greenhouse gas emission reduction target to 80% below 1990 levels by 2050; and

- introduced five year carbon reduction budgets.

In addition, the Chancellor's Budget Statement of April 2009 proposed a cut in CO_2 emissions of 34% below 1990 levels by 2020.

The UK Low Carbon Transition Plan July 2009:

- was presented to Parliament under the Climate Change Act 2008;

- is a wide ranging document covering: power, homes and communities, workplaces and jobs, transport, agriculture and waste; and

- the relevant energy related policies in the Plan are the same as those in the UK Renewable Energy Strategy 2009 (see below).

2.1.2 Energy Policy

The Energy White Paper 2007:

- set an aspiration to stimulate the renewables sector in order to produce 10% of electricity from renewable sources by 2010 and 20% by 2020;

- stated that onshore and offshore wind were expected to be the largest contributors in 2010; and

- stated that the planning system should give weight to the wider benefits of renewables even if there are no immediately apparent local benefits (Renewables Statement of Need).

The European Union Renewable Energy Directive 2009:

- requires that 15% of all UK energy is to come from renewables (electricity, heat and transport) by 2020.

The UK Heat and Energy Saving Strategy: DECC/CLG Consultation 2009:

- places an increased emphasis on delivering greater energy efficiency in existing dwellings;

- suggests the need for stronger incentives to move towards a low carbon future;

- provides a new focus on district heating; and

- encourages the development of combined heart and power (CHP).

The definition of zero carbon consultation:

- relates predominantly to the new definition of zero carbon homes that will apply for new homes built from 2016 (as stated in the Building a Greener Future policy statement, 2007) but also seeks views on the Government's ambition for new non-domestic buildings to be zero carbon from 2019 (as stated in the Budget 2008);

- suggests that the zero carbon definition should take in to account:
    - emissions from space heating, ventilation, hot water and fixed lighting (regulated emissions);
    - expected energy use from appliances and non-fixed lighting (unregulated emissions); and
    - exports and imports of energy from the development (and directly connected energy installations) to and from centralised energy networks.
- raises the possibility of greater flexibility in the use of off-site solutions for tackling residual emissions and puts forward a menu of 'allowable solutions' for dealing with such emissions;
- suggests that the definition will not include embodied energy or transport; and
- states that the policy for tackling emissions from non-domestic buildings needs to address similar objectives and principles as those for homes.

The UK Renewable Energy Strategy (UKRES) July 2009:

- commits the UK to meet the European Union 2009 Directive target of 15% of all UK energy to come from renewables (electricity, heat and transport) by 2020;
- suggests that to achieve the EU target, more than 30% of electricity must be supplied by renewables by 2020 (2% of this from small scale generation) – much will be supplied by onshore and offshore wind; biomass, hydro and wave will also be important;
- states that a Heat and Energy Saving Strategy is being developed, with 12% of heat to come from renewables by 2020;
- introduces a Renewable Heat Incentive (2011) and Feed-in-Tariffs (2010) which will provide guaranteed payments to individuals, business and communities for renewable heat and small scale electricity generation;
- suggests that a strategic approach to planning is required to ensure that regions can deliver their renewable energy potential in line with the 2020 targets;
- states the need for a swifter delivery of renewable projects through the planning system and quicker, smarter grid connection;
- states *"At the heart of our Strategy is an approach that is based on an assessment of the renewables capacity and constraints to deployment in each region and which seeks to ensure willing engagement by regional bodies, local authorities and*

communities. Through the planning system, communities will play an integral role in decisions on where renewable energy is located" (Page 18 paragraph 4.3);

- states *"…we expect regions to set targets for renewable energy capacity in line with national targest, or better where possible"* (Page 75, paragraph 4.23, see also paragraph 4.33);
- states that *"…applicants for renewable energy should no longer be questioned about the energy need of their project either in general or in particular locations"* (Page 76, paragraph 4.23); and
- commits to the development of a draft National Policy Statement (NPS) on energy including renewables, to be published in Autumn 2009, and a draft Planning Policy Statement (PPS) reviewing/updating PPS1 Supplement and PPS22, to be published by the end of 2009.

Some of the suggestions in the 2008 consultation version of the Strategy have not been carried through into the final version – these include renewable energy growth points, comparison with the process of delivering housing targets, a requirement to allocate and safeguard sites (although there is similar wording on this in PPS1 Supplement). The emphasis for planning policy development is on the forthcoming Energy NPS plus the combined proposed revised PPS1/22, and the new generation of Regional Strategies delivering the 2020 targets following an evidence-based assessment of opportunities and constraints. However, there is very little guidance in UKRES 2009 specific to LDF content or spatial policy.

There is no guidance on how much of the 30% renewable electricity target will be achieved by offshore renewables. Offshore wind in particular will be significant by 2020, but how this will affect regional targets for onshore renewables is not clear. However, it is clear from the performance of the various English regions to date that some are certain to undershoot the 30% target – in particular the South East, West Midlands and Greater London. In the grand scheme of things lower performance in these regions could be compensated for by offshore capacity (this however is supposition as there is no guidance on this).

2.1.3 Code for Sustainable Homes

The Code for Sustainable Homes was introduced in April 2007 as a single national standard and sustainability rating system for new build homes. The Code looks at the overall sustainability of a new home against a full range of criteria including energy, water, waste, materials, biodiversity and other sustainability criteria[1].

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[1] The Code was introduced as a direct replacement for the EcoHomes standard. Please note, unless stated otherwise, information in this section is taken from CLG's 'Code for Sustainable Homes, Technical Guide, October 2008'.

Since May 2008 a rating against the Code has been mandatory for any new build homes and it is now mandatory for a Code sustainability certificate to be included within a property's Home Information Pack. However, for the time being, this can be a 'nil rated certificate' of non-assessment for privately built housing (unless specified otherwise within Local Development Documents). All new social housing in England has to be built to a minimum of Code level 3.

The timescale for the introduction of higher levels of the Code for social housing can be found in table 2.1. In addition, the table shows the equivalent carbon aspects of the Code which will be required for private housing through a tightening of the Building Regulations. This is to enable the delivery of the government target of zero carbon homes by 2016 (see section 2.1.2).

Table 2.1: National implementation of Code for Sustainable Homes

Year	Public sector	Private sector (equivalent Code levels for carbon aspects in building regulations)
2008	Code Level 3	
2009		
2010		Code Level 3
2011		
2012	Code Level 4	
2013		Code Level 4
2014		
2015		
2016	Code Level 6	Code Level 6

The Code for Sustainable Homes sets six levels of sustainability - the higher the level the better the performance - and these levels are indicated by stars. Each level includes mandatory requirements for energy & carbon performance and water usage, together with tradable requirements for other aspects of sustainability.

As of April 2009, there have been three updates in the technical guidance documentation; October 2007, April 2008 and October 2008. There will be further updates in the future (the one due in April 2009 has been delayed; at the time of writing it is expected to be published very soon).

The levels are assessed by means of both a design stage assessment (to give an interim certification level) and a post-construction assessment. Once both assessments have been completed, a final code certification will be awarded stating the level achieved.

The certification levels achieved (interim and final) are provisional until they are confirmed by the Building Research Establishment (BRE). Upon submission, BRE carries out quality control checks to ratify the level awarded by the assessor.

The Code for Sustainable Homes technical guide describes the Code Levels as follows:

Table 2.2: Code for Sustainable Homes levels

Code level	Description
1	• Above regulatory standards. • Similar standard to BRE's EcoHomes 'Pass' level. • Similar standard to the Energy Saving Trust's 'Good practice' standard.
2	• Similar standard to BRE's EcoHomes 'Good' standard.
3	• Broadly similar to BRE's EcoHomes 'Very good' standard. • A similar standard to the Energy Saving Trust's 'Best practice' standard.
4	• Current exemplary performance.
5	• Exemplary performance with high standards of energy and water efficiency.
6	• Aspirational standard based on zero carbon emissions for the dwelling and high performance across all environmental categories.

Further information on the scoring system for the Code for Sustainable Homes is provided in appendix A.

2.1.4 BREEAM

The Building Research Establishment's Environmental Assessment Method (BREEAM) is the world's longest established and most widely used environmental assessment method for buildings. It is regarded by the UK's construction and property sectors as the measure of best practice in environmental design and management for non-domestic buildings.

As with the Code for Sustainable Homes, BREEAM certification is undertaken by licensed assessors. BREEAM assesses buildings' performance in the following areas:

- management - overall management policy, commissioning site management and procedural issues;
- energy use - operational energy and carbon dioxide (CO_2) issues;
- health and well-being: indoor and external issues affecting health and well being;
- pollution - air and water pollution issues;
- transport - transport-related CO_2 and location-related factors;

- land use - green and brownfield sites;
- ecology - ecological value conservation and enhancement of the site;
- materials - environmental implication of building materials, including life-cycle impacts; and
- water - consumption and water efficiency.

Credits are awarded in each area according to performance. A set of environmental weightings then enables the credits to be added together to produce a single overall score. The building is then rated on a scale of:

- pass;
- good;
- very good;
- excellent; and
- outstanding (please note that this category has only recently been added).

2.1.5 Planning Policy Statements

PPS1 Supplement Climate Change 2007:

- takes precedence over other PPS's if there is a policy conflict;
- suggests that planning authorities should consider opportunities for core strategies to add to RSS policy in order to achieve progress in achieving the PPS's Key Objectives (paragraph 18);
- requires core strategies and supporting Local Development Documents (LDDs) to provide a framework that promotes and encourages and does not restrict renewable and low-carbon energy development (paragraph 19);
- states that planning authorities should '*alongside any criteria-based policy developed in line with PPS22, consider identifying suitable areas for renewable and low carbon energy sources'* (paragraph 20);
- states that planning authorities should *'expect a proportion of the energy supply of new development to be secured from decentralised and renewable or low-carbon energy sources'* (paragraph 20);

- suggests that planning authorities should give positive consideration to the use of local development orders (LDOs) across the whole or part of their area to secure renewable and low carbon energy supply systems (paragraph 21);

- provides a list of climate change considerations for use by planning authorities in determining which sites are suitable for which types and intensities of development (paragraph 24);

- from an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies, including microgeneration, requires planning authorities to:

    - set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources and

    - where there are particular and demonstrable opportunities for greater use of decentralised and renewable or low-carbon energy than the target percentage, bring forward development area or site-specific targets to secure this potential (paragraph 26);

- suggests that there will be situations where it could be appropriate for planning authorities to require levels of building sustainability in advance of those set out nationally (paragraph 31) but that these should focus on development area or site-specific opportunities and utilise the different levels of the Code for Sustainable Homes (paragraph 32);

- requires planning authorities to monitor and review the implementation of their policies and respond promptly and effectively if the expected outcomes are not being delivered (paragraph 34);

- states that planning authorities should, where possible, make use of Design and Access statements to obtain information from applicants about their approach to energy and sustainable construction (paragraph 41); and

- provides a list of criteria for use in assessing the environmental performance of proposed developments (paragraph 42).

PPS22 Renewable Energy 2004:

- requires Regional Spatial Strategies to include:

    - renewable energy targets for electricity;

    - criteria-based policies for renewable energy developments; and

- o the identification of broad areas at the regional/sub-regional level where development of particular types of renewable energy may be considered appropriate.

- states that Local Development Documents:
  - o may include on-site renewable energy policies (Merton rule); and
  - o should include criteria-based policies for renewable energy developments to reflect local circumstances; and
  - o should only identify specific sites for renewable energy if a developer has already indicated an interest in the site and confirmed its viability.

Other planning policy statements

A number of other Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) also have implications for planning policy relating to climate change, renewable energy and sustainable construction. These are briefly summarised in the table below.

Planning Policy Statement	**Key policy areas covered relating to climate change**
PPS1: Delivering Sustainable Development	Address causes and potential impacts of climate change; Reduce energy use; Reduce emissions; Promote renewable energy use; and Location and design of development.
PPS3: Housing	Delivery of well designed homes; Making best use of land; and Encouraging new building technologies to deliver sustainable development.
PPG4: Industrial, Commercial Development and Small Firms[2]	Reduce the need to travel; and Location of business development.
PPS6: Planning for Town Centres[3]	Reduce the need to travel; Encourage use of public transport; and Facilitate multi-purpose journeys.
PPS7: Sustainable Development in Rural Areas	Protect natural resources; and Provide for sensitive exploitation of renewable energy sources.
PPS9: Biodiversity and	Account for climate change on distribution of habitats and

[2] The Department for Communities and Local Government is currently consulting on new PPS4: planning for Sustainable Economic Development which, when finalised, will replace PPG 4.
[3] The Department for Communities and Local Government is currently consulting on proposed changes to PPS 6.

Planning Policy Statement	Key policy areas covered relating to climate change
Geological Conservation	species, and geomorphologic processes and features.
PPS12: Local Development Frameworks	Act on a precautionary basis to reduce the emissions that cause climate change and to prepare for its impacts.
PPG13: Transport	Reduce the need for travel, especially by car, by influencing the location of development, fostering development which encourages walking, cycling or public transport.
PPS23: Planning and Pollution Control	Reduce greenhouse gas emissions and take account of potential effects of climate change where possible.
PPS25: Development and Flood Risk	Planning policies and decisions should reflect the increased risk of coastal and river flooding as a result of climate change.

2.1.6 Planning and Energy Act 2008

The Planning and Energy Act 2008 states that local authorities can include policies in their LDF requiring:

- a proportion of the energy used in a development to come from renewable and low carbon sources in the locality of the development; and

- energy efficiency standards that exceed the requirements of building regulations.

2.1.7 Overview

This brief review of the national and EU policy context provides the following framework for considering the scope of LDF policy for energy in West Oxfordshire:

A higher profile for Sustainable Energy policy in LDFs

PPS1 Supplement paragraph 19 requires core strategies to include policy dealing with climate change and promoting sustainable energy. These policies are to reflect local opportunities and can go further than current RSS.

Renewable Energy Targets

The application of the 2009 EU Renewable Energy Directive target that by 2020 15% of all energy used in the UK must come from renewables has yet to be absorbed into UK planning policy. Targets for renewable energy included within the South East Plan are based largely on the 2003 and 2007 Energy White Paper objectives and focus only on electricity generating capacity and have a 20% target for renewable electricity by 2020. UKRES 2009 has increased the renewable electricity target to at least 30%, and renewable heat will begin to play a significant role.

UKRES 2009 places emphasis on the new generation of Regional Strategies providing the planning framework including guidance on spatial policy required to achieve 30% renewable electricity and 12% renewable heat by 2020. However, work on the new

South East Strategy has not yet commenced and its completion will follow after the district's Core Strategy.

Only the South West RSS currently includes a renewable heat target in policy. While this is a modest target, it is being monitored and progress is being made. Other regions can be expected to follow this lead.

The newly adopted South East Plan includes sub regional targets for renewable electricity generation and all local authorities will need to contribute to the sub regional targets in order to demonstrate conformity with the Plan. Further details on the targets are provided in section 2.2.

While there is no explicit PPS requirement to include local authority-specific renewable energy targets in an LDF this is clearly emerging as the direction of travel. Already local authority renewable electricity generating capacity targets are included within Yorkshire and the Humber RSS and they are encouraged within the South East Plan (see below).

Spatial guidance

Plans must become more site and area specific. PPS1 Supplement overrides the reticence in PPS22 regarding identifying sites by encouraging the identification of suitable areas. The UK Renewable Energy Strategy 2009 (in contrast to the 2008 draft version) does not contain any specific guidance on spatial planning. More guidance is likely to be included in the forthcoming National Policy Statement and the revision to PPS1 and PPS22.

Criteria-based policies

Criteria-based policies which reflect local circumstances should be included in LDFs to guide the development control process.

Development-specific targets

Development-specific targets for renewable energy generation are encouraged in LDFs and such policy should include both renewable and other low carbon forms of energy supply.

2.2 Regional Spatial Strategy for the South East

2.2.1 Current state of play

The final version of the South East Plan (Regional Spatial Strategy for the South East) was issued by Government Office for the South East (GOSE) in May 2009.

A Partial Review of the precursor to the South East Plan, Regional Planning Guidance 9 for the South East, including policies covering 'Energy Efficiency and Renewable Energy' went to Examination in Public, EiP, in 2004, leading to the publication of a revised Chapter 10 of RSS for the South East by GOSE during the same year covering these topics.

Because these policies were considered to be recently finalised at the time of the South East Plan EiP in 2006/7, they were not reconsidered or amended.

Although the South East Plan is newly approved, the process of preparing its policies on energy efficiency and renewables means that they predate the finalisation of PPS22 in 2004, quite apart from other key documents such as PPS1 Supplement on Climate Change.

2.2.2 South East Plan policy content

Key policies in the South East Plan are summarised below with the most significant policies repeated in full:

Policy CC1 Sustainable Development includes:

- a greenhouse gas emissions reduction objective, but no target is specified.

Policy CC2 Climate Change includes:

- CO_2 reduction targets of 20% below 1990 levels by 2010, at least 20% by 2015 and 80% by 2050;

- the improvement of energy efficiency and carbon performance of new and existing buildings; and

- encouragement of the use of renewable energy.

Policy CC3 Resource Use requires plans:

- to include measures to increase the efficiency of resource use in new and existing development

Policy CC4 Sustainable Design and Construction reads as follows:

"The design and construction of all new development, and the redevelopment and refurbishment of existing building stock will be expected to adopt and incorporate sustainable construction standards and techniques. This will include:

> *i. consideration of how all aspects of development form can contribute to securing high standards of sustainable development including aspects such as energy, water efficiency and biodiversity gain*
>
> *ii. designing to increase the use of natural lighting, heat and ventilation, and for a proportion of the energy supply of new development to be secured from decentralised and renewable or low-carbon sources*

iii. securing reduction and increased recycling of construction and demolition waste and procurement of low-impact materials

iv. designing for flexible use and adaptation to reflect changing lifestyles and needs and the principle of 'whole life costing'.

Local planning authorities will promote best practice in sustainable construction and help to achieve the national timetable for reducing carbon emissions from residential and non-residential buildings. There will be situations where it could be appropriate for local planning authorities to anticipate levels of building sustainability in advance of those set out nationally, for identified development area or site-specific opportunities. When proposing any local requirements for sustainable buildings, local planning authorities must be able to demonstrate clearly the local circumstances that warrant and allow this and set them out in development plan documents."

Policy NRM 11 Development Design for Energy Efficiency and Renewable Energy reads as follows:

"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."

Policy NRM12: Combined Heat and Power reads as follows:

"Local development documents and other policies should encourage the integration of combined heat and power (CHP), including mini and micro–CHP, in all developments

and district heating infrastructure in large scale developments in mixed use. The use of biomass fuel should be investigated and promoted where possible.

Local authorities using their wider powers should promote awareness of the benefits of mini and micro-CHP in the existing build stock."

Policy NRM13 Regional Renewable Energy targets:

- includes targets for installed renewable electricity generation capacity within the region by 2010, 2016, 2020, 2026; and

- suggests that "*The renewable energy resources with the greatest potential for electricity generation are onshore and offshore wind, biomass, and solar. The renewable energy resources with the greatest potential for heat generation are solar and biomass."*

Policy NRM14: Sub-Regional Targets for Land Based Renewable Energy:

- includes targets for installed renewable electricity generation capacity within the Thames Valley and Surrey sub-region of 140MW by 2010 and 209MW by 2016; and

- states that *"Local authorities should collaborate and engage with communities, the renewable energy industry and other stakeholders on a sub-regional basis to assist in the achievement of the targets through:*

    - *undertaking more detailed assessments of local potential*

    - *encouraging small scale community-based schemes*

    - *encouraging development of local supply chains, especially for biomass*

    - *raising awareness, ownership and understanding of renewable energy."*

The supporting text states that *"Overall….the Thames Valley and Surrey appear to have the greatest potential for onshore wind development and also for the installation of photovoltaics reflecting the likely rate of new development."* (paragraph 9.86) and that *"more detailed local consultation and assessments should be undertaken to refine these indicative targets and define more specific local targets…."* (paragraph 9.88).

Policy NRM15: Location of Renewable Energy Development reads as follows:

"Local development documents should encourage the development of renewable energy in order to achieve the regional and sub-regional targets. Renewable energy development, particularly wind and biomass, should be located and designed to minimise adverse impacts on landscape, wildlife, heritage assets and amenity. Outside of urban areas, priority should be given to development in less sensitive parts of countryside and coast, including on previously developed land and in major transport areas.

The location and design of all renewable energy proposals should be informed by landscape character assessment where available. Within areas of protected and sensitive landscapes including Areas of Outstanding Natural Beauty or the national parks, development should generally be of a small scale or community-based. Proposals within or close to the boundaries of designated areas should demonstrate that development will not undermine the objectives that underpin the purposes of designation."

The supporting text states that:

- *"Priority should be given to the development of renewable energy schemes, particularly larger scale ones, in less sensitive areas including previously developed and industrial land and areas where there is already intrusive development or infrastructure, for example major transport corridors…."* (paragraph 9.96);

- *"However, wind and other renewable energy development should not be precluded in AONBs and the national parks as there will be locations where small scale construction e.g. a wind development of between one and four turbines not generating more than 5MW, can be accommodated where conflict with statutory landscape protection purposes set out in PPS7 can be avoided or minimised through careful siting and design, including reducing the cumulative impact of a number of individual schemes."* (paragraph 9.97); and

- *"….Renewable energy developments should not necessarily conflict with the objectives of Green Belt"* (paragraph 9.98).

Policy NRM16: Renewable Energy Development Criteria reads as follows:

"Through their local development frameworks and decisions, local authorities should in principle support the development of renewable energy. Local development documents should include criteria-based policies that, in addition to general criteria applicable to all development, should consider the following issues:

> *i. the contribution the development will make towards achieving national, regional and sub-regional renewable energy targets and carbon dioxide savings*
>
> *ii. the potential to integrate the proposal with existing or new development*
>
> *iii. the potential benefits to host communities and opportunities for environmental enhancement*
>
> *iv. the proximity of biomass combustion plant to fuel source and the adequacy of local transport networks*
>
> *v. availability of a suitable connection to the electricity distribution network."*

2.2.3 Overview

The following content from South East Plan policy needs to be fed into and included within LDFs:

- policy for the reduction of greenhouse gas emissions;
- promotion of sustainable construction, including identifying development area or site-specific opportunities for levels of building sustainability in advance of those set out nationally;
- a local target for decentralised and renewable or low-carbon energy in new development;
- the promotion of energy efficiency and a wide range of renewables;
- particular attention to the opportunities posed by regional growth areas and eco-towns;
- policies to support the use of combined heat and power (CHP) at a variety of scales of development, and district heating (DH);
- local renewable energy targets which help to deliver regional and sub-regional targets;
- criteria-based policy for renewable energy development which reflects local circumstances and which:
    - considers issues such as contribution to meeting targets, and benefits to host communities;
    - ensures that the location of renewable energy projects minimises adverse impacts on landscape, wildlife, heritage assets and amenity;
    - outside urban areas, gives priority to development in less sensitive parts of countryside and coast, including on previously developed land and in major transport areas;
    - ensures that the location and design of renewable energy development is informed by landscape character assessment where appropriate;
- policy which does not preclude small scale or community based renewable energy projects within and close to designated landscapes (small scale wind could be between one and four turbines not generating more than 5MW) or in the Green Belt.

2.2.4 Gaps in South East Plan content in relation to current national policy guidance and requirements

Comparing the South East Plan content with the evolving requirements of national planning and energy policy reviewed in section 2.1 above reveals some gaps in RSS coverage which could/should be addressed in the West Oxfordshire LDF:

- lack of district-specific targets for electricity and heat renewables;
- limited criteria policies to guide the development of renewables; and
- no spatial guidance for the development of renewables and low carbon energy.

2.3 West Oxfordshire District Council

Key aspects of the current local policy situation in West Oxfordshire are described below.

2.3.1 Core strategy so far: interim position statement

This interim position statement includes:

- Witney is the principal focus for new development; and
- housing growth at Carterton and Chipping Norton.

It includes the following objectives:

- *"Reduce the causes of and adverse impacts of climate change, particularly flooding";* and
- *"Improve the sustainable design and construction of new development, including energy, water efficiency and water management".*

The emerging approach set out in the document proposes that:

- new developments will be required to incorporate a *"high standard of sustainable design and construction, optimising energy and resource efficiency and delivering a proportion of renewable or low carbon energy on site"*;
- *"Proposals for renewable energy developments of a scale appropriate to the West Oxfordshire context will be considered favourably";* and
- *"Standards for sustainable design and construction and targets for decentralised and renewable or low-carbon energy (both District-wide and site specific/development*

area/targets/standards) will be set. Opportunities will be sought to achieve high standards/targets, where these are viable and deliverable, for example on larger sites".

In relation to the emerging approach, the document states that:

- any targets or standards set will need to be evidence-based, viable and feasible; and

- interim advice on sustainable construction is being produced, augmenting the West Oxfordshire Design Guide.

2.3.2 West Oxfordshire Local Plan adopted 2006

Sustainability is a strong emphasis of the local plan. As well as a general built environment policy which includes sustainability considerations, policy NE12 specifically addresses renewable energy development. It reads as follows:

"Proposals for the development of renewable energy schemes will be permitted if all the following criteria are met:

> *i. there would not be an unacceptable impact upon the environment and resources of the area;*
>
> *ii. an unacceptable level of nuisance by reason of noise, safety, shadow flicker, electromagnetic interference or reflected light will not be created.*

Within the Cotswolds Area of Outstanding Natural Beauty, proposals will only be acceptable where they are small in scale and where it can be shown to be in the public interest and no alternative sites exist."

2.3.3 West Oxfordshire Design Guide

The West Oxfordshire Design Guide has been adopted as a Supplementary Planning Document and the guidance within it can therefore be a material consideration in determining a planning application in West Oxfordshire. Applicants are encouraged to refer to the guide in the Design and Access statements submitted with their applications. It states:

'The Council is committed to promoting sustainable development, including the preservation of energy and resources and the reduction of pollution. New development should further these aims, considering such factors as building orientation, re-use of materials, insulation, solar shading, water conservation and innovative heating and power generation systems. Design and Access Statements should address these issues and provide an assessment of the environmental impact of the proposed new development'.

The guide includes a section on sustainable design and construction which sets out detailed guidance for the following elements of the design process: site and layout, buildings and building materials.

2.3.4 Overview

Already the emerging Core Strategy and Local Plan anticipate a number of future requirements, including:

- the need for sustainable design and construction policy;

- the use of targets for on-site renewable and low carbon energy;

- a focus on what larger development sites can deliver;

In addition, both the emerging Core Strategy and the adopted Local Plan recognise that clear criteria are required to safeguard both amenity and landscape when renewables, particularly wind, are being developed.

The Local Plan rules out renewable energy developments in the AONB unless they are small in scale, can be shown to be in the public interest and no alternative sites exist. 'Small-scale' development is not defined, but the South East Plan definition of small scale wind was already part of RPG9 when the Local Plan was adopted.

3. Current progress in delivering renewable energy

3.1 Introduction

This section discusses the sub-regional targets for renewable electricity generation in the context of the progress being made currently in delivering renewable energy schemes in the district and at sub-regional level and the evidence available on key constraints and opportunities.

Policy NRM14 (Sub-Regional Targets for Land Based Renewable Energy) of the South East Plan includes targets for installed renewable electricity generation capacity within the Thames Valley and Surrey sub-region of 140MW by 2010 and 209MW by 2016. Understanding the implications of this for the district is complicated by:

- The wording of the policy, which restricts the target to ‘renewable electricity generation’. This contrasts with recent national policy statements which refer to ‘renewable or low carbon energy’. The latter could include, for example, fossil-fuel powered district heating schemes which deliver significant carbon savings compared to traditional heating schemes but which do not generate electricity (unless they form part of a Combined Heat and Power system) and could not be classified as renewable and may not, therefore, contribute to the South East Plan target.

- The absence of sub-regional studies which assess variations in the potential to deliver against the target across the sub-region. Some areas may be better placed than others to deliver higher levels of renewable electricity generation capacity which would, in turn, lessen the requirements on other parts of the sub-region. In the absence of this sub-regional level of understanding, it may be difficult to set specific district-level targets.

- The absence of up-to-date data on existing renewable electricity generation capacity in the sub-region. The SEE-Stats (South East Renewable Energy Statistics) website[4] provides sub-regional data on renewable energy installations in the sub-regions of the South East but this was last updated in June 2007. The position of the Thames Valley and Surrey sub-region as at June 2007 is summarised below.

[4] an initiative undertaken by TV Energy and sub-regional data partners on behalf of the South East of England Sustainable Energy Partnership, led by the Government Office for the South East (GOSE)

3.2 Sub-regional statistics, June 2007

The chart below shows installed and planned capacity for renewable electricity generation in the sub-region in June 2007 compared to the 2010 target. (It should be noted that although landfill gas is estimated to be the largest renewable resource in the region as a whole statistics are not available to break down capacity between sub-regions. The following figures for the Thames Valley sub-region do not therefore include landfill gas installed capacity). There was approximately 72MW of installed capacity with a further 37MW planned. This implies a shortfall of 31MW compared to the 2010 target. The current shortfall is unknown.

The data suggests that the vast majority (65MW) of installed capacity is from only two schemes:

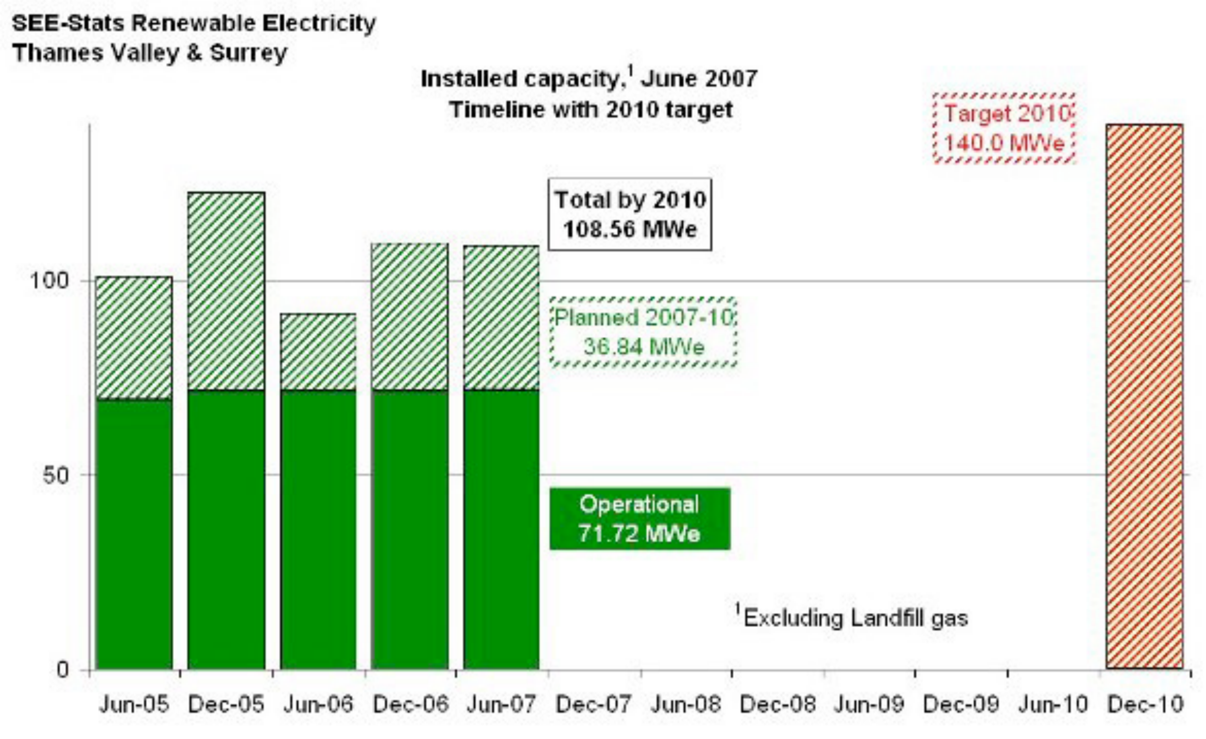
- the Slough Heat and Power Biomass CHP scheme, which has 40MW installed capacity; and

- co-firing of biomass with coal at Didcot power station, which equates to 25MW installed capacity.

In contrast, planned capacity is almost exclusively made up of smaller wind schemes.

Of further note is the very slow rate of progress in terms of installed and planned capacity between 2005 and 2007.

Figure 3.1: Operational and planned renewable electricity capacity, Thames Valley and Surrey sub-region (Source: SEE-Stats)



Although up-to-date district-level data is not readily available, the current contribution of the district to both installed and planned capacity is believed to be relatively insignificant, with only small-scale schemes having been granted permission to date. However, the fact that there are a significant number of small-scale schemes which have been granted permission, demonstrates that renewable and low carbon technologies are feasible in the local area.

The current heavy reliance on a small number of large schemes in the sub-region would suggest that further large schemes are likely to be necessary in future if the targets are to be met. This is particularly true of the 2016 target, which constitutes a near tripling of the installed capacity as at June 2007.

3.3 Sub-regional evidence base

As noted above, no resource assessment studies have been carried out at the sub-regional level, which makes the apportionment of the sub-regional target between the various local authority areas problematic.

Cherwell's non-statutory Local Plan refers to some research studies published in 1994 which estimated the amount of energy it would be technically feasible to develop from renewable resources in Oxfordshire. The draft results from the *Southern Region Renewable Energy Planning Study – Oxfordshire* (1994) suggests that there is a potential resource of about 60 Megawatts from renewable energy sources. The Local Plan goes on to say that this total is unlikely to be developed in practice and that the types of renewable energy schemes with the most potential in Oxfordshire are municipal solid waste combustion, short rotation coppice, wind energy and landfill gas.

More recently, TV Energy produced two reports for the South East of England Development Agency (SEEDA), entitled *Progressing Renewable Energy in the SE of England*. The first of these, published in January 2008, noted that the Thames Valley sub-region makes the largest contribution to regional renewable energy generation, 72MW in 2008, not including landfill gas and that this is expected to increase to 102MW by 2010. This falls significantly short of the sub-regional target set in the South East Plan. The report goes on to suggest that in the Thames Valley the greatest potential is wood from existing woodland and new short rotation coppice. In addition, it suggests that the sub-region has wind potential in the form of single turbines and small clusters of turbines. No information is presented on individual local authority areas.

Interestingly, the report forecasts that the overall regional renewable energy targets for both 2010 and 2020 will be exceeded, almost entirely because of the growing significance of offshore wind energy. This is predicted to make up the vast majority of the region's renewable generating capacity in 2010 and even more emphatically in 2020. If accurate, this would suggest that the South East Plan has underestimated the importance of offshore wind in the setting of regional and sub-regional targets. It should be noted that while RSS Policy NRM13 appears to include offshore wind in its capacity targets for the region, PPS22 paragraph 4 does not endorse this approach but requires the separation of the contribution that can be made by offshore resources from onshore sources of renewable electricity. This is to ensure that offshore projects are not used as a justification for setting lower onshore targets. As noted in paragraph 2.2.1 above, drafting the RSS energy policies took pace before the finalisation of PPS22, which probably accounts for this anomaly.

The second TV Energy report, dated June 2008, concludes that, at best, the region will achieve 7% of electricity supply from renewables by 2010, short of the national 10% target but in excess of the South East Plan target. The report fixes a target for 2020 of 20% of electricity supplied by renewables (double the South East Plan target) and then proceeds to develop scenarios, which relate the scale of renewables/low carbon energy development to the different sizes of settlement, discussing how it could be achieved.

For the purposes of this study, the usefulness of this is quite limited since it is a desk study rather than something based on an assessment of the region's resources. There is less breakdown by sub-region than in Report 1 and, again, no reference to individual local authority areas. However, the report goes on to set out the number and scale of developments theoretically needed to meet the 2020 target, against two different scenarios, both based predominantly on biomass/CHP and wind, but one with a higher biomass/CHP content and one with a higher wind content. Were a district-level target to be set, there may be some merit in applying these scenarios to the settlements, and growth areas in the district, in order to explore and illustrate the scale and nature of development that may be needed.

3.4 Key local barriers to delivery

In order to understand some of the key barriers to delivering renewable energy schemes within West Oxfordshire, discussions have been undertaken with a development control officer and a planning policy officer. In addition, the committee reports on two recent wind turbine applications have been reviewed and information gathered from other local policy documents.

Planning constraints vary considerably with the technology. For example, ground and air sourced heating and cooling raise few planning issues as the water circulation pipes are below ground and the equipment is small scale and can be easily accommodated with the building being served. Solar technologies using building mounted panels may raise design issues particularly in conservation areas. Biomass plant may raise issues in relation to the transport and storage of the fuel, the design of the plant room, the height of the plant's chimney and noise associated with chipping. There may also be concerns relating to point source emissions. Wind power, particularly when using modern large turbines, tends to raise the most planning issues and is subject to more constraints than other technologies.

The following exploration of barriers is intended as a general commentary on some of the key issues and is not intended in any way to be exhaustive. Relevant issues are explored in more detail in relation to individual technologies in the following sections.

The key issues discussed are:

• visual impacts on local landscapes;

• impacts on landscape designations;

• impacts on the historic environment;

• the dispersed settlement pattern in the district;

• highways and access issues; and

• potential conflicts with aviation activities.

3.4.1 Visual impacts on local landscapes

West Oxfordshire is a largely rural district with highly valued local landscapes, much of which is nationally designated as an Area of Outstanding Natural Beauty (AONB). As the landscape character assessment for West Oxfordshire suggests:

> *It embraces large areas of unspoilt countryside within its boundaries and a diverse pattern of landscapes, including rolling limestone uplands, pastoral river valleys, historic parkland, remnants of ancient forests, low-lying farmland and riverside meadows, with a scattering of rural villages and some larger settlements.*[5]

The council places significant importance on conserving and enhancing the landscape character of the district. This will therefore be a constraint on renewable energy developments, particularly those such as wind turbines which have significant visual impacts.

Making a planning judgement on the acceptable level of visual impact can be difficult since there is no guidance in relation to such 'acceptable levels' in national or regional policy. However there are well established approaches to assessing sensitivity of different landscape character areas to wind development, the impact of individual wind developments and cumulative impact. Much of the guidance in the field has been developed by The Landscape Institute and Scottish Natural Heritage.

The PPS1 Supplement sets out the following guidance in respect of landscape impact in preparing and implementing Core Strategy policy:

> *"In particular planning authorities should: - ensure that any local approach to protecting landscape and townscape is consistent with PPS22 and does not preclude the supply of any type of renewable energy other than in the most exceptional circumstances"* (paragraph 20).

PPS22 guidance is set out in its Key Principles to the effect that planning policy should encourage the development of renewable energy and that it should be capable of being accommodated in most locations, providing that impacts can be addressed satisfactorily, In addition, PPS22 states that:

> *"Local landscape and local nature designations should not be used in themselves to refuse planning permission for renewable energy developments. Planning applications for renewable energy developments in such areas should be assessed against criteria based policies ..."* (paragraph 15).

PPS7 provides further general advice on local landscape designations:

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[5] Atlantic Consultants (1998) *West Oxfordshire Landscape Assessment*, West Oxfordshire District Council

"The Government recognises and accepts that there are areas of landscape outside nationally designated areas that are particularly highly valued locally. The Government believes that carefully drafted, criteria-based policies in LDDs utilising tools such as landscape character assessment, should provide sufficient protection for these areas, without the need for rigid local designations that may unduly restrict acceptable, sustainable development and the economic activity that underpins the vitality of rural areas" (paragraph 24).

Taken together this advice makes it clear that the general approach to assessing the potential landscape impact of renewable energy development, particularly by wind turbines, should be to follow what are now well established approaches to landscape impact assessment, using landscape character and sensitivity as a starting point. The Government has made it very clear in the above guidance that it does not want to see blanket restrictions based on local landscape designations being used to hold back renewable energy projects.

Additional considerations apply in the case of designated landscapes, as described in the following paragraph and in section 2.2 above which deals with RSS for the South East.

3.4.2 Impacts on landscape designations

Cotswolds Area of Outstanding Natural Beauty

A significant proportion of the district of West Oxfordshire is in the Cotswolds Area of Outstanding Natural Beauty.

As already noted, the South East Plan states that wind and other renewable energy development should not be precluded in AONBs and that there will be locations where small scale construction can be accommodated. Small scale wind development is defined as between one and four turbines not generating more than 5MW subject to demonstration that conflict with landscape protection policies can be avoided or minimised through careful siting and design. This is helpful guidance in that it sets down a scale of development above which wind projects are unlikely to be acceptable and provides criteria against which schemes can be judged. (A recent Call-In Public Inquiry into the proposed Glyndebourne single wind turbine within the South Downs AONB considered the proposal against the South East Plan criteria and permission was granted for a 70m, 850kW turbine).

The Cotswolds AONB management plan has been adopted as supplementary guidance and is therefore a material consideration in planning decisions. It recognises the need to mitigate and adapt to climate change and includes policy CCP2 which states that measures are taken to mitigate the causes of climate change. Linked to this, action CCP4 reads:

> *Encourage and support appropriate scale renewable energy generation in order to help meet national and regional targets for renewable energy generation to mitigate the impact of climate change by reducing greenhouse gas emissions.*

The Cotswolds Conservation Board also issued a position statement on renewable energy in 2005, which recognises that *'small scale renewable energy projects may well be able to be accommodated within the landscape without causing harm.'* It goes on to state that:

- Wind farms or large scale biomass energy generation facilities are likely to be inappropriate.

- Small scale single wind turbines promoted by individual businesses and local communities and designed to produce electricity for local use can be more readily assimilated into the landscape (this definition of 'small scale' may need to be revised in the light of the definition suggested in the South East Plan).

- With care solar photovoltaic and solar thermal applications can be installed with only limited visual impact and should be encouraged.

- Ground source heat pumps should be encouraged in new constructions or conversions.

- Small scale hydro applications would be welcome provided biodiversity issues are taken into account.

- Bioenergy would be welcome for its contribution to farm diversification. However the siting of a large scale facility may be difficult. Small to medium scale community projects are encouraged, in particular where they generate heat.

- Biofuels schemes are welcomed in principle provided care is taken to ensure that the scale of the processing site including traffic flows is consistent with the landscape character and tranquillity and that agricultural monoculture is avoided. Large scale industrial processing sites will not meet these criteria.

- The use of wood to provide heat and or electricity would also have benefits for woodland management and waste reduction.

As noted above there is the potential for conflict between the definition of 'small scale' wind development as envisaged in the AONB Management Plan and the definition provided by the South East Plan. Small scale turbines serving individual businesses and communities are likely to be in the 2-50kW range of capacity with overall heights to tip of, say, 15-20m. In contrast the South East Plan clearly envisages the possibility of development on a more significant scale - a cluster up to four 1.25MW turbines with heights to tip of, say, 90m. It is worth noting that the South Downs AONB Joint Committee opposed the proposed Glyndebourne single 70m tip height wind turbine and explicitly disagreed with the South East Plan definition of small scale, preferring their own definition which is similar to that in the Cotswolds AONB Management Plan.

Other landscape and biodiversity designations

There are a number of other landscape and biodiversity designations which will impact on the opportunities for renewable energy development.

Two parishes are part of the Oxford green belt. Although a constraint, as the South East Plan states, renewable energy developments should not necessarily conflict with the objectives of green belt (paragraph 9.98). PPS 22 states:

> *'When located in the green belt, elements of many renewable energy projects will comprise inappropriate development, which may impact on the openness of the green belt. Careful consideration will therefore need to be given to the visual impact of projects, and developers will need to demonstrate very special circumstances that clearly outweigh any harm by reason of inappropriateness and any other harm if projects are to proceed. Such very special circumstances may include the wider environmental benefits associated with increased production of energy from renewable sources.'*

The district also contains a significant number of designated ancient woodlands. In addition, the Council supports the Wychwood Forest Project, which aims to revive the landscape character and mix of habitats found in the area when it was a royal hunting forest in the Middle Ages. It covers 41 parishes in West Oxfordshire.

Cassington Meadows is recognised as being internationally important in biodiversity terms and is a Candidate Special Area of Conservation.

There are 29 SSSI's in West Oxfordshire and 112 locally designated County Wildlife Sites. Whilst this may generate some constraints for renewable energy, it is important to be clear about the purpose of SSSI designation when considering the potential for conflict with renewable energy developments. For example, SSSIs concerned with the protection of flora or geology are unlikely to be subject to indirect impacts from wind developments.

In addition, there are two National Nature Reserves (Wychwood Forest and Chimney Meadows) and two Local Nature Reserves.

Large areas of the district are part of Conservation Target Areas (CTAs), which are based around SSSIs and County Wildlife Sites. CTAs are areas of habitat that are in good condition and, although often fragmented, are in relatively close proximity to each other. These are to be targeted for conservation action and biodiversity enhancement in order to ensure continued protection, and to initiate expansion and linkage between these areas. CTAs may represent a constraint to renewable energy use particularly renewable sources which might have ecological or biodiversity impacts, for example micro hydro, wind, biomass. As with the SSSIs, the level of constraint will depend on what the CTAs have been designated for.

3.4.3 Impacts on the historic environment

Renewable energy developments will need to be sensitive to the potential impacts on the historic environment in West Oxfordshire, which is highly valued.

There are approximately 3,200 Listed Buildings in West Oxfordshire. About 92% are of Grade II interest, 6.6% are of Grade II* interest and 1.4% are Grade I.

There are nearly 50 conservation areas in West Oxfordshire.

A register of historic parks and gardens has been produced by English Heritage under the National Heritage Act 1983. They are graded I, II* and II, with Grade I representing sites of international importance. The Register is regularly updated.

There are 16 Parks and Gardens of Special Historic Interest (designated by English Heritage) in West Oxfordshire. Although the listing of the sites carries no statutory obligations, the Government has advised local authorities to consider the impact of development upon such historic parks and gardens as a material consideration in planning terms and to consult English Heritage on any development proposals that may affect them. The West Oxfordshire Local Plan makes it clear that the Council will resist proposals for development that would damage the appearance or character of historic parks and gardens, whether they are registered or not.

In addition, Blenheim Palace is also registered as a World Heritage Site. Although no further additional statutory controls follow from the inclusion of a site in the World Heritage List, its inclusion does however highlight the outstanding international importance of the site which should be taken into account when considering any proposals likely to affect Blenheim.

There are a large number of surviving historic landscapes, ancient monuments and archaeological sites in West Oxfordshire, including over 150 Scheduled Ancient Monuments.

Scottish Planning Advice Note 45 (PAN45) on Renewable Energy Technologies provides some specific guidance on the visual effects of renewable energy developments on historic sites at different distances. It suggests that:

- the indirect visual effects on the setting of nationally important monuments are not considered likely to be significant beyond 15km; and

- the indirect visual effects on historic sites of regional significance are not considered likely to be significant beyond 5km.

PAN45 also provides useful guidance on how general perception of the prominence of a wind farm changes as distance increases.

In 2005 English Heritage issued specific guidance on "Wind Energy and the Historic Environment.[6]" This includes guidance on how to assess the impact of a wind project on the setting and visual amenity of historic sites. It suggests that the following factors should be borne in mind when assessing the acceptability of developments within the setting of historic sites are:

- *Visual dominance: Wind turbines are far greater in vertical scale than most historic features. Where an historic feature (such as a hilltop monument or fortification, a church spire, or a plantation belonging to a designed landscape) is the most visually dominant feature in the surrounding landscape, adjacent construction of turbines may be inappropriate.*

- *Scale: The extent of a wind farm and the number, density and disposition of its turbines will also contribute to its visual impact.*

- *Intervisibility: Certain archaeological or historic landscape features were intended to be seen from other historic sites. Construction of wind turbines should respect this intervisibility.*

- *Vistas and sight-lines: Designed landscapes invariably involve key vistas, prospects, panoramas and sight-lines, or the use of topography to add drama. Location of turbines within key views, which may often extend beyond any designated area, should be avoided.*

- *Movement, sound or light effects: The movement associated with wind turbines as well as their scale may be a significant issue in certain historic settings. Adequate distance should always be provided between important historic sites and wind turbine developments to avoid the site being overshadowed or affected by noise and shadow flicker effects.*

- *Unaltered settings: The setting of some historic sites may be little changed from the period when the site was first constructed, used or abandoned. Largely unaltered settings for certain types of sites, particularly more ancient sites, may be rare survivals and especially vulnerable to modern intrusions such as wind turbines. This may be a particular issue in certain upland areas.*

Combining the guidance provided in PAN45 on the way in which the perception of a wind farm changes with distance and the six English Heritage criteria make it possible to consider the severity and significance of impact on historic sites.

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[6] English Heritage (2005) *Wind Energy and the Historic Environment*

3.4.4 Dispersed settlement pattern

The dispersed pattern of development in the district has a number of implications for the scope for renewable energy development, particularly:

1. Because few areas are distant from existing settlements or individual houses, the amenity impacts of wind development (visual impact, noise, shadow flicker, TV reception and impacts during construction) are likely to be significant in many parts of the district.

2. Because district heating schemes require a certain mass and density of residential development in proximity to non-residential development with a high heat demand, there are likely to be limited opportunities for such schemes in the district.

A buffer of 800m between individual dwellings and turbines has been adopted as a constraint in assessing the potential for wind development in section 4.5. Commercial turbines in the 2 - 3 MW range are large - up to 125m tip height and this degree of separation is required for both noise and visual impact reasons. Some developers may regard 800m as being too generous and may be able to justify smaller distances based on specific turbines and layouts. However it is considered that 800m provides the right starting point in assessing the capacity of the district for large wind turbine developments.

Smaller turbines are also possible, requiring reduced separation distances. For example, 400/500m separation for a turbine less than 1 MW capacity. However, commercial developers tend not to favour smaller turbines, which are more likely to be used to serve, for example, a single major power user on an industrial estate.

It is important to distinguish between impact on residential visual amenity and impact on landscape character when assessing wind proposals. Impact on residential visual amenity should ideally be assessed by a 'residential survey' which considers the visual impact on individual dwellings closest to the proposal and groups of dwellings as distance increases.

Other impacts referred to above such as noise and shadow flicker generally require similar distances to those needed in respect of visual amenity. Impacts such as TV interference and construction disturbance can often be mitigated or dealt with by planning condition.

3.4.5 Highways and access issues

Highways and access issues may act as a constraint on renewable energy development, particularly in relation to the construction phase, given that many of the roads in the district are unsuited to large vehicles and pass through numerous settlements. . Normally wind developers undertake specialist studies which will demonstrate how the blades (the longest single element) can be transported to site. Delivery of biomass fuel to large projects may also raise highways and access issues.

3.4.6 Potential conflicts with aviation activities

Aviation activities in West Oxfordshire

Wind turbines can have an impact on aviation activities, typically on radar systems or on low flying. The operation of airports, airfields and military facilities may, therefore, constrain the development of wind schemes in parts of West Oxfordshire.

RAF Brize Norton, a safeguarded military aerodrome (a term explained below) and the largest RAF base in the UK is located near to Carterton in the south west of the district. The official safeguarding zone covers much of the district.

Other facilities which may place constraints on wind development include:

- RAF Fairford, a standby airfield used by the US Air Force in neighbouring Gloucestershire, near to the south west boundary of West Oxfordshire, which is a safeguarded military aerodrome;

- the smaller RAF airfield at Little Rissington, also in Gloucesterhsire, near to the western boundary of West Oxfordshire, which is a safeguarded military aerodrome;

- Dalton Barracks (previously known as RAF Abingdon), near to the southern boundary of West Oxfordshire in Vale of White Horse district, which is a safeguarded military aerodrome;

- RAF Benson and the nearby Chalgrove airfield, near to Wallingford in South Oxfordshire, which are both safeguarded military aerodromes;

- Oxford (Kidlington) Airport, a commercial facility, just over the district boundary in neighbouring Cherwell and which is an officially safeguarded civil aerodrome. The safeguarding zone covers much of the district. This facility does not currently have a radar but we understand that the operator is considering future installation; and

- numerous smaller airfields both within West Oxfordshire, including at Enstone and Oaklands Farm (near Stonesfield), and in neighbouring districts, including Long Marston in Warwickshire (also referred to as Kineton), a private airfield near to the northern boundary of West Oxfordshire.

Guidelines

As a result of the potential conflicts between wind turbines and aviation activities, procedures have been established to manage potential conflicts.

The Wind Energy, Defence and Civil Aviation Interests Working Group, with representatives from the Ministry of Defence (MoD), the Department for Transport, the Civil Aviation Authority (CAA), the National Air Traffic Services (NATs), the Airport Operators Association, the British Wind Energy Association and government, has produced guidelines[7] which explain Government's policy and the need for wind energy, the issues relating to the potential impact of wind farms on aviation activity, and the planning and consultation process.

The guidelines explain the system of 'aerodrome safeguarding', which refers to the control of building (including wind turbines) around an aerodrome. The objectives of the safeguarding process are threefold:

1. to prevent the granting of planning permission for developments which would impact upon the safe use of aerodromes or communication, navigation or surveillance (CNS) systems (including radar);

2. to ensure that the cumulative effects of previous and continuing developments are taken into account; and

3. to ensure that planning permission, where granted, is subject to appropriate conditions.

Requirements for safeguarding aerodromes and other sites (both civil and military) are set out in Government documentation[8]. The process is based on safeguarding maps that are lodged with local planning authorities (LPAs). LPAs are required to consult the relevant civil aerodrome representative directly about wind farm proposals that fall within areas covered by safeguarding maps.

Aerodrome safeguarding is limited to the vicinity of the aerodrome. The definition of 'vicinity' will vary depending upon the activity that takes place at that aerodrome but can be as large as 30km. The LPA is required to consult the relevant aerodrome regarding any wind turbine proposal within the safeguarded zone.

A number of airfields have developed specific wind turbine safeguarding maps. These depict those areas where development would be undesirable, those where development would be undesirable but some may be possible, and those areas where in principle, development could be tolerated but with some constraints (particularly to address cumulative effects and proliferation issues). We understand that a wind turbine safeguarding map has been produced for RAF Brize Norton but that it only identifies the area within which they would wish to be consulted about any proposals for wind turbines. The safeguarding zone covers the whole of West Oxfordshire.

The Ministry of Defence has also placed safeguarding zones around other facilities. For example, RAF Croughton, a major US Air Force communications base close to the

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[7] Wind energy, defence & civil aviation interests working group (2002) *Wind energy and aviation interests: Interim guidelines,* Department of Trade and Industry.
[8] Safeguarding Aerodromes, Technical Sites and Military Explosives Storage Areas: the Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) Direction 2001.

Cherwell district boundary in Northamptonshire has a technical safeguarding zone in place to prevent interference with the VHF and UHF radio transmitters used on the site.

It should be noted that development proposals within these safeguarding zones will not necessarily result in the aerodrome objecting to the proposal. Since the interactions between wind turbines and aviation activities is complex and subject to a wide range of factors, each proposal is assessed individually. Further guidance on the range of issues associated with wind turbines and their effect on aviation that will need to be considered when assessing the viability of wind turbine developments has been provided by the Civil Aviation Authority[9].

The interim guidelines encourage developers to consult voluntarily with the relevant aerodrome or other safeguarded site before their formal planning application is submitted in order to identify and, if possible, resolve issues. Consultation happens through a standard Wind Farm Developers Application Proforma contained with the guidelines in which developers list the exact locations, dimensions, construction details and output of all proposed turbines.

With regard to other non-officially safeguarded aerodromes, the interim guidelines urge each to establish 'an agreed consultation procedure' with the local planning authority, to produce 'non-official safeguarding maps', and to use the general advice within the legislation.

There is no specific legislative requirement for LPAs to notify aviation stakeholders of any wind farm planning applications that do not fall within statutory safeguarding areas. However, there is a requirement, set out in paragraph 25 of Planning Policy Statement 22, for LPAs to satisfy themselves that defence and aviation issues have been addressed before considering planning applications:

> *Regional spatial strategies should not include specific policies relating to the impact of wind turbines on airport operation, radar and aircraft, and neither they nor local development documents should include policies in relation to separation distances from powerlines, roads, and railways. It is the responsibility of developers to address any potential impacts, taking account of Civil Aviation Authority, Ministry of Defence and Department for Transport guidance in relation to radar and aviation, and the legislative requirements on separation distances, before planning applications are submitted. Local Planning Authorities should satisfy themselves that such issues have been addressed before considering planning applications.*

In order to ensure compliance with this policy, it is advisable for the LPA to consult with Defence Estates and NATS regarding any wind turbine application, regardless of height.

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[9] Civil Aviation Authority (2009) *CAP 764: CAA Policy and Guidelines on Wind Turbines*.

There is a substantial amount of activity going on to identify, develop and implement solutions to the potential impacts that wind turbines can have on radar systems. Together with stakeholders in the aviation and wind development sectors, the Department for Business, Enterprise and Regulatory Reform (BERR) has developed an Aviation Plan to move this work forward so that wind farms can be developed while, at the same time ensuring national security and the continued safe operation of the aviation environment. The overall aim of the Aviation Plan is to provide a suite of generic mitigation solutions to which wind farm developers and their aviation stakeholders can turn when discussing the best potential solutions for any particular wind proposal. It is, however, still in the early stages of development.

3.4.7 Overview

There are significant constraints on large-scale renewable energy schemes, particularly wind turbines, in West Oxfordshire due to the highly-valued landscape and historic environment, which are subject to significant protective safeguards. In addition, the dispersed settlement pattern in the district means that large-scale wind turbines on most sites will generate some amenity impacts and this development pattern will also limit the opportunities for district heating schemes. The district is also used extensively for aviation activities, and this is likely to act as a further significant constraint on large-scale wind turbine development in large parts of the district, although the specific impacts on aviation activities will need to be assessed on a site-by-site basis in consultation with airfield operators.

4. Feasibility and potential of renewable energy and low carbon technologies

4.1 Introduction

This section of the report reviews the appropriateness and potential of renewable energy and low carbon technologies and their potential use in new developments in the West Oxfordshire District Council area.

Firstly, we provide an overview of the micro-scale renewable and low-carbon energy generation technologies likely to be appropriate to meet the requirements of new housing in the district. A resource assessment for each technology, including larger scale wind and CHP/district heating developments then follows, making it possible to reach some conclusions about the appropriate applications for each of these, and the key constraints on their use.

It is important to note that the data contained within this report relates predominantly to domestic housing – both new build and existing homes. This is due to the variability of energy demand in non-domestic speculative developments, and the fact that data relating to technologies in non-domestic buildings is highly variable and not readily available. Data sources have been highlighted where appropriate.

It is also important to note that renewable technologies are rapidly evolving. As the technologies develop, they are likely to become viable in more situations, including those which are currently considered to be marginal.

4.2 Overview of small-scale renewable energy and low carbon technologies

Table 4.1 below summarises the costs and potential financial and carbon savings associated with the use of small-scale low carbon and renewable energy technologies in new build developments in West Oxfordshire. Table 4.2 provides the same information for existing buildings, where this data is available. Technologies shown as ‘green’ are considered feasible in most sites, subject to the considerations referred to in the table. Technologies shown as ‘yellow’ are likely to be feasible in a more restricted range of developments.

The figures shown are indicative only and will vary according to the specific device chosen, the site of installation and the fuel source being substituted.

The General Permitted Development Amendment Order (GPDO) 2008 (SI 2008 No.675) gives deemed planning consent for the installation of 'Domestic Microgeneration Equipment'. The Order covers specific technologies – PV, solar hot water, ground sourced heat pumps, biomass heating systems, CHP systems. In all cases the Order is restricted to the use of these technologies in housing and there are a number of stated exceptions where planning permission will still be required – in particular in World Heritage Sites and conservation areas, and in respect of listed buildings. In addition Listed Building Consent will still be required even in cases where the GDPO gives deemed planning consent. The GDPO Amendment is helpful in that it takes away the necessity for planning permission for the straightforward application of the most common technologies. The 2008 GDPO Amendment does not cover micro-wind turbines or air source heat pumps. Further guidance has been promised but has not yet been issued.

A fuller explanation of each technology and its potential application in the district can be found in appendix B.

Please note that the figures quoted in tables 4.1, 4.2 and appendix B do not take in to account the impacts of the announcements made in the recent UK Renewable Energy Strategy. The introduction of a Feed-in-Tariff for electricity (due April 2010) and the Renewable Heat Incentive (due April 2011) is likely to have a significant impact on the savings to the end user from the installation of many of the small-scale technologies. This will be of primary relevance to the retrofit of devices to existing homes, where the homeowner will benefit directly. However, it may also result in homes which include renewable technologies becoming more attractive to buyers, and may therefore also provide an incentive for developers to install them.

Table 4.1: Domestic-scale renewable energy and low carbon technologies in new-build developments – a summary

	Typical system size	Typical cost (£)	Saving to end user (£/yr)	CO_2 saving/ year	Viability	Site specific?	Considerations
Solar PV 	1.5-3kWp	5-7,500 per kWp	230[10]	800kg		No	Due south orientation for optimum output; permitted development; avoid shading; roof must withstand weight; cleaning required; GPDO 2008 Amendment permits a wide range of domestic PV applications, with exceptions in conservation areas and on listed buildings
Solar hot water* 	3-4m^2	3-5,000	50 to 65	325-640kg		No	Orientation not as important as for PV; permitted development; good for urban settings; output reduced in winter and by shading; requires high-efficiency boiler to top up and prevent Legionella; GPDO 2008 Amendment permits a wide range of domestic SHW applications, with exceptions in conservation areas and on listed buildings
Ground source heat pump* 	8-12kW	6-12,000[11]	250 to 880	1.2-6.9 tonnes		Yes	Can heat more than one home and meet 100% of space heating needs; compatible heating system required; sufficient space or suitable ground conditions needed; GPDO 2008 Amendment permits a wide range of domestic GSH applications, with no exceptions
Air source heat pump* 	5kW	6,000[12]	185 to 760	0.83-6 tonnes		No	Easy installation; less space needed and cheaper than ground source heat pumps, but less efficient; suitable for urban areas; noise issues.
Small-scale hydro 	2.5-100kW	100kW - low head[13]: 115000–280000 100kW - high head[14]: 85000–200000	£450[17]	2,300kg		Yes	Can provide all of a home's electricity demands; low maintenance costs; planning permission required; Environment Agency permission required; cost very site specific.

	Typical system size	Typical cost (£)	Saving to end user (£/yr)	CO_2 saving/ year	Viability	Site specific?	Considerations
		2.5 kW - low head[15]: 5500–7500 2.5 kW – high head[16]: 12500–14000					
Biomass stove* 	5-11kW	2-4,000	-20 to -82[18]	335-840kg		No	Can be carbon neutral; fuel can be stored; regular fuel supply required; ash must be cleaned out regularly; flue required; only certain devices permitted in smoke control areas; GPDO 2008 Amendment permits flues for domestic biomass heating systems subject to exceptions in conservation areas
Biomass boiler* 	20kW	5-14,000	-65 to 555[19]	4.4-10 tonnes		No	Can meet 100% heating and hot water demand; suitable for community heating, but backup boiler may be needed to cope with peak demand; can be considered carbon neutral; space for fuel storage required; regular fuel supply required; ash must be cleaned out regularly; flue required; only certain devices permitted in smoke control areas.
Wind turbine 	1kW (building mounted)	1700	Uncertain	Uncertain		Yes	UK has Europe's largest wind resource; not permitted development; less suitable for urban areas; no conclusive data on efficiencies when roof-mounted.
	2.5kW (free standing)	7500	150 to 250	1700kg		Yes	

	Typical system size	Typical cost (£)	Saving to end user (£/yr)	CO_2 saving/ year	Viability	Site specific?	Considerations
	6kW (free standing)	19,000	250 to 450[20]	Variable		Yes	
	1.8MW (free standing)	Variable[21]	Variable	Variable		Yes	UK has Europe's largest wind resource; planning permission required; suitable for rural use; more visible than smaller technologies.
CHP	1kWe	1,500	40 - £90[22]	2,000kg		Yes	System should be sized around heat and electrical demand, requirement for natural gas connection or biomass source (biomass – can be considered carbon neutral; space for fuel storage required; regular fuel supply required); flue required; only certain devices permitted in smoke control areas; planning permission required.

*Depends on fuel type being replaced.
Data sourced from the Energy Saving Trust, DECC's Low Carbon Buildings Programme, the Greater London Authority's 'Integrating renewable energy into new development: Toolkit for planners, developers and consultants', and the National House-Building Council Foundation's 'A review of microgeneration and renewable energy technologies.
All images sourced from The Energy Saving Trust, except air source heat pump courtesy of North Kesteven Council.

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[10] Assumes 50% of generated electricity consumed onsite, 50% exported as well as a 12.12p/kWh cost for standard rate electricity and 9.39p/kWh buy back rate of electricity.
[11] Distribution system costs excluded. Assumptions based on use in a well-insulated house.
[12] Distribution system costs excluded. Assumptions based on use in a well-insulated house.
[13] British Hydro Power Association.
[14] British Hydro Power Association.
[15] UK energy supplier.
[16] UK energy supplier.
[17] Assumes that all of the electricity generated is consumed within the household, and price is approximately 8.5p/kWh.
[18] Assumes fuel costs of 5.94p/kWh for pellets (bag supply). – denotes a minus figure.
[19] Assumes fuel costs of 3.57p/kWh for pellets (bag supply). – denotes a minus figure.
[20] Assumes that all of the electricity generated is consumed within the household, and price is approximately 8.5p/kWh.
[21] The Westmill wind farm project in South Oxfordshire (which comprises five turbines) cost £7.6million in total. See http://www.westmill.coop/westmill_windfarm.asp
[22] Savings of £40 are relative to a conventional boiler, assuming that a half export reward tariff is available (e.g. 5p/kWh against a retail price of 10p/kWh). If a theoretical full price export reward tariff were to be assumed, the maximum annual cost saving for this same house would be over £90.

Table 4.2: Domestic-scale renewable energy and low carbon technologies in existing buildings – a summary

	Typical system size	Typical cost (£)	Saving to end user (£/yr)	CO_2 saving/ year	Viability	Site specific?	Considerations
Solar PV 	1.5kWp	6000 per kWp	230[23]	512kg		No	Due south orientation for optimum output; permitted development; avoid shading; roof must withstand weight; cleaning required; GPDO 2008 Amendment permits a wide range of domestic PV applications, with exceptions in conservation areas and on listed buildings
Solar hot water* 	3-4m^2	3-7,000	£34[24] - £190[25]	400kg[26] - 1000kg[27]		No	Orientation not as important as for PV; permitted development; good for urban settings; output reduced in winter and by shading; requires high-efficiency boiler to top up and prevent Legionella; GPDO 2008 Amendment permits a wide range of domestic SHW applications, with exceptions in conservation areas and on listed buildings
Ground source heat pump* 	8-12kW	6,000[28]	80–£120[29] per m^2	Not known		Yes	Can heat more than one home and meet 100% of space heating needs; compatible heating system required; sufficient space or suitable ground conditions needed; GPDO 2008 Amendment permits a wide range of domestic GSH applications, with no exceptions
Air source heat pump* 	5kW	6,000[30]	Not known	Not known		No	Easy installation; less space needed and cheaper than ground source heat pumps, but less efficient; suitable for urban areas; noise issues.
Small-scale hydro 	2.5-100kW	100kW - low head[31]: 115000–280000 100kW - high head[32]: 85000–	£450[35]	2,300kg		Yes	Can provide all of a home's electricity demands; low maintenance costs; planning permission required; Environment Agency permission required; cost very site specific.

	Typical system size	Typical cost (£)	Saving to end user (£/yr)	CO_2 saving/ year	Viability	Site specific?	Considerations
		200000 2.5 kW - low head[33]: 5500–7500 2.5 kW – high head[34]: 12500–14000					
Biomass stove* 	20kW	5-14,000[36]	Not known	Not known		No	Can be carbon neutral; fuel can be stored; regular fuel supply required; ash must be cleaned out regularly; flue required; only certain devices permitted in smoke control areas; GPDO 2008 Amendment permits flues for domestic biomass heating systems subject to exceptions in conservation areas
Biomass boiler* 	15kW	>6000	Not known	4.4-10 tonnes		No	Can meet 100% heating and hot water demand; can be considered carbon neutral; space for fuel storage required; regular fuel supply required; ash must be cleaned out regularly; flue required; only certain devices permitted in smoke control areas.
Wind turbine 	1kW (building mounted)	1700	Uncertain	Uncertain		Yes	
	2.5kW (free standing)	7500	150 to 250	1700kg		Yes	UK has Europe's largest wind resource; not permitted development; less suitable for urban areas; no conclusive data on efficiencies when roof-mounted.
	6kW (free standing)	19,000	250 to 450[37]	Variable		Yes	

	Typical system size	Typical cost (£)	Saving to end user (£/yr)	CO_2 saving/ year	Viability	Site specific?	Considerations
	1.8MW (free standing)	Variable[38]	Variable	Variable		Yes	UK has Europe's largest wind resource; planning permission required; suitable for rural use; more visible than smaller technologies.
CHP	1kWe	1,500	40 - £90[39]	2,000kg		Yes	System should be sized around heat and electrical demand, requirement for natural gas connection or biomass source (biomass – can be considered carbon neutral; space for fuel storage required; regular fuel supply required); flue required; only certain devices permitted in smoke control areas; planning permission required.

*Depends on fuel type being replaced.
Data sourced from the Energy Saving Trust, DECC's Low Carbon Buildings Programme, the Greater London Authority's 'Integrating renewable energy into new development: Toolkit for planners, developers and consultants', and the National House-Building Council Foundation's 'A review of microgeneration and renewable energy technologies.
All images sourced from The Energy Saving Trust, except air source heat pump courtesy of North Kesteven Council.

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[23] Assumes 50% of generated electricity consumed onsite, 50% exported as well as a 12.12p/kWh cost for standard rate electricity and 9.39p/kWh buy back rate of electricity.
[24] Where property uses natural gas (at 1.5 p/kWh).
[25] Where property uses grid electricity (at 8.5 p/kWh).
[26] Where property uses natural gas.
[27] Where property uses grid electricity.
[28] Distribution system costs excluded.
[29] Will depend on economies of scale and type of installation.
[30] Distribution system costs excluded. Assumptions based on use in a well-insulated house.
[31] British Hydro Power Association.
[32] British Hydro Power Association.
[33] UK energy supplier.
[34] UK energy supplier.
[35] Assumes that all of the electricity generated is consumed within the household, and price is approximately 8.5p/kWh.
[36] Figure from the Low Carbon Buildings Programme.
[37] Assumes that all of the electricity generated is consumed within the household, and price is approximately 8.5p/kWh.
[38] The Westmill wind farm project in South Oxfordshire (which comprises five turbines) cost £7.6million in total. See http://www.westmill.coop/westmill_windfarm.asp
[39] Savings of £40 are relative to a conventional boiler, assuming that a half export reward tariff is available (e.g. 5p/kWh against a retail price of 10p/kWh). If a theoretical full price export reward tariff were to be assumed, the maximum annual cost saving for this same house would be over £90.

Technologies shown as 'green', and therefore considered feasible in most developments in the district, include solar PV, solar hot water, ground and air source heat pumps and biomass boilers. Although these technologies do have some basic installation requirements, they are suitable for use in both existing buildings and in most new developments, which can be designed to avoid shading in the case of solar technologies and to allow room for a ground loop to be installed for a ground source heat pump to be used. Although the feasibility of biomass installations depends on the cost and local supply of biomass fuel, it is improved by the economies of scale offered by larger developments.

Technologies shown as 'yellow' – and therefore feasible only in certain instances – include wind turbines, biomass stoves, hydro power and CHP installations.

Analysis of available Met Office data has demonstrated that there is only sufficient wind resource to power wind turbines in a small proportion of West Oxfordshire district. A cluster of areas to the north west of the district have wind speeds above 5/ms, which we have taken as the bare minimum for viability. Local topography and other obstructions such as trees and buildings will also affect the operation of wind turbines, particular smaller ones, and are very site-specific. Assessing which size and what number of turbines to install will depend to a great extent on the local situation, thus a more detailed assessment at the site level will be required. Wind issues are discussed further in section 4.5.

We have also classified biomass stoves as 'yellow'. This is because other renewable and low carbon technologies such as ground source heat pumps are considered a more suitable option for heating new build developments. In addition, although the feasibility of biomass installations depends on the cost and local supply of biomass fuel, it is improved by the economies of scale offered by larger developments.

Hydro power systems can obviously only be installed where a suitable water resource is available nearby. To determine whether it would be feasible to use such a resource where one exists, a site assessment will be required in order to collect flow rate and head (the height water falls) data.

CHP installations will need connection to either the natural gas network, or in the case of biomass fuelled systems, access to a regular supply of fuel and adequate storage space.

4.3 Resource assessment: feasibility of small scale renewable energy technologies in West Oxfordshire

This section of the report follows on from table 4.1 and considers the feasibility of renewable energy and low carbon technologies in the West Oxfordshire District Council area.

For certain technologies, where appropriate, we have considered local renewable energy or low carbon resource availability in more detail using GIS mapping (e.g. the mapping of wind speeds), while other technologies' feasibility can be assessed more generally (e.g. photovoltaic systems).

4.3.1 Photovoltaic systems

Where basic requirements for orientation, tilt and shading can be met, we foresee no problems with the installation of PV systems in the area. As noted in table 4.1 the General Permitted Development Amendment Order 2008 gives deemed planning consent for the installation of PV on existing dwellings with the exception of listed buildings and certain specific applications in conservation areas.

4.3.2 Solar hot water

Where basic requirements for orientation, tilt and shading can be met, we foresee no problems with the installation of solar hot water systems in the area. As noted in table 4.1 the General Permitted Development Amendment Order 2008 gives deemed planning consent for the installation of solar hot water panels on existing dwellings with the exception of listed buildings and certain specific applications in conservation areas.

4.3.3 Ground source heat pumps

Ground source heat pumps (GSHPs) are a good renewable heating option to consider in rural areas since it is likely that new development will include large areas for horizontal trench systems. As noted in table 4.1 the General Permitted Development Order 2008 Amendment permits domestic GSHP applications with no exceptions.

Vertical borehole systems will also be suitable in both urban and rural areas, although a geotechnical site-specific survey will be required to reduce the uncertainty associated with ground conditions.

The British Geological Survey has an on-line service offering simple, or more detailed, GeoReports that provide information on local ground conditions relevant for ground source heat pumps. For example, an online GSHP report suitable for single dwelling applications currently costs £50. Larger schemes, with multiple boreholes, will require a trial borehole and/or a thermal properties field test.

A recent housing scheme in West Oxfordshire, incorporating multiple vertical boreholes, had problems associated with aquifers. Any site specific survey should therefore take this issue into consideration.

4.3.4 Air source heat pumps

Air source heat pumps (ASHPs) are cheaper and easier to install than GSHPs. They can be installed with less disruption and take up less space, making them suitable for use in both urban and rural locations. ASHPs could be a good alternative to GSHPs, especially where the latter are not viable due to land constraints (e.g. size or suitability for drilling).

Unlike other technologies such as PV and solar thermal, the 2008 GDPO Amendment does not cover air source heat pumps and so planning permission will be required for installations in existing domestic properties. Further guidance has been promised but has not yet been issued.

4.3.5 Micro hydro

Kinetic energy from moving water can be used to drive an electricity generator, just as it has been used in the past to drive water mills. Hydro electric plants can be very large – generating hundreds of megawatts – or very small. Micro hydro schemes generally have a capacity under 100kW. Average domestic systems are between 1kW and 5kW in size, while commercial systems are above 25kW in size.

Where a development is located next to a suitable water source, micro hydro systems could be used to supply electricity to individual households, although it will be more cost-effective to connect a system to several buildings.

There are a number of environmental impacts associated with hydro systems. This includes the visual and noise impacts of the hydro turbine, which can be mitigated relatively easily. The main issue relates to the river's ecology. To reduce ecological impacts, systems should be designed to restrict the proportion of the total flow diverted through the hydro-turbine.

As the Environment Agency controls all water courses in England and Wales, permission in the form of a licence is usually required to remove water from a water course. Advice on reducing ecological impacts is also available.

It has been suggested that the mill infrastructure associated with previous blanket making facilities around Witney provide a particular opportunity for larger scale installations. However, the report *Low Head Hydro Power in the South-East of England – A Review of the Resource and Associated Technical, Environmental and Socio-Economic Issues*, produced in 2004, indicated that there was insufficient head of water at most of the mills along the River Windrush. The permission of the Environment Agency would still need to be sought to exploit these sites, but it can sometimes be easier to get permission for an installation where some infrastructure already exists.

No research has been carried out to assess the extent of this potential as part of this project but there are likely to be sites where the use of micro hydro would be appropriate locally.

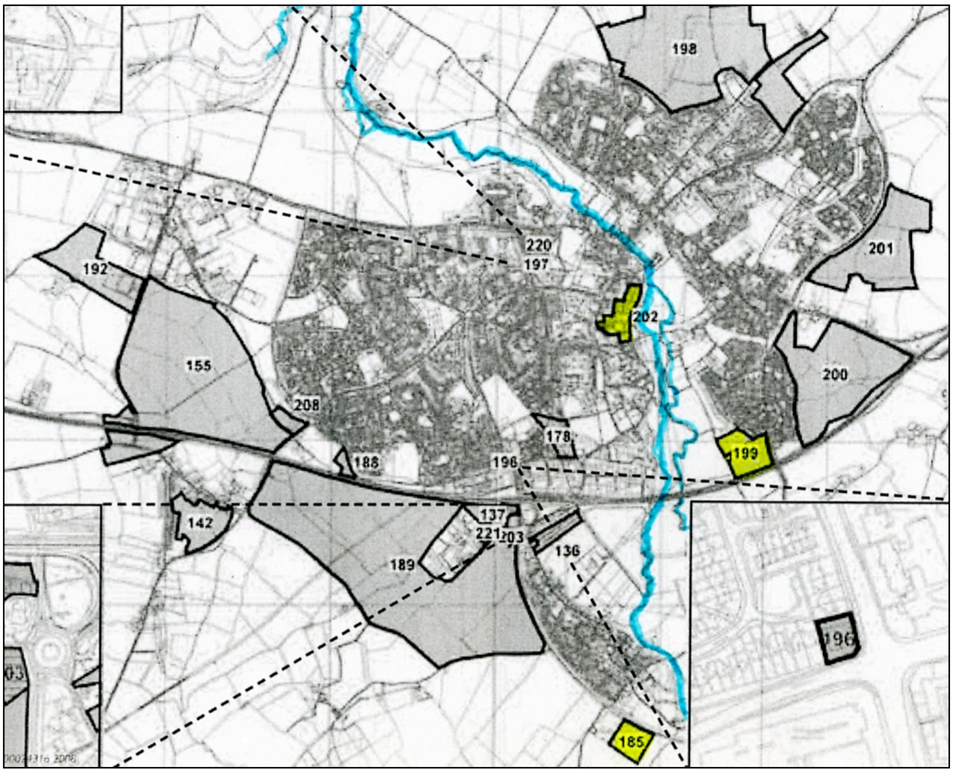
The GIS map below highlights the water courses in the West Oxfordshire District Council area. While data on flow rates were not available to the project team, the map below is still useful in highlighting areas of potential.

Figure 4.1 Water courses in West Oxfordshire

Opportunities could exist in Witney since a water course runs through the centre of the town, with several tributaries to the east and west of the main water course (see map below, taken from the Site Allocations Consultation Document). Based on submitted development sites listed in the Site Allocations Document, there are three sites located close to this water course that could warrant further investigation: references 185, 199 and 202. However, as noted above, a hydropower report produced in 2004 indicated that there was insufficient head of water at most of the mills along the River Windrush.

It is important to highlight that the predicted impacts of climate change in the South East may result in reducing the viability of micro-hydro electric systems. This is due to a number of factors including increased water scarcity caused by more water being taken from the water table to sustain the growing population in the South East and decreased rainfall in summer.

Figure 4.2 – Witney - sites close to water course



There is also a water course which runs to the West of Carterton. This is close to submitted development sites (as listed in the Site Allocations consultation document) 134, 148, 149 and 159.

If flow-rates/head height look promising for these sites, then we would recommend that a site specific analysis (in co-ordination with the Environment Agency) is undertaken to determine the feasibility of this technology at each site.

No opportunities exist in the area immediately around Chipping Norton.

There is a water course to the west of Woodstock, but this is well away from the submitted development sites which are all located to the east of the town. There is a water course to the east of Eynsham, but it appears to be more than 1km away from any of the submitted development sites.

4.3.6 Biomass stoves and boilers

Biomass is a good, viable option for new build development, since site plans can be designed to incorporate space to store fuel and accommodate delivery vehicles. This type of technology can be incorporated into developments at a range of different scales. This can be on a small or medium scale, with the application of biomass stoves and boilers in individual dwellings or large buildings, or on a site-wide basis through the deployment of combined heat and power and/or district heating systems. Further information on these larger systems can be found in section 4.4.

As noted in table 4.1 the General Permitted Development Order 2008 Amendment permits flues for domestic biomass heating systems in existing dwellings subject to exceptions in conservation areas.

There are no smoke control areas in West Oxfordshire, meaning that exempt appliances do not have to be specified.

It is more important however, to determine whether a reliable source of fuel is available locally. Details of existing local suppliers of biomass can be found in Appendix B.

Discussions have been undertaken with key officers at Cherwell and West Oxfordshire Councils on this issue. West Oxfordshire District Council recently commissioned a study to calculate local wood biomass resources but neither council yet has any other information on how much wood biomass is currently available.

It was suggested that enough biomass is probably available to support a local industry, but it is a challenge to persuade investors to purchase wood chipping and similar equipment while there are no local boilers to supply. The Council's Landscape and Forestry Officer highlighted that while the promotion of biomass is often focussed on new development, there are also opportunities for use in existing development. This includes, for example, country estates, farmers and landowners, employment sites and public buildings.

Discussions have also been undertaken with a local woodchip supplier, who suggested that there is currently no market in Oxfordshire for wood fuel. The firm supplies Berkshire and Staffordshire instead, and the company director reflects that it would be more environmentally sensible to reduce the miles the product must travel, in order to minimise the emissions associated with its use. The firm suspects that district councils in the area have access to enough waste wood from their own operations to supply a local biomass market. However, until more biomass boilers are installed in local developments, this resource will continue to go to waste and no more wood fuel suppliers are likely to be set up in the area.

Oxfordshire County Council runs the Oxfordshire Woodland Project[40], set up to provide information to small private woodland owners and community groups across the county and promote woodland management for all of the benefits this provides – including sustainability. The project receives funding from the district councils in Oxfordshire. Some information is available online regarding growing firewood but no other details were found specifically relating to wood biomass production. The manager of this project does not have any knowledge of specific documentation relating to biomass availability in the northern Oxfordshire area but commented that much may be inferred from the Forestry Commission's periodic census. Oxfordshire has quite a large number of small woodlands, all capable of producing biomass. However, management in these small woodlands is relatively unpredictable and a proportion of owners burn their entire annual production of firewood themselves. On the other hand, northern Oxfordshire, particularly in the Wychwood area, has several large blocks of woodlands owned by only a few estates (e.g. Blenheim, Cornbury). Though the Woodland project is not involved in the management of large woodlands, the officer contacted was aware of local interest in biomass. Whilst it has not been possible to make direct contact with estate managers during this project, council officers commented that estate managers have plans in place to effectively manage and produce biomass within the estates.

The Sylva Foundation[41], based in Oxfordshire but operating nationally, also provides information to woodland owners to support sustainable woodland management. The Foundation was also contacted to ask for information about local wood biomass resources. It replied to say it is working with a number of woodland owners and stakeholders in developing the wood fuel network in Oxfordshire. The organisation has also recently set up a national project to support woodland owners' engagement with the wider wood chain (for both timber products and wood fuel). A web-based map resource[42] has been developed to provide businesses with local and regional woodland resource information. Registered businesses can send 'expressions of interest' in a particular wood to the relevant woodland owner. It is intended this system will form a first step towards establishing further supply networks for timber and wood fuel in England.

The eventual aim is to map all of England's woodlands to compile inventory data to help provide an estimate of the potential productivity of English woodlands. Among other things, this information should help enable the increasing demand for woodfuel to be met.

Through our discussions with council officers and other stakeholders, it is evident that there is a need for ongoing work to develop working supply chains in the West Oxfordshire area, to establish wood fuel heating as a viable and well understood option in the marketplace. Without this, there is a danger that developers will not have the confidence to invest in this sector. Discussion of a project currently being taken forward

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[40] Further information is available on the Oxfordshire County Council website.
[41] http://www.sylva.org.uk/
[42] http://www.myforest.org.uk/

by West Oxfordshire District Council and the potential for a strategic approach to developing a biomass supply is included in section 7.4.

4.3.7 Wind

Small scale wind turbines are available for domestic and other applications, such as serving a village hall, a school, or business or agricultural activities. Typically, small scale turbines are readily available in the range of 1-6kW installed capacity. A *Domestic small-scale wind field trial report* published by the Energy Saving Trust in July 2009 shows that building mounted wind turbines do not perform well unless the building in question is in an exposed position with no obstruction in the direction of the prevailing wind. The report also shows that freestanding small-scale turbines can perform well, but again only if they are located on a windy site free from obstructions or the effects of turbulence caused by buildings or trees.

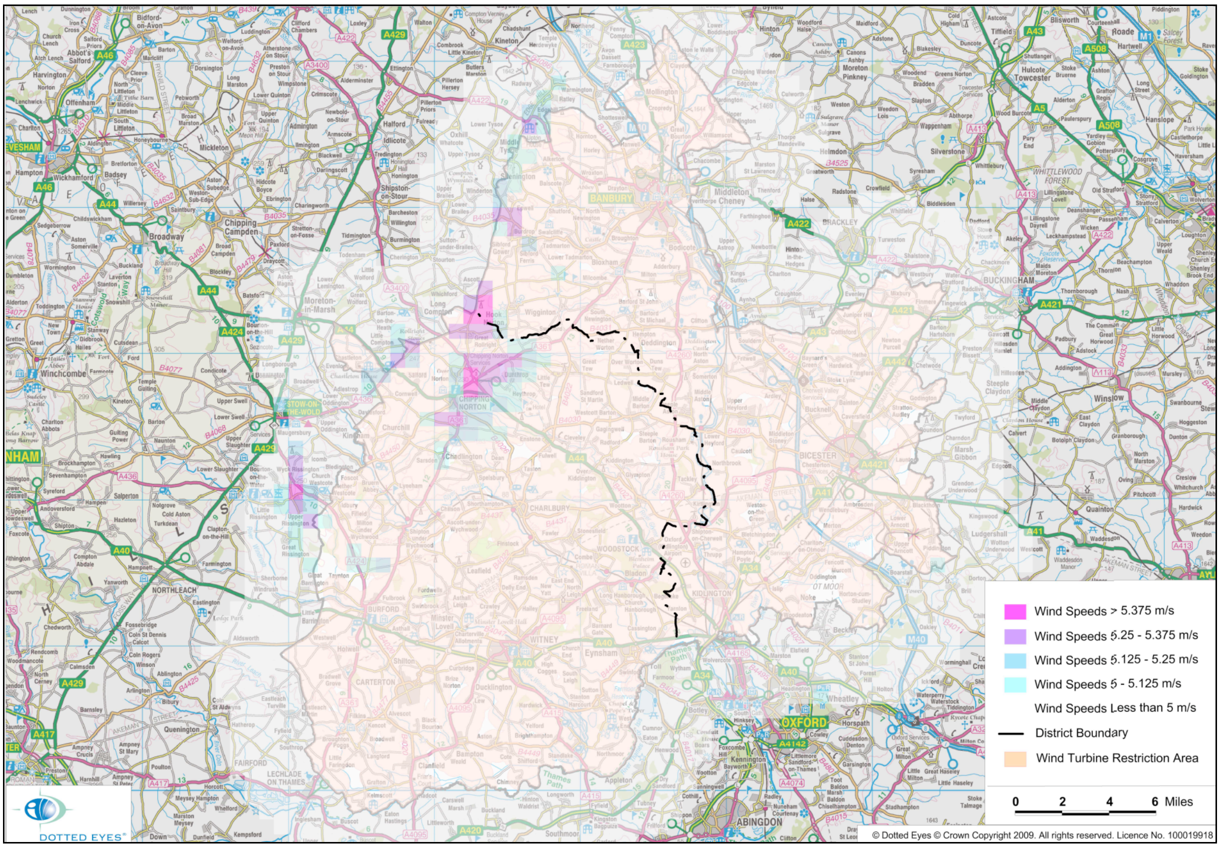
Where small-scale wind turbines can be located at sites with good, reliable windspeeds, away from obstructions, they could be suitable for use in the West Oxfordshire area. The key constraints are discussed in general terms in section 3.4 and a further more detailed resource assessment for larger scale wind developments is provided in section 4.5 below.

The requirement for good and unobstructed wind could raise the issue of landscape impact in what are considered to be sensitive locations. Government guidance on this topic is set out in paragraph 3.4.1 above.

The GIS map below highlights the opportunity for small-scale wind turbines in the West Oxfordshire District Council area. Data from the Met Office has been used to highlight areas of the district where wind speeds are above the likely cut-in speed of 5m/s[43] at a height of 10m.

[43] Wind speeds of 5m/s and above are recommended for small scale turbines. Source: Energy Saving Trust: www.energysavingtrust.org.uk/Generate-your-own-energy/Wind-turbines.

Figure 4.3: Wind speeds at 10m height in West Oxfordshire and Cherwell districts



As highlighted in figure 4.3, only a small proportion of West Oxfordshire district appears to have sufficient wind resource for small-scale wind turbines. Only areas to the north and west of the district have wind speeds above 5/ms. These areas lie within the RAF Brize Norton wind turbine restriction area and would therefore require consultation with the Ministry of Defence. Site-specific studies, including the collection of accurate wind speed data using anemometers, would be necessary in order to explore opportunities and other constraints.

Due to the lack of viable wind speeds across the district, and the fact that small-scale turbines do not reach optimum performance in built up areas, it is unlikely to be possible to use this technology effectively on major new development sites in the district, with the possible exception of exposed sites around Chipping Norton.

4.3.8 CHP

Where basic requirements such as a source of fuel (natural gas or biomass for example, is available, and heat and electrical demand can be met, we foresee no problems with the installation of CHP systems in the area.

Unlike other technologies such as PV and solar thermal, the 2008 GDPO Amendment does not cover micro-CHP and so planning permission will be required for installations in existing domestic properties.

4.4 Larger scale CHP/district heating

Please note, opportunities for stand-alone CHP units to serve individual buildings are covered under section 4.2 and 4.3 – small-scale renewable energy and low carbon technologies.

4.4.1 Introduction

Basic description

The council should consider the potential benefits of encouraging greater use of medium- and large-scale decentralised energy systems to reduce local CO_2 emissions. If the UKRES 2009 heat targets are to be met, a sustained programme of developing district heating and CHP networks in existing urban areas will be required as well as action to ensure that the proposed growth areas make maximum use of low carbon and renewable energy technology.

Decentralised energy systems can either provide heat and power (Combined Heat and Power, or CHP), or just heat (district heating). District heating systems require a network of insulated pipes to be laid to supply space heating and hot water to multiple buildings from a single generation plant. The heat can be provided from a variety of sources including geothermal, waste heat from industry or purpose-built heating plants.

Alternatively, the source could be a Combined Heat and Power system, whereby the heat produced when fuel is burnt to generate electricity is used (rather than being lost to the environment, as with most centralised power stations). Remote electricity generation is often only around 30% efficient, compared to 75% or more for Combined Heat and Power[44], which as well as utilising the 'waste' heat also avoids the losses incurred when electricity travels large distances over transmission and distribution networks. CHP electricity is provided to local customers via a private wire network.

In the UK, most district heating networks are either linked to a gas-fired CHP system, or use waste heat already generated from industry. However, recent years have seen a number of heat-only networks being created that are powered by biomass, mostly in off-gas areas where the high cost of electric, oil or LPG heating makes district heating more financially attractive.

Biomass CHP is still an emerging technology and several high profile, large-scale schemes have experienced teething problems. However, reliability appears to be

[44] www.defra.gov.uk/environment/climatechange/uk/energy/chp/.

increasing, and attention has recently turned towards smaller plants. For example, the Government is funding five new biomass CHP plants through its Bioenergy Capital Grants Scheme – in Somerset, Wiltshire, Devon and Staffordshire. These will have electrical outputs of 2.5-7MWe. Whilst gas-CHP is a low carbon technology, due to its high efficiency, biomass-CHP offers even greater carbon savings as the fuel is carbon neutral.

As the necessary heat and electricity supply infrastructure can be installed at the same time as other services (water and drainage systems, for example), new developments offer an ideal opportunity for district heating and CHP systems to be installed. Decentralised energy systems can be retrofitted to existing buildings, but it can be quite challenging, expensive and disrupting to inhabitants to do so.

The size of district heating and CHP systems should be determined by the heat and electrical loads of the site in which they are to be installed. This can range from a few kilowatts up to several megawatts. As a general rule, systems become more economic the larger they are.

Systems can be installed as follows:

- Block-by-block – each block in a development has its own communal energy installation and distribution system. This would usually only apply to larger tower blocks;

- Site-wide – a single energy generation source serves several buildings connected by a district heating network (more generation sources can be added as demand changes, for example in phased developments); or

- City-wide – where larger units are used to supply heat and power to whole areas, not just individual developments, as seen in Woking, Southampton, Nottingham and Sheffield.

District heating and CHP systems have received some bad publicity in the past. Some early technologies were found to be inefficient and unreliable, and they could often not be controlled on an individual household basis. However, several systems did work effectively and still do. Modern systems have learned the lessons from their predecessors' experience, and heat can now be both controlled and metered.

Benefits

The key benefits of larger scale CHP/district heating can be summarised as follows:

- very efficient use of fuel and can run on renewable energy sources;

• biomass-burning systems can be carbon neutral (and bring other related benefits, such as creating new jobs in the biomass supply chain and environmental benefits including improving biodiversity);

• on-site heat and power supply reduces power generation and distribution costs and losses;

• excess electrical production can be exported back to the grid if it is not sold directly to the local community via a private wire network.

Constraints

The key barriers to the development of larger scale CHP/district heating can be summarised as follows:

• the technology is only suitable for higher density developments - the Energy Saving Trust recommends that housing developments using CHP meet a minimum density of 50 dwellings per hectare, although this may not be necessary across the whole of a development site;

• biomass systems require reliable fuel supply (and storage space), while non-renewable systems will need to be connected to the national gas grid;

• high initial cost of the infrastructure – particularly the pipe network;

• the need for long term commitment to the development and running of a network;

• UK energy policy is based on choice whereas CHP/district heating developments require long term commitment by consumers if the network is to remain economic;

• the need to achieve a balanced heat load that has varied demand patterns and peaks – mixing domestic, commercial/industrial, institutional loads is desirable; and

• the technology has received bad publicity in the past, including reliability and controllability issues. Whilst these have been overcome, public resistance may remain.

Cost

Costs of this type of technology will be very site-specific and depend on the number of houses and the size of heat and power demand to be supplied. The cost of installation depends heavily on location and can have a strong impact on project feasibility. Detailed site assessments will need to be carried out to determine whether this technology is technically and economically viable within each development. Historically, schemes have only been considered to be financially viable in large scale, high density developments with a good balance of heat load (e.g. residential mixed with leisure, schools, hospitals, business). However, with the drive for lower emissions from new buildings, it is anticipated that CHP and DH will become more common in smaller, lower density developments. In particular, the government's Cost Analysis of the Code for Sustainable Homes (CLG, 2008), found that for developments comprising houses in a market town scenario (i.e. with a typical site area greater than 2 hectares, a density of 50 dwellings per hectare and comprising 27% flats):

- **For Code Level 4** (which requires regulated carbon emissions to be 44% lower than current Building Regulations), the most cost effective way of meeting the minimum energy requirements would be through biomass district heating (in addition to improved controls, air tightness and insulation, and solar water heating). Additional costs per unit (in addition to measures required to reach Code Level 3) are estimated at:
  - ☐ £5,952 for a detached house
  - ☐ £2,495 for a mid-terraced house
  - ☐ £3,423 for a terraced house
- **For Code Level 5** (which requires regulated[45] emissions to be zero), biomass CHP would be required. Additional costs per unit (in addition to the measures required to reach Code Level 4, i.e. on top of the biomass heating system) are estimated at:
  - ☐ £7,264 for a detached house
  - ☐ £4,555 for a mid-terraced house
  - ☐ £5,238 for an end-of-terrace house

Costs for flats are generally lower. For small development scenarios (with a typical site area of 0.3 hectares, a density of 30 dwellings per hectare and comprising all houses), no CHP is recommended on the basis that it is prohibitively expensive, but biomass heating is recommended for Code Level 5.

It should be noted that the capital costs associated with biomass boilers are generally much higher than fossil fuelled boilers with a similar output rating. This is largely why, to-date, they have only been used in off-gas areas where they are better able to compete with the high costs of electric/oil heating. To help offset this, the Bioenergy Capital Grant Scheme[46] is designed to support the installation of bioenergy projects, with a new round of this grant expected to open later this year. In addition, the Renewable Heat Incentive that is going to come into place in 2011 is likely to increase commercial interest in biomass fired DH/CHP projects.

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[45] Regulated emissions are those arising from space & water heating, lighting and pumps and fans

[46] www.biomassenergycentre.org.uk/portal/page?_pageid=77,225275&_dad=portal&_schema=PORTAL

4.4.2 Examples of existing CHP and DH schemes

Large-scale CHP and DH schemes have traditionally been associated with high-rise developments in large cities or with remote communities that are off the gas network. With the move to zero carbon homes, this is changing. This section provides some examples of CHP/DH schemes that exist outside of large cities

Carbon Challenge is a scheme that was launched in 2007 by English Partnerships (now part of the Homes and Communities Agency), involving four schemes building to Code Level 6 (zero carbon). These include:

- South Bank, comprising 344 units in Peterborough. This is planned to include a CHP system powered by anaerobic digestion. Surplus energy from the plant will be used in greenhouses, the community hall, crèche and spa.

- Hanham Hall, South Gloucestershire[47], which involves 200 homes in the grounds of an old hospital. The feasibility study considered a number of different technologies to provide heat. CHP was considered the most cost effective in whole life cost terms and the developers opted for a biomass boiler. A glass house will be present on the site that will use some of the spare heat for food growing purposes. In principle, Hanham Hall should be connected to a wider community district heat network, so that the surplus heat is available for other buildings in Hanham. In practice, some heat dumping will be necessary during summer months.

Other examples of non-city CHP include:

- A scheme in Wick which involves a combined heat and power system that also harnesses the waste heat from the local distillery. Heat and electricity is provided to around 180 households so far as well as other buildings in the area. The capital cost of £7.6 million was partly funded by the now defunct Community Energy Programme.

- Titanic Mill, Linthwaite[48] is a six storey former textile mill near Huddersfield, recently converted to 130 residential apartments plus commercial space. A 100kWe woodchip fuelled CHP system will provide heating and hot water to the building via a shared heating system. Central gas boilers are also present to provide backup at peak times. It was decided to delay the installation of the woodfired CHP until the final apartment had been sold, in order to maximise efficiency. At the time of writing, the heating system was being supplied by the backup gas boilers. This development is unusual in terms of being a relatively high density (6 storey) development in a rural location, thus making it well suited to CHP.

Examples of biomass district heating networks in off-gas areas include:

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47 http://www.hanhamhall.co.uk/overview/

48 http://www.energysavingtrust.org.uk/business/PublicationDownload/?oid=264874&aid=763899

- South Shropshire Housing Association[49], which has installed a biomass boiler to provide hot water and central heating to 90 of the its affordable homes. The facility cost £850,000. Residents get annual fixed prices for their heating and hot water.

- Hoathly Hill Community in rural West Sussex. 27 units, ranging from 1 bedroom flats to 4-bedroom detached houses plus three community buildings. Previously heated by LPG. Wood chip to fuel the boiler is produced at the Balcombe Sawmill. The project has cost nearly £400k. The community raised £160k in grants from a number of sources. The balance was shared between the households connecting up to the system and part financed by a loan from Triodos Bank. Fuel costs (wood chip) are less than half the cost of the LPG previously used.

- Kielder village, a remote community in the heart of Kielder Forest, Northumberland, was the site of the first wood-fired community heating scheme in England[50]. Commissioned in 2004, a central boiler house provides heat, through a system of insulated district heating pipe, to a range of buildings including the Kielder Castle visitor centre, a primary school and youth hostel, workshops and six new houses. The capital cost was in excess of £300,000.

- Penforma, in Wales, comprises offices for Gwynedd council staff and elected members. Adjacent is the Min-y-Mor residential care home and Penrodyn sheltered housing flats, each of which cater for about 30 residents. The three buildings have a total floor area of 6,608m2, and demand about 1,250MWhrs annually to provide heating and hot water. They were originally heated by a combination of oil and electric boiler systems. The 550kW boiler can be fuelled by either woodchip or wood pellet. The fuel store has an approximate capacity of 150m^3 and delivery should be about once a week during very cold weather, and about once every 14 to 18 days at other times.

4.4.3 Existing schemes and feasibility studies

West Oxfordshire District Council has a gas-CHP system installed at its leisure centre in Carterton.

No feasibility studies were known of in the district, although a CHP scheme is proposed as part of neighbouring Cherwell's planned Eco-Town development at North West Bicester[51], which would deliver space heating and hot water to the site and includes an anaerobic digester to treat site sewage. The proposed site strategy also includes biomass (woodchip) boilers. The North West Bicester Eco-Town site is divided into two zones: an inner core zone and an outer zone. The core zone of buildings will be connected to a district heating system to deliver space heating and hot water functions. These will be supplied from an Energy Centre on site, which will include a

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49 www.energysavingtrust.org.uk/Resources/Dailynews
50 Further information is available from the Biomass Energy Centre website
51 NW Bicester Eco-town - Concept Study: www.cherwell.gov.uk/media/pdf/g/5/Bicester_Eco-Town_Concept_Study_-_Feb_2009_(_a3_low_res).pdf

biomass boiler, a bio-gas CHP system (fuelled by an anaerobic digestion system for all sewage, waste and food waste), and a gas fired boiler back up and thermal store. In addition, all buildings in this zone will have rooftop PV systems.

Outside the core zone all homes will have rooftop PV panels, solar thermal panels and wood fired boilers. For non-domestic buildings ground source heat pumps will be installed. All buildings will be connected to a site-wide private wire network. Finally, a number of off-site wind turbines are likely to be required to achieve zero carbon overall.

The site will include 5,000 homes over an area of 125ha. This equates to an average housing density of 40 homes/ha. This is still lower than the density generally deemed necessary to make CHP viable (particularly for very energy efficient buildings, such as are planned for the Eco-town), but it could be that the core zone will be built to a higher density than the outer zone. (We could not find any data about the split in dwelling numbers and area between the core and outer zones.)

The North West Bicester Eco-Town model is based on the development of an Energy Services Company (ESCo), managed by a Community Trust. The ESCo would maintain and operate the energy infrastructure on-site (not just CHP), along with the landscape areas, recycling and community facilities. This ESCO model, which would be established as a not-for profit organisation, would therefore be classified as a Multiple Utility Services Company (MUSCo).

4.4.4 Potential for large-scale CHP/DH in West Oxfordshire

Please note that sections 4.2 and 4.3 (small scale technologies) look at the opportunities for CHP in individual, non domestic buildings such as care homes and leisure centres. This section looks at the potential for CHP or DH serving larger sites in West Oxfordshire.

To be technically and financially viable, district heating and combined heat and power systems require developments to have a suitable demand for heat and, in the case of CHP, heat and power.

The more consistent the demand for heat (or cooling[52]), over a 24 hour period and seasonally, the more potential there is for the use of district heating and combined heat and power.

Because the demand for heat from residential areas fluctuates throughout the course of a day and night, developers favour sites where this can be balanced with a demand from leisure centres, industrial estates, retail areas and offices, and/or large existing housing sites, etc.

[52] Heat from district heating systems and CHP systems can be used to provide cooling using a process known as absorption chilling.

Rules of thumb

Historically, there have been three rules of thumb to consider when identifying developments where large-scale CHP may be viable. (For district heating, similar rules of thumb apply in terms of dwelling density and proximity to non-domestic heat load, although it has been associated with smaller scale developments, generally in off-gas settings.)

1. **Dwelling density**, or dwellings per hectare (dph). For CHP to be technically viable, a minimum heat density of 3,000 kW/km^2 is required[53]. In terms of buildings built to current Building Regulations Part L1 standards, this generally requires some areas of at least 50 dph.[54] In a very few cases, with the right balance of heat load, 35 dph may be sufficient (this is only slightly above the 30 dph that PPS3 has specified as a minimum standard in most cases[55]). It should be noted that these levels of dwelling densities do not have to be applied across an entire site. It may be that some areas of a development are of higher density than other areas.

2. **Size of development.** For CHP to be commercially viable, there need to be sufficient customers to make the scheme profitable. 100 dwellings is generally considered the absolute minimum (and at this size of development, there would need to be a substantial amount of complementary heat load). Ideally a development would have 350 or more dwellings. Developments of around 200 or more houses may be an attractive commercial proposition for an Energy Services Company (ESCo), with one company taking on responsibility for maintaining the scheme and billing residents.

3. **Proximity of other, non-residential development**, located within 1km of the new development, which would have a higher and more continuous demand for heat and power (e.g. leisure centres, schools, care homes, industrial estates, retail areas and offices, or large existing housing sites) will also be necessary to make a scheme viable (these are referred to below as 'complementary heat load'.)

As already mentioned, the move to low carbon homes is encouraging wider consideration of district heating and CHP, even where these rules of thumb are not met. This is the case despite the fact that, with higher requirements for energy efficiency, the heat load of developments will be reduced, thus requiring a higher density of developments to provide the same heat load. By striving to encourage developments that meet these rules of thumb wherever possible, the council will be making it more financially viable for developers to include CHP or DH within developments.

[53] CLG (2009) *Heat and Energy Saving Strategy Consultation*
[54] See for example Cyril Sweett (2007) *A cost review of the Code for Sustainable Homes*, Report for English Partnerships and the Housing Corporation
[55] PPS3 specifies that "30 dwellings per hectare (dph) net should be used as a national indicative minimum to guide policy development and decision-making, until local density policies are in place."

We have therefore looked at the sites included in the Site Allocations Document (submitted for consideration by developers and landowners) and assessed them against these rules of thumb. Please note, we have only looked at sites capable of accomodating more than 100 units (generally considered to be the absolute minimum for a CHP scheme), and sites greater than 2 hectares (which, given the generally lower densities of developments outside of cities would probably be the minimum size required to accommodate 100 houses). We have also only looked at developments that include housing since, while it may be possible to connect existing non-domestic buildings to a new CHP or DH network, it would be very costly and disruptive to retrofit such a network to domestic properties and therefore non-domestic developments are unlikely to have the necessary complementary heatload. There may also be scope for biomass district heating to be employed on smaller sites in those areas that are off the gas network – this is addressed below.

To identify sites for consideration, we cross-referenced the West Oxfordshire Local Development Framework – *Core Strategy So Far: interim position statement* with the *Planning for the Future - Site Allocations: Issues & Options Consultation* (March 2008) and *Further Sites Consultation* (July 2008) documents. We looked at sites listed in the Site Allocation Consultation documents that corresponded to the likely development sites listed in the interim Core Strategy, i.e. those in Witney, Carterton, Chipping Norton, Eynsham and Woodstock.

Sites including housing over 2 hectares are listed below – there are 23 in total. The Site Allocation Consultation Documents provide information on the size (hectares) and locations of submitted development sites. However, no information is provided on the proposed number of dwellings, so we do not know the likely density of these developments. We have looked at the proximity of each site to other potential heat load and made some comments about how each site could be developed to maximise the potential for CHP/DH.

The following tables show that there are a number of opportunities to maximise the potential for CHP/DH within the submitted development sites; the most promising sites are highlighted in yellow.

Most development potential is around the three towns of Witney, Carterton and Chipping Norton (see table below).

Table 4.1 – New homes to be built in West Oxfordshire by 2026

Area	New homes to be built 2006-26	New homes built 2006-08	Existing commitments	Remain-ing
Witney	3000+	900	650	1450+
Carterton	1500	550	430	520
Chipping Norton	800	200	200	400
Elsewhere	<2000	400	600	1000

Witney

Development to the north, east, south and west of Witney has been suggested to the Council. These sites are classified as urban extensions, which can be defined as a planned expansion of the town often on surrounding greenfield land.

Land to the west of the town is allocated in the current Local Plan as a future reserve site for mixed use development. This is indicated in the LDF Core Strategy Interim Position Statement as the preferred future direction of growth for new housing, employment and community facilities. To encourage CHP/DH, the Council should aim for a portion of the dwellings (>200) to be built to a density of over 50dph. These should be located as close as possible to the non-domestic development with the highest heat load e.g. a school.

Table 4.2 – Suggested development sites in Witney

<table>
<tr><th>Site Ref</th><th>Location</th><th>Proposed use</th><th>Area (ha)</th><th>Proximity to other heat loads</th><th>Suitability for CHP</th></tr>
<tr><td>178</td><td>Buttercross Works</td><td>Housing</td><td>3</td><td>Close to a school and leisure centre</td><td>A small site, located within the town. If density of >50dph can be achieved (with ideally > 200 dwellings) close the school/leisure centre, could be a good candidate for CHP</td></tr>
<tr><td>189</td><td>Land south of the A40</td><td>Mixed use – housing, employment, primary school, shops, community facilities, open space</td><td>107.1</td><td>Mixed use, including school and community facilities</td><td>Urban extension - likely to be lower density than town centre sites.
To maximise potential for CHP, aim for >200 dwellings at >50dph closest to the school and community facilities</td></tr>
<tr><td>199</td><td>Land off Stanton Harcourt Road</td><td>Housing, with less noise sensitive development at southern part of site</td><td>6.17</td><td>None obvious</td><td>Small urban extension - likely to be lower density than town centre sites.
Site is for housing only and there are no complementary heat loads, therefore less likely to be a candidate for CHP.</td></tr>
<tr><td>200</td><td>Cogges Triangle</td><td>Mixed use – housing, community uses and P&R</td><td>31.73</td><td>Limited information available about the non housing aspects of the development. Community facilities might provide a good heat load</td><td rowspan="2">These sites are all urban extensions and are likely to be lower density than town centre sites. If part of the housing is developed close to other heat loads (e.g. schools, community facilities), CHP may be feasible. Developer would need to include at least 200 dwellings at a density of >50dph to maximise the potential for CHP</td></tr>
<tr><td>201</td><td>Land north of Oxford Road</td><td>Mixed use – housing, community uses, employment</td><td>23.01</td><td>Limited information available about the non housing aspects of the development. Community facilities and ‘employment’</td></tr>
</table>

				might provide a good heat load	
198/ 250	North Witney	Housing with associated infrastructure, open space, services and/or facilities	60.71	Limited information available about the non housing aspects of the development. If 'associated infrastructure' includes a school, then this could provide a good heat load	
155	North Curbridge	Mixed use – housing, employment, local centre, primary school, open space, park and ride	72.63	School and other non-defined non-domestic buildings	

Carterton

Development will include major redevelopment of MOD housing estates. Carterton Town Council has indicated desire for a further 1000 homes to be built within or on the edge of town.

In addition, there is the existing gas-fired CHP scheme at the leisure centre. Planned developments located close to the leisure centre (within 1km) could potentially be connected to this system. However, having consulted the Site Allocations document for suggested development sites in Carterton, there is only one site within 1km. Depending on the heat load of that site, the development could benefit from connection.

Table 4.3 – Suggested development sites in Carterton

Site Ref	Location	Proposed use	Area (ha)	Proximity to other heat loads	Suitability for CHP
148	Land off Alvescot Road	Mixed use – housing, restaurant/pub, fire station	4.86	Restaurant, pub, fire station – none of these are likely to have high heat loads	To maximise potential for CHP, developer should aim for >200 dwellings at >50dph closest to the non domestic development
149	Land south of Alvescot Road	Housing	10.39	None obvious	Urban extension - likely to be lower density than town centre sites. No complementary heat loads and housing only, therefore less likely to be a candidate for CHP
159	Land West of Upavon Way 'The Warren'	Housing and public open space	5.77	Close to a school	To maximise potential for CHP, developer should aim for >200 dwellings at >50dph closest to the school (south east of the site)
147/ 234/ 193/ 273	Land north of Carterton	Unknown	100	None obvious	Urban extension - likely to be lower density housing than town centre sites.

					Unknown whether there will be complementary heat loads, therefore less likely to be a candidate for CHP
147/ 234	Land north of Carterton	Housing	33.19	None obvious	Urban extension - likely to be lower density than town centre sites. No complementary heat loads and housing only, therefore less likely to be a candidate for CHP
156	Land south of Milestone Road	Housing	4.59	Adjacent to industrial estate	To maximise potential for CHP, developer should aim for >200 dwellings at >50dph closest to the industrial estate

Chipping Norton

In Chipping Norton, development will take place in sites that become available as existing health care facilities in the town move out. There is also the potential to expand east. However, the Council's strategy states that any proposal to accommodate a major urban extension of 500 or more new homes would have an unacceptable impact upon the character and setting of this small market town.

Table 4.4 – Suggested development sites in Chipping Norton

Site Ref	Location	Proposed use	Area (ha)	Proximity to other heat loads	Suitability for CHP
204/ 212	Land east of Chipping Norton/ Tank Farm	Housing/ mixed use including employment	40.87	Mixed use, but no information on other developments. A big site, so likely to include a school and community facilities	Large urban extension sites. If part of the housing is developed close to other heat loads (e.g. schools, community facilities), CHP may be feasible. Developer would need to include at least 200 dwellings at a density of >50dph to maximise the potential for CHP.
213	Rockhill Farm	Housing or employ-ment	2.76	None obvious	Small urban extension site. Unlikely to meet density requirements. Site is close to sites 204/212 - could potentially link with a scheme there if these sites developed.
270	W End Farm, Churchill Rd	Housing (with open space on land to north)	3.01	None obvious	Small urban extension site. Unlikely to meet density requirements. No obvious complementary heat load.

Eynsham

There are a number of submitted development sites to the west of the village.

Table 4.5 – Suggested development sites in Eynsham

Site Ref	Location	Proposed use	Area (ha)	Proximity to other heat loads	Suitability for CHP
150	Land north of A40	Mixed use – P&R, retail, housing	5.4	Mixed use. Retail unlikely to offer a significant heat load	Small urban extension site. Unlikely to meet density requirements. To maximise potential for CHP, developers should aim for >200 dwellings at >50dph closest to non domestic buildings.
179	Land to the west of Eynsham	Housing and playing fields	10.46	Quite close to a large school site	Small urban extension site. Unlikely to meet density requirements. To maximise potential for CHP, developers should aim for >200 dwellings at >50dph closest to school.
209	Land to West of Station Road	Housing	2.3	Adjacent to employment area.	Small urban extension site. Unlikely to meet density requirements. Would need at least 100 dwellings to warrant further investigation No obvious complementary heat load
210	Land to East of Station Road	Housing	2.52	None obvious	Small urban extension site. Unlikely to meet density requirements. Also a small site. Would need at least 100 dwellings to warrant further investigation
224	Chilbridge Rd	Housing	2.15	None obvious	Small urban extension site. Unlikely to meet density requirements. Would need at least 100 dwellings to warrant further investigation

Woodstock

There are a number of submitted development sites, including a larger site for 180 homes, with employment and community facilities.

Table 4.6 – Suggested development sites in Woodstock

Site Ref	Location	Proposed use	Area (ha)	Proximity to other heat load	Suitability for CHP
162	Woodstock East	Mixed use – housing,	16.2	Employment and community uses	Urban extension. To maximise potential for

		employment, community uses		– no details provided, so unable to determine whether this might provide substantial heat load	CHP, developers should aim for >200 dwellings at >50dph, closest to non domestic buildings.
163	Land north of Marlborough School	Housing	2.3	Close to school and industrial park	Small site. Unlikely to meet density requirements. Would need at least 100 dwellings to warrant further investigation. To maximise potential for CHP, developer should aim for >50dph closest to the industrial estate.
164	Woodstock Football Club	Housing	2.2	Adjacent to a school	Small site. Unlikely to meet density requirements. Would need at least 100 dwellings to warrant further investigation. To maximise potential for CHP, developer should aim for >50dph closest to the industrial estate.

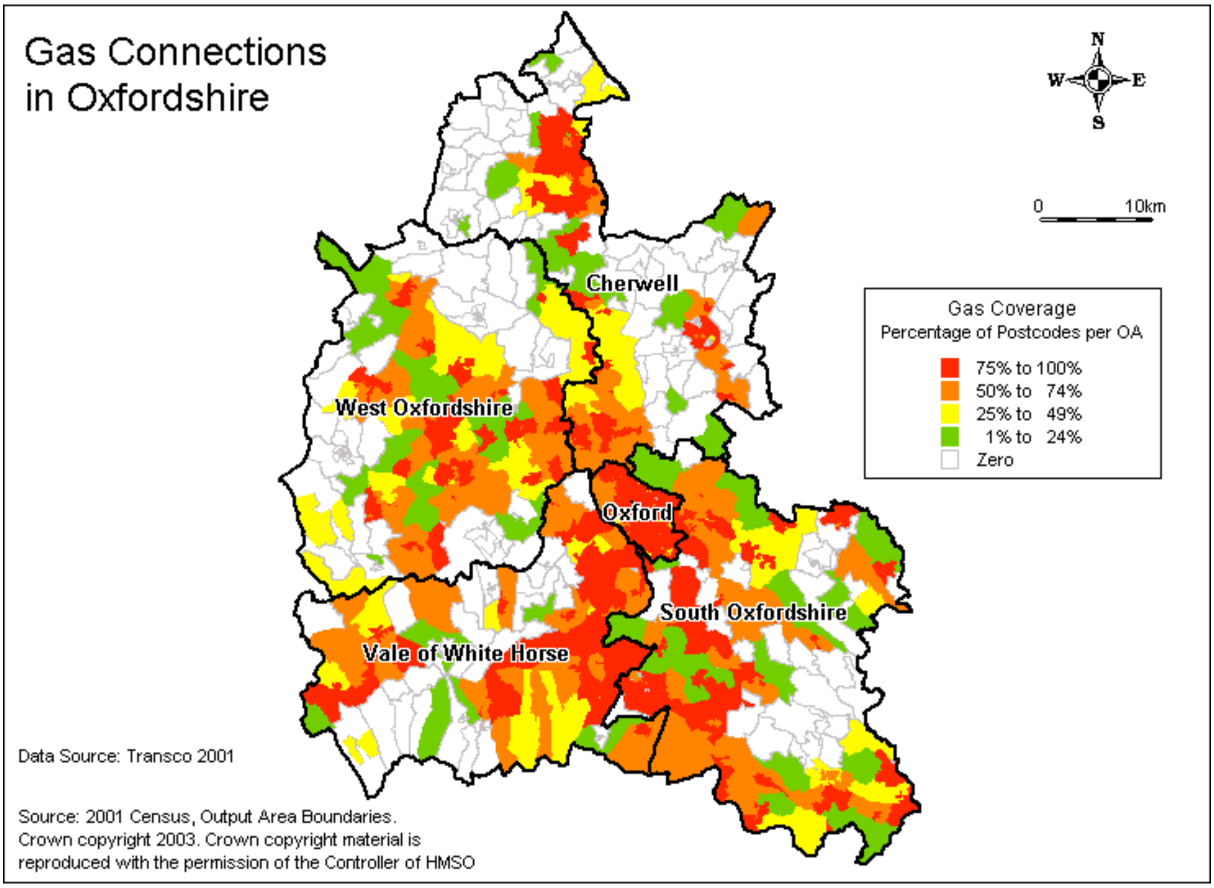
Other suggested development sites are only likely to accommodate small-scale development, which would not be suitable for CHP schemes.

4.4.5 Resource Assessment

For systems powered by gas, the main consideration will be access to the gas network. The map below[56] indicates which areas of the council are off-gas (i.e. those areas that are unshaded, plus a portion of those areas shaded green or yellow). It appears that each of the settlements listed above have a high proportion of properties served by gas. It should be noted that this data is from 2001. It has not been possible to obtain more recent data at the district level.

[56] www.ruralfuelpoverty.org.uk/rural2.php?mopt=1&pid=gas_areamap&step=3&county=10

Figure 4.4: Gas connections in Oxfordshire



For systems powered by biomass, the main considerations for developers will be:

• A secure supply of appropriate quality fuel;

• Sufficient space on development sites to store fuel prior to use;

• Appropriate access to the development site to enable fuel to be delivered; and

• Specific air quality issues which need to be taken into account.

Secure supply of appropriate quality fuel

As highlighted in section 4.3.6, the West Oxfordshire area is already served by existing biomass suppliers. However, there remains a need for a strategic approach to biomass to be developed in order to ensure that a working supply chain is established. This will enable biomass to be established as a viable and well understood option in the marketplace. Without this strategic approach, there could be a danger that developers will not have the confidence to invest in this sector. This is addressed further in section 7.4.

Sufficient space on development sites to store fuel prior to use

Developers will need to ensure that sufficient space is allocated within the development site's plans to store the biomass fuel.

Appropriate access to the development site to enable fuel to be delivered

Developers will also need to ensure that appropriate access to the development site is planned to ensure that the biomass fuel can be delivered. Particular consideration should be given to the delivery vehicles route through the development in order to minimise vehicle traffic and noise for residents.

Specific air quality issues which need to be taken into account

As highlighted in section 4.3.6 there are no smoke control areas within the local authority boundary. This means that exempt appliances (as per the Clean Air Act 1993) do not have to be specified on development sites.

4.4.6 Conclusions

We recommend that, where possible, the council aims for developments that include at least a proportion (ideally >200 homes) of housing greater than 50 dwellings per hectare located within 1 kilometre of complementary heat load (particularly those with high heat loads such as schools, hospitals, or leisure centres, as well as business and industry). We believe that this will be most easily achieved in those developments that are shaded yellow in the tables above. Should the council wish to require level 4 or higher of the Code for Sustainable Homes, then it will be more cost effective for developers to meet the energy requirements of Level 4 on these sites. (It should also be noted that these energy requirements are planned to become mandatory for all developments built after 2013.)

While specifying Code Level 4 or higher for domestic developments is likely to ensure that larger developments do incorporate CHP or DH, there is no such guarantee that requiring high BREEAM standards for non domestic buildings will ensure that CHP or DH is considered. Therefore, for non-domestic developments, the council could require all applications over a certain size to have an assessment of the feasibility of CHP and DH. For example, in Surrey, the LPAs can require an assessment of CHP or DH as part of any planning applications involving a development of over 5,000m.

In addition, for off-gas developments over, say, 50 units, the council could consider encouraging the use of biomass district heating.

4.5 Larger scale wind developments

4.5.1 Introduction

Wind power can be an economically viable form of electricity generation at the large scale. Large scale turbines, typically, would have a height to the tip of the blades of 90-125m. Wind turbines can be directly connected to new development via a private wire network so that the electricity they produce is supplied only to buildings within those developments. To take one example, a well-located 600kW turbine could be expected to generate enough power to supply 300 households' electricity demands. However, to serve a group of houses, there would need to be a back-up supply at times of inadequate wind and the facility to spill electricity to the national grid when demand is low, so any supply to a group of houses would also have to be grid connected. The only application of non-grid connected private wire would be when the user – say a hospital or a large manufacturer had a constant demand that would always exceed turbine output. As wind turbines generally perform better further away from buildings, this can lead to increased private wire network costs. Such networks may therefore become prohibitively expensive at some sites around the district.

An alternative would be to install a larger wind farm not directly connected to new development. The electricity that is generated can be supplied directly to the National Grid, where if funded by a developer it can be used to 'offset' some of the emissions that their developments generate via their use of National Grid electricity. As highlighted in previous sections of this report, it is important to note that the Code for Sustainable Homes does not allow 'offsite' options such as these. However, it is widely expected that this criteria will be removed following the definition of zero carbon consultation through 'allowable solutions'.

Turbines can also be community-owned. For example, the five 1.3MW capacity wind turbines that make up the Westmill community wind farm in South Oxfordshire supplies enough electricity to power around 2,500 homes every year.

4.5.2 Opportunities and considerations

The key opportunities and considerations in relation to larger scale wind can be summarised as follows:

- the UK has the largest wind resource in Europe;
- turbines can be used to generate electricity close to the point of use;
- excess output can be sold to the National Grid;
- wind speeds increase with height and higher outputs can be expected in unobstructed locations; and
- output will fall as soon as the wind drops.

4.5.3 Barriers

- Generally less suitable in urban areas but opportunities may exist in industrial areas; and

- because of their scale and visual impact, they can be subject to significant planning constraints, depending on location (see section 3.4 and below).

4.5.4 Costs

A wind turbine's output depends on the wind resource specific to the proposed site. This will be monitored by the developer for at least one year using an on-site meteorological monitoring mast. Other key variable costs include the cost of grid connection and foundations. These factors will have a direct bearing on the payback period for this technology.

The calculation of carbon emission savings will also depend on the wind resource and the assumptions made as to the mix of fuels being used to generate the electricity displaced by the turbine.

4.5.5 Future considerations

According to the British Wind Energy Association (BWEA), a 20-turbine wind farm needs about 1km^2 of land, but only around 1% of this space is needed for foundations, access roads and electrical infrastructure to be installed. The remaining area can be used as agricultural land or for natural habitat. When turbines are decommissioned, the total area of land can be returned (as near as is practical) to its original state, and the BWEA recommends that local authorities consider decommissioning when they grant planning permission for wind farm developments.

4.5.6 Existing schemes and feasibility studies

Issues relating to current progress with wind schemes are discussed in some detail in section 3.4. No large scale schemes have yet been developed in the district.

The project team have found no wind feasibility studies for the area.

4.5.7 Demand assessment

Unlike district heating and CHP, the electrical output from wind turbines means that the technology does not have to be in close proximity to the development. The current definition within the Code for Sustainable Homes requires offsite technologies to be connected to the actual development by a private wire connection. However, it is widely accepted that this requirement will be removed as part of the consultation on the definition of zero carbon. Wind energy on a favourable site can be one of the more economic forms of renewable energy currently available and allowing developers to utilise off-site wind energy as part of their solution to meeting higher levels of the Code for Sustainable Homes or BREEAM will significantly reduce costs.

4.5.8 Resource assessment

Wind speed data was obtained from the Department for Business, Enterprise and Regulatory Reform (BERR). The BERR data provides annual average wind speeds at a height of 45m above ground level for 1km grid squares.

Figure 4.5 below shows the 1km grid squares with wind speeds of 6-6.5 metres per second (m/s) and 6.5 m/s plus. There may be some opportunities for wind turbines within the grid squares where the average wind speed is between 6 and 6.5 m/s but the main opportunities for viable schemes involving large turbines are likely to be found where the wind speeds are above 6.5 m/s and these are the areas, therefore, that we have focused on in our analysis. The map shows that the majority of opportunities for large turbines are likely to be found in the northern part of the district.

4.5.9 Spatial analysis

As discussed in section 3.4.4, an 800m buffer is likely to be necessary between all large turbines and residential buildings. Because of the dispersed settlement pattern in the district, when applying such a buffer, this greatly reduces the areas of opportunity presented by the higher wind speeds and suggests that there are only likely to be opportunities for single turbines or small clusters of turbines in the district. Figure 4.6 shows the areas with wind speeds of 6.5 m/s or above (using Met Office data) which are 800m from a residential building (using data supplied by West Oxfordshire District Council). Smaller turbines with an overall height of say 25m would not require such a large buffer from residential buildings and there will be many more opportunities for such schemes, typically serving schools, farms or commercial buildings.

Other potential constraints were also mapped, in order to provide a more detailed understanding of the potential for large turbines. This included:

• the aerodrome safeguarding zones around Oxford airport and RAF Brize Norton;

• ancient woodlands;

• Sites of Special Scientific Interest (SSSI's);

• the Cotswolds Area of Outstanding Natural Beauty (AONB);

• Special Areas of Conservation; and

• Local Nature Reserves.

At the level of analysis in this study, only a general indication of the spatial opportunities for large turbines can be gained. Local topography and other obstructions such as trees and buildings will also affect the operation of wind turbines, particular small-scale turbines, and are very site-specific. A number of other potential constraints were not considered in detail within the study including impacts on cultural heritage, impact on landscape and visual amenity, electromagnetic interference on TV reception and telecoms transmissions, ecology, and hydrology. Assessing which size and what number of turbines would be appropriate in different locations will depend to a great extent on the local situation, and much more detailed assessments would need to be required at the site level prior to schemes coming forward. Grid connection issues would also need to be explored for all sites.

Figure 4.6 shows that the areas which we would suggest warrant further investigation for large scale turbines. They are as follows:

- an area to the north west of Burford (numbered 1 in figure 4.6);

- an area around the village of Leafield (numbered 2 in figure 4.6);

- an area to the north west of the village of Chadlington (numbered 3 in figure 4.6);

- an area to the south west of the village of Enstone (numbered 4 in figure 4.6);

- an area to the north east of Chipping Norton (numbered 5 in figure 4.6);

- an area to the north west of the village of Great Rollright (numbered 6 in figure 4.6); and

- an area around the village of Middle Barton (numbered 7 in figure 4.6).

This should not be taken as an exhaustive list. Because of the grid based nature of the wind speed data in particular, local analysis may reveal other small sites with sufficient wind resource. Technological improvements in the future may also allow viable development to take place in areas with lower wind speeds. In addition, local topography may mean that a smaller buffer from residential buildings may be appropriate at some sites.

Area 1 lies within the aerodrome safeguarding zone for RAF Brize Norton so any proposals for wind schemes in this area would require early consultation with the Ministry of Defence (MoD) to determine the extent of impacts on the operation of the airfield. Consideration would also need to be given to potential impacts on nearby RAF Little Rissington and RAF Fairford, both of which are in neighbouring Gloucestershire. The area also lies within the AONB meaning that, under the South East Plan guidelines, the maximum scale of development which could be accommodated would be between one and four turbines not exceeding 5MW capacity and only then if it can be demonstrated that conflict with landscape protection policies can be avoided or minimised through careful siting and design. Further constraints directly affecting this area include areas of ancient woodland and a Site of Special Scientific Interest. It appears unlikely that large scale turbines could be accommodated in this area.

Area 2, similarly, lies within a sensitive enclosed landscape within the AONB. The area also contains areas of ancient woodland, a National Nature Reserve and SSSI, lies within the safeguarding zone for RAF Brize Norton and partially within the safeguarding zone for Oxford airport. It appears unlikely that large scale turbines could be accommodated in this area either.

Area 3 surrounds the A361 to the north west of the village of Chadlington. Although within the AONB, the landscape is more open than other parts of the AONB and is described as 'farmland plateau' in the Oxfordshire Wildlife and Landscape Study. Although in proximity to an area of ancient woodland and SSSI, none of the other mapped constraints affect this site. Providing that topple distances from the roads (typically the turbine height plus 10%) can be maintained and landscape impacts carefully managed, this area may be capable of accommodating a single turbine or small cluster of turbines. Opportunities for community-owned schemes linked to local villages could be explored in relation to small-scale opportunities such as this.

Area 4 appears to be a more significant opportunity and lies on the boundary of the AONB. Being partially within the AONB, according to the South East Plan guidelines the maximum scale of development which could be accommodated would be between one and four turbines not exceeding 5MW capacity and only then if it can be demonstrated that conflict with landscape protection policies can be avoided or minimised through careful siting and design. However, a number of other constraints would need to be carefully explored including a small area of ancient woodland, the presence of historic tumuli and the Wychwood Way footpath which bisects the area. The area also lies within the safeguarding zone for Oxford airport, meaning any proposals for wind turbines would require early consultation with the airport to determine whether there would be any significant impacts on the safe operation of the airport.

Area 5 lies outside of the AONB to the north east of Chipping Norton, close to the A361. The area is in proximity to ancient woodland but none of the other mapped constraints directly affect this site. The landscape is relatively open and is described as 'farmland plateau' in the Oxfordshire Wildlife and Landscape Study. Providing that topple distances from the main road (typically the turbine height plus 10%) can be maintained and landscape impacts carefully managed, this area may be capable of accommodating a single turbine or small cluster of turbines. Opportunities for community-owned schemes linked to local villages could be explored in relation to small-scale opportunities such as this.

Area 6 is within the AONB and is within an area of 'rolling clayland' according to the Oxfordshire Wildlife and Landscape Study. None of the other mapped constraints directly affect this site. However, closer examination of the OS map for this area suggests that there may be a farmhouse within this area which has not been picked up in the dataset provided by the Council for mapping the residential buffer zones. If this is the case, this area is unlikely to be able to accommodate any turbines.

There may be a small number of small opportunity sites (most likely for single turbines) within area 7, which surround the village of Middle Barton. Opportunities for community-owned schemes linked to Middle Barton could be explored. The area lies outside the AONB but within the safeguarding zone for Oxford airport, meaning any proposals for wind turbines would require early consultation with the airport to determine whether there would be any significant impacts on the safe operation of the airport. Potential impacts on the operation of the private airfields at nearby Enstone and Oaklands Farm would also need to be explored further.

4.5.10 Conclusions

This part of study has shown that there are relatively few opportunities for the development of larger commercial scale wind farms in the District. In addition the areas identified above still need to be examined in greater detail to determine whether or not they have genuine development potential.

The opportunities identified are relatively scattered and located in the north and west of the District, most of which is included within the AONB designation. There is no obvious spatial pattern of clusters or groupings of sites that would lend themselves to identification in the Core Strategy descriptive text or by symbol in the Key Diagram. This being the case the Core Strategy text should probably be limited to making the point that while there is some potential for some larger, commercial, wind turbines the development pattern is likely to be one of single turbines and small clusters, scattered rather than being grouped in a particular part of the District. While the South East Plan definition of small scale wind development would allow consideration to be given to the sites identified within the AONB this designation significantly raises the level of policy testing that any project would have to satisfy.

Having drawn these conclusions it is important to remember that technology will change and sites with lower wind speeds may become commercially attractive in the future.

In the light of the above conclusions, and given that more work would be required to 'prove the sites identified above, there is generally insufficient evidence at the present time to identify suitable areas for larger scale wind development as encouraged by PPS1 Supplement paragraph 20. One possible exception to this would be Area 4 above, but further work would have to be undertaken before it could be specifically identified in the Core Strategy.

One interesting aspect of the sites identified above is that some of them may lend themselves to community wind projects, in that they would only support single turbines or small clusters and are located relatively close to small towns and villages. In its recently published *UK Renewable Energy Strategy* the Government recognises that local communities will need to 'host' renewable energy projects and makes reference to wind farms that are owned by groups and individuals who are local to the project. This can be a way of breaking down resistance to renewable energy and wind turbines in particular. Some wind developers are keen to introduce an element of community ownership into their projects and a variety of models are emerging for this form of development. It would seem appropriate for the Core Strategy to encourage community wind turbine development given the nature and distribution of the development opportunities identified in this study.

Figure 4.5: Average annual wind speeds at 45m height across West Oxfordshire district

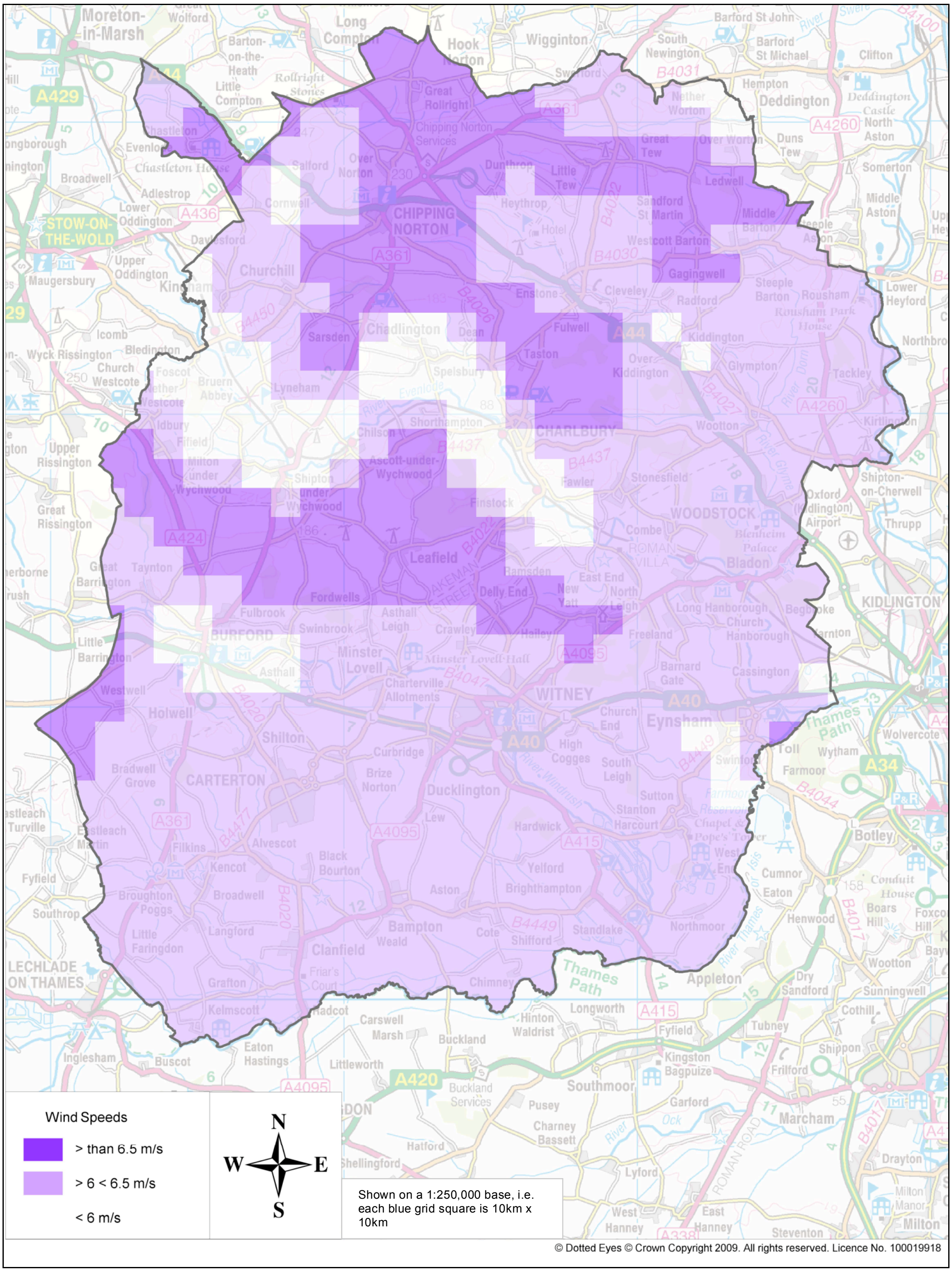
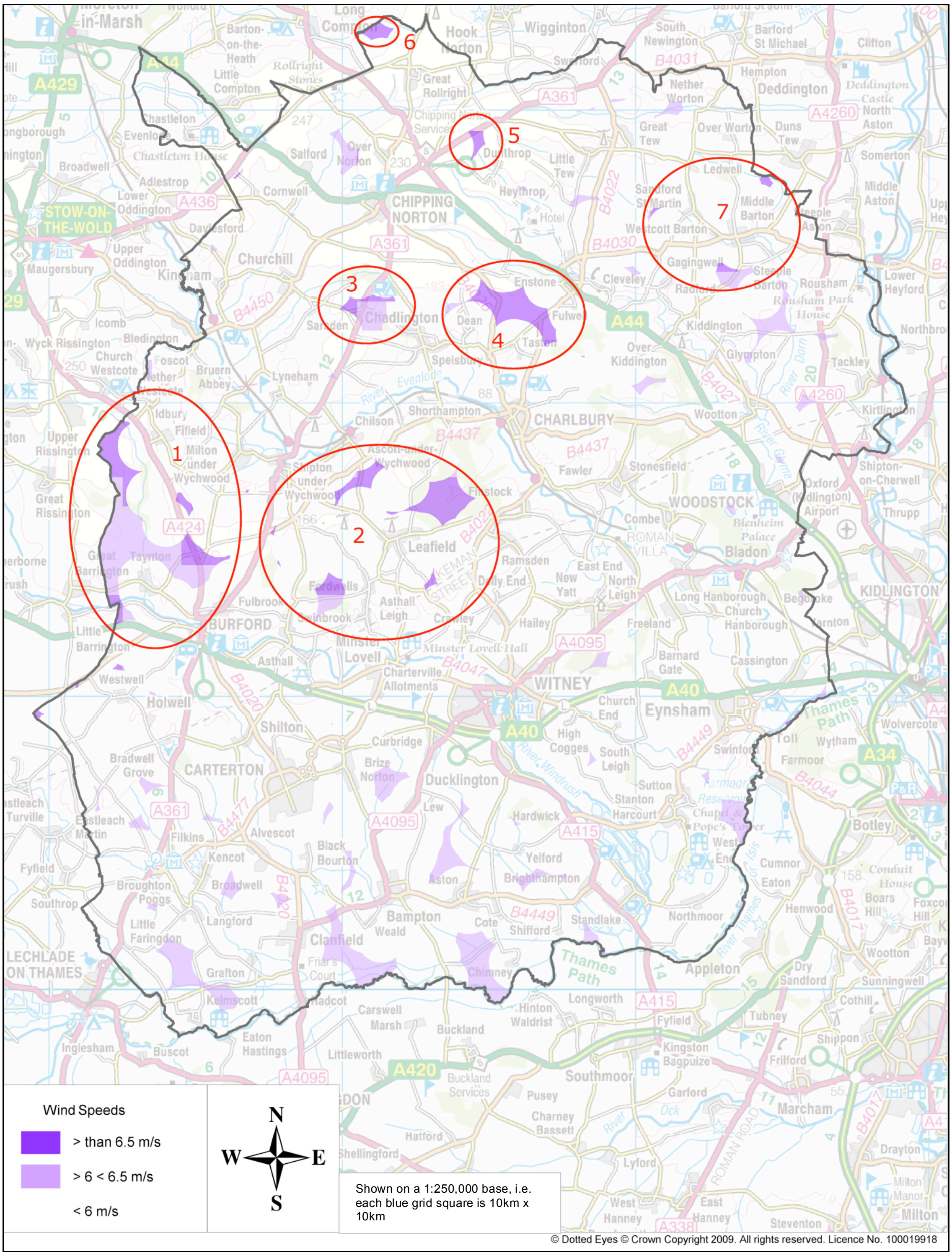


Figure 4.6: Areas within West Oxfordshire district with wind speeds above 6.5 m/s and at least 800m from a residential building



5. Core strategy 'options testing'

5.1 Introduction

This section utilises the findings of the study to provide a broad commentary on the potential 'directions for growth' for West Oxfordshire as set out in the *Core Strategy So Far* interim position statement, February 2009, in terms of their implications for reducing carbon emissions, generating renewable energy and achieving more sustainable construction.

5.2 Overall approach

The *Core Strategy So Far* Interim Position Statement, February 2009, proposes to direct the majority of new development during the plan period to urban extension sites on the periphery of the District's main settlements Witney, Carterton and Chipping Norton.

This study has shown that West Oxfordshire can make a contribution to achieving the UK Renewable Energy Strategy 2009 (UKRES 2009) targets for electricity and heat, as well as contributing towards the targets and policy framework provided by the South East Plan. This study has also suggested that if the UKRES 2009 heat targets are to be met, a sustained programme of developing district heating and CHP networks in existing urban areas will be required as well as action to ensure that the proposed growth areas make maximum use of low carbon and renewable energy technology.

The strategy of choosing locations within or on the immediate edge of existing urban areas for major housing is a good first step as this can facilitate links between heating networks within existing and future areas of development.

Section 4.4.3 of this study considers the potential for CHP/district heating in respect of 23 sites in the District which have been suggested to the Council. The Site Allocation Consultation Documents provides information on the size (hectares) and locations of submitted development sites. However, no information is provided on the proposed number of dwellings, so the likely density is uncertain. The proximity of each site to other potential heat loads was considered and comments are included in Tables 4.2 – 4.6 on how each site could be developed to maximise the potential for CHP/DH.

In general CHP/DH development will be facilitated by:

- Siting new development in proximity to existing heat loads – in particular town centres and major institutions such as hospitals. This helps in the creation of a heat load with varied peaks in demand.

- Achieving higher residential densities – this particularly helps to reduce the cost of the pipe network.

- Larger development sites have more potential than small sites.

- Relatively isolated sites have less potential than sites that are more integrated in the urban area.

The following sections consider the development sites Witney, Carterton and Chipping Norton.

5.3 Development sites in Witney

Development to the north, east, south and west of Witney has been suggested to the Council. These sites are classified as urban extensions, which can be defined as a planned expansion of the town often on surrounding greenfield land.

Land to the west of the town is allocated in the current Local Plan as a future reserve site for mixed use development. This is indicated in the LDF Core Strategy Interim Position Statement as the preferred future direction of growth for new housing, employment and community facilities. To encourage CHP/DH, the Council should aim for a portion of the dwellings (>200) to be built to a density of over 50dph. These should be located as close as possible to the non-domestic development with the highest heat load e.g. a school.

Section 4.4.3 and Table 4.2 consider the suitability of sites at Witney for CHP/DH development. The main messages to come out of this analysis are that the most suitable sites are those close to other facilities that offer the potential for creating a varied heat load – schools, leisure centres, community facilities and other mixed uses. In addition higher densities would have to be achieved - up to 50 dwellings per hectare for at least 200 dwellings. Smaller housing-only sites are not considered suitable for CHP development.

5.4 Development sites in Carterton

Of the sites reviewed in section 4.4.3 and Table 4.3 in Carterton there are a number of sites considered to have potential for CHP/DH development, the majority being larger sites with mixed development, but also a housing development adjacent to an industrial estate. It is important to highlight that higher densities of up to 50 dwellings per hectare for at least 200 dwellings would be required. The remaining sites are considered to be poor candidates as they not close to potential complementary heat loads.

5.5 Development sites in Chipping Norton

Of the sites reviewed in section 4.4.3 and Table 4.4 in Chipping Norton, only one is considered to have any potential for CHP/DH development and then only if higher densities of up to 50 dwellings per hectare for at least 200 dwellings are achieved. The remaining sites are considered to be poor candidates as they are not close to potential complementary heat loads.

5.6 Development sites in Eynsham

Section 4.4.3 and Table 4.5 consider the suitability of sites in Eynsham for CHP/DH. The two potential developments include a site with both housing and non-domestic buildings, while the other housing development is located close to a school which would offer a complementary heat load. As reiterated throughout the report, higher densities would have to be achieved - up to 50 dwellings per hectare for at least 200 dwellings. The smaller housing-only sites are not considered suitable for CHP development.

5.7 Development sites in Woodstock

Of the development sites reviewed in section 4.4.3 and Table 4.6 in Woodstock, there is one site considered to have a good potential for CHP/DH, and includes both housing and non-domestic buildings. Developers would need to apply higher densities to parts of these sites - up to 50 dwellings per hectare for at least 200 dwellings. While located in close proximity to complementary heat loads, the other two sites are very small and are therefore less likely to be candidates for CHP/DH.

5.8 Other renewable technologies and development sites in West Oxfordshire

The above review has focused on CHP/DH potential. Other renewable technologies will also be relevant within the major development sites.

The review of sites for large scale wind development set out in section 4.5 did not identify any suitable areas for consideration in the vicinity of the Witney and Carterton areas for development, although there is some potential close to Chipping Norton. The suggested separation distance of up to 800m between large turbines and dwellings for visual amenity and noise considerations means that wind technology at this scale would not have a part to play in directly serving developments on the sites reviewed above. However the use of smaller scale wind turbines within school grounds or on the edge of the development may be worth considering.

In addition to the use of small scale renewables such as solar hot water and PV to comply with the higher levels of the Code for Sustainable Homes it is likely that the introduction of the Feed in Tariff in April 2010 and the Renewable Heat Incentive in April 2011 (which will provide financial incentives for the production of small scale renewable electricity and heat respectively) will encourage the use of these technologies in the development areas as well as generally throughout the District.

In the northern part of the District, in the areas around Chipping Norton the wind resource is generally favourable for the development of smaller wind turbines, which could be related to either new or existing development.

5.9 Village Development

The Core Strategy Issues and Options Consultation, March 2008, sets out the current Local Plan strategy for development in smaller settlements and villages. Group C Service Centres can be considered for some housing and economic development, in Group B Medium Sized Villages development will be more limited and generally confined within existing built up areas, in Group A Smaller Villages only small scale housing can be considered. The underlying rationale behind this type of policy is to ensure that new development is distributed in a sustainable manner, particularly in respect of transport.

Section 4.5.9 and figure 4.6 of this report identify potential areas for larger scale wind development. It is noted in section 4.5.10 that some of the sites identified for larger scale wind development may lend themselves to community wind projects, in that they would only support single turbines or small clusters and are located relatively close to small towns and villages. It is further suggested that it might be appropriate for the Core Strategy to encourage community wind development.

Of the seven areas considered for their larger scale wind development potential three considered to warrant further investigation are also close to either Group C or Group B settlements. Wind Area 4 shown in Figure 4.6 is close to Enstone, Wind Area 5 is close to Chipping Norton and Wind Area 7 is close to Middle Barton.

It may be worthwhile considering whether the addition of a community wind turbine or cluster of turbines would have any bearing on the sustainability rating of the host villages or clusters of villages.

5.10 Conclusion

This section has provided a broad commentary on the extent to which the overall strategy for development set out in the *Core Strategy So Far: Interim Position Statement* 2009 and the earlier Core Strategy Issues and Options Consultation 2008 mesh with the general goals of reducing CO_2 emissions, encouraging renewables and low carbon energy and achieving more sustainable construction.

Part of the answer is that some of those goals will be achieved by a range of measures being applied by the Government, for example:

- The application of the Code for Sustainable Homes and BREEAM and the tightening if Building Regulations will help to achieve more sustainable construction.

- The Feed in Tariff and Renewable Heat Incentive in the future will do for small scale renewables what the Renewables Obligation has done for large scale electrical renewables over a number of years.

The more specific to West Oxfordshire answer is that the District's LDF can mesh the above goals and its overall strategy for development by:

- Assisting the development of CHP/DH by allocating development sites which are capable of accommodating mixed development with a varied heat load, are close to existing heat loads, and are suitable for higher density development.

- Considering ways of encouraging the development of community wind projects and see if they have any bearing on the sustainability rating of their host villages or small towns.

- Including a policy for distributed low carbon and renewable energy for all new development.

Opportunities for large scale wind are not linked to major development proposals; in fact in some respects they can be incompatible. However this study has shown that opportunities for large scale wind are relatively limited in the District.

6. Assessment of policy wording options

6.1 Introduction

The review of current national, regional and emerging local policy, along with examples of good practice elsewhere, highlights a number of key issues for policy wording in the LDF. These are discussed below in relation to five areas of policy which would need to be included in the Core Strategy:

1. overarching district-level climate change policy to cover the scope of climate change-relevant policies throughout the plan, split under the two broad headings of mitigation and adaptation:

   a. mitigation - to include: sustainable patterns of development as the context for the selection of areas for development; emphasis on public transport/walking/cycling; energy efficiency in new development; renewable and low carbon energy – both decentralised and larger scale

   b. adaptation – to include: design approaches that are resilient to climate change, minimise the risk of flooding and minimise the urban heat island effect

2. energy policies:

   - hierarchy: policy which first requires the use of less energy (lean), is efficient (clean) and promotes renewables (green)

   - targets: renewable and low carbon energy objectives and targets

   - carbon offset funds and the Community Infrastructure Levy

3. policy on stand-alone renewable energy developments; and

4. policy on sustainable construction and embedded renewable energy.

In addition, the possible need for a supplementary planning document is discussed.

6.2 Overarching district-level climate change policy

6.2.1 Context

South East Plan policies CC1 and CC2 provide guidance on aspects of sustainable development and set out targets for CO_2 reduction in the region as a whole. It would be sufficient for the LDF to refer to these policies and state that the council will work towards achieving the RSS targets. Such a commitment could be expressed either as one of the Core Strategy objectives or as a statement within the body of the Plan and will provide the context for more specific policies on decentralised, low carbon and renewable energy, and sustainable construction.

Reference could also be made to broader council commitments such as the signing of the Nottingham Declaration and the climate change commitments in the Sustainable Community Strategy.

Planning is only one aspect of the response needed to achieve such targets and further research into carbon trajectories for the district is likely to be necessary in order to establish the contribution of planning policy alongside other responses. This could utilise the local authority carbon trajectories tool provided by the South East Partnership Board, supplemented by local data.

6.2.2 Mitigation

A series of strategic level bullet points could be set out which would provide a climate change context for key proposals in the plan dealing with mitigation, for example:

- settlement patterns, distribution of development and selection of growth points;
- transport proposals which seek to reduce the need to travel and encourage the use of walking, cycling and public transport;
- energy efficiency, renewable and low carbon energy – setting the climate change context for the policies that will follow; and
- reference to the energy hierarchy (see 6.3.1).

6.2.3 Adaptation

As above, a series of strategic level bullet points could be set out which would provide a climate change context for key proposals in the plan dealing with adaptation, for example:

- design approaches resilient to climate change – the use of passive solar design approaches for heating and cooling;

• minimising the risk of flooding – context for later policies on flood risk areas and assessment;

• reducing urban heat island effects – by provision of open space and water, planting and green roofs for example; and

• any other district-specific priorities in terms of climate change adaptation.

6.3 Energy policy

6.3.1 Energy hierarchy

It is important to establish an order of priority in the application of energy policy and in the assessment of proposals. It would be counter-productive to encourage the increased generation of on-site renewables if energy is being wasted by lack of efficiency measures. A simple three-step hierarchy, as used in the London Plan, is suggested:

1. lean - use less energy, in particular by the use of sustainable design and construction measures (and signpost the following policy – see section 6.5);

2. clean – supply energy efficiently and give priority to decentralised energy supply; and

3. green – use renewable energy.

The application of the energy hierarchy in assessing proposals may require explanation within SPD.

The resource assessments in section 4 highlighted the very significant role which biomass will need to play if the district is to make a significant contribution to national and regional renewable energy targets. An energy hierarchy policy could be used, therefore, to specifically encourage biomass use. This is discussed further in section 7.4.

6.3.2 District renewable energy target

The South East Plan does not provide district-specific targets, but encourages their development in LDFs. The possibility of setting such a target is discussed here.

An electricity target would ideally be made up of an estimate of the number of large scale wind turbines which could be accommodated in the district, plus an estimate of the number and scale of district-level CHP systems which could be accommodated. In addition, assumptions could be made about the much smaller contributions which could be made by micro-generation. However, the resource assessments conducted as part of this study suggest that in the current context, there are few, if any, sites which we could confidently assume will come forward for large scale turbines. In addition, much more work is needed on the options for major development before we could assume that development on these sites would incorporate CHP.

There is also the question of whether the renewable energy targets should include heat as well as electricity generation. The stretching targets for heat generation set in the new UK Renewable Energy Strategy suggest that this is likely to be necessary in the future even though there are no heat targets currently in the South East Plan. Such a heat target would, again, ideally be based on the resource assessments for CHP/district heating on the larger development sites, plus a generic aspiration for the use of solar hot water systems and other forms of heat microgeneration. However, as with an electricity target, there is currently too much uncertainty about number and scale of the CHP/district heating systems which could be accommodated.

In the light of these uncertainties, we could not currently recommend that the council adopt renewable energy generation targets. A sub-regional study is required which examines resource variations across the sub-region and the ability, therefore, of different districts to contribute to the meeting of the sub-regional target. The information should begin to emerge, at least partially, as LDF development continues in other parts of the sub-region and similar studies to this are undertaken in individual districts. This needs to be drawn together in such a way that the sub-regional targets can be apportioned according to the variations in capacity in the different districts.

Such a study would, of course, need to be updated as the implications of the higher electricity and heat targets in the new UK Renewable Energy Strategy begin to feed through in to the planning system. In our view, such a study would be an essential building block in the application of the new UKRES targets in the future development of the new Regional Spatial Strategy.

In the absence of such a study, the Core Strategy should make reference to the need to contribute to the delivery of the existing regional renewable electricity target but also make reference to the need to contribute to the achievement of the electricity and heat targets set in the new UKRES, which will begin to feed in to national and regional policy in the coming months and years.

6.4 Policy on stand-alone renewable energy developments

National and regional policy makes it clear that core strategies should express clear support in principle for renewable and low carbon energy developments. In addition, policy will need to provide criteria for decision-making and some spatial guidance. Both of these aspects are discussed below.

6.4.1 Criteria

The South East Plan states that, in addition to general criteria applicable to all development, criteria-based policies for renewable energy schemes should consider the following issues:

i. the contribution the development will make towards achieving national, regional and sub-regional renewable energy targets and carbon dioxide savings

ii. the potential to integrate the proposal with existing or new development

iii. the potential benefits to host communities and opportunities for environmental enhancement

iv. the proximity of biomass combustion plant to fuel source and the adequacy of local transport networks

v. availability of a suitable connection to the electricity distribution network

A criteria-based policy will need to be developed, therefore, which takes in to consideration the issues listed above, as well as any other locally significant issues. This would need to include positive criteria around the potential local environmental, economic and community benefits of renewable energy development, including contributing to district-level emissions reduction and/or renewable energy generation targets, alongside reference to the key issues identified in section 3.4, i.e.:

• impacts on landscape and biodiversity designations;

• visual impacts on local landscapes;

• impacts on the historic environment;

• impacts on residential amenity; and

• highways and access issues.

6.4.2 Spatial guidance

The South East Partnership Board guidance *Climate Change within Local Development Frameworks* (June 2009) warns against being overly specific in spatial terms in the Core Strategy about the opportunities for renewable energy. It states:

> *'Locational policies in the Core Strategy should not identify specific locations. This level of detail should be in other DPDs and SPDs, as viable schemes in areas excluded may come forward with suitable mitigation measures. A spatially specific policy may result in some opportunities being dismissed at the outset.'* (p. 21)

This appears to be the approach adopted by Oxford City Council. Their *Proposed Changes to the Submission Core Strategy* (April 2009) states:

> *The Site Allocations DPD will consider whether there are any suitable sites in Oxford for renewable and low-carbon energy generation and related infrastructure to serve wider developments (p65)*[57]

However, as noted in section 2, national guidance is pointing in the direction of more specific spatial guidance. In our view, some specific guidance in the Core Strategy would allow the council to adopt a strategic approach to stating their preferences, rather than simply responding to developer choices. In addition, given the limited opportunities for large renewable and low carbon energy developments in the district, identifying spatial preferences will help to enable the most to be made of those limited opportunities. In doing so, this will help to demonstrate conformity with the taxing sub-regional renewable energy targets in the South East Plan.

However, as discussed in section 4.5.10, there are few opportunities in the district for the development of larger commercial-scale wind farms. The limited opportunities that do exist are subject to constraints which would require further exploration. They are also relatively scattered, with no obvious spatial pattern of clusters or groupings of sites that would lend themselves to identification either in the text of the Core Strategy or in the key diagram.

This being the case the Core Strategy text should probably be limited to making the point that while there is some potential for some larger, commercial-scale wind turbines, the development pattern is likely to be one of single turbines and small clusters, scattered rather than being grouped in a particular part of the District.

However, the potential for larger scale biomass CHP/DH plant serving existing development and the major development sites could be shown on the key diagram and referred to in the supporting text. This, of course, depends on which of the major sites are taken forward in to the next stage of the Core Strategy.

The RSS sets out policy in relation to the AONB very clearly in its encouragement of small scale renewable energy development and its definition of what constitutes small scale wind projects. Given the coverage of this topic and its recent endorsement there is no virtue in looking further at this area of policy

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[57] although it should also be noted that it goes on to suggest that the strategic locations in the Core Strategy offer opportunities to incorporate large scale or area-wide renewable energy or low-carbon technologies and that the appropriate technologies for each location will be investigated through the AAP/SPD processes.

6.5 Policy on sustainable construction and embedded renewable energy

6.5.1 Sustainable construction

As discussed in section 2, there is a clear commitment from government to achieve zero carbon homes by 2016 through a tightening of the Building Regulations. Similarly, the government has committed to ensuring zero-carbon non-domestic buildings by 2019. In addition, there is a timetable in place for increasing wider sustainability standards for social housing through the use of the Code for Sustainable Homes.

However, in addition to these national requirements, national policy encourages local planning authorities to identify opportunities to require levels of building sustainability in advance of those set out nationally. Where local planning authorities wish to do so, the PPS1 supplement on climate change requires the use of the different levels of the Code for Sustainable Homes to specify the standards required.

It is important to ensure that such requirements are based on an understanding of local feasibility and cost issues are therefore critical. These are discussed further below, in relation to both the Code for Sustainable Homes and BREEAM (Building Research Establishment Environmental Assessment Method - a similar construction standard for non-domestic buildings).

6.5.2 Specifying overall Code/BREEAM requirements

The council will need to decide whether to specify a Code/BREEAM level for private developments.

This could be a district-wide requirement, such as in the example from Dover below. Although this is not encouraged in the PPS1 supplement on climate change, which instead suggests that local planning authorities should focus on development area or site-specific opportunities, we feel that a strong case could be made for a district-wide requirement because of the contribution that such a requirement could make to a wide range of policy objectives. These are discussed further in section 6.5.8.

Proposed Core Strategy Policy - Dover

All new developments are required to meet Code for Sustainable Homes standards or equivalent. New developments are required to meet Code Level 3 with immediate effect (from granting of permission), at least Code Level 4 from 1 April 2013 and at least Code Level 5 from 1 April 2016.

All new non-residential developments over 1,000m2 gross are required to meet BREEAM Very Good or equivalent with immediate effect (relevant versions cover offices, retail, industrial, education and healthcare).

More information and supporting guidance will be provided with the Development Contributions SPD.

Notes for accompanying planning documents and tools: Planning applications will require credit scoring strategies and preassessments for the required Code for Sustainable Homes or BREEAM levels. Planning conditions will be set to require interim and final Code certificates and post-construction BREEAM certificates as appropriate. The 1,000m2 gross threshold is derived from Government guidance on the scale of major development. Non-residential development below the threshold is expected to face significantly higher unit costs to achieve BREEAM ratings.

Development Contributions SPD (or future Community Infrastructure Levy): For new developments that cannot meet the carbon and water reduction targets in DM3 onsite and for new non-residential developments of less than 1,000m2 gross, applicants must achieve commensurate energy and water savings elsewhere in Dover District. The actions or sums paid must achieve the difference between the onsite performance of the development and the immediate, 2013 and 2016 energy and water standards expected for developments. Dover District will publish updates concerning details of the energy and water efficiency schemes that will be eligible and the cost per tonne of CO2 and per m3 of water saved.

Applicants must prove they cannot meet requirements onsite through an open book accounting approach to show the development would not go ahead. Planning conditions will be applied to all domestic and commercial extensions and conversions to require cost effective energy and water efficiency measures to be included, aiming for no net increase in energy or water demand from the property.

As a further example from a nearby authority, South Oxfordshire has set the following requirements in a Supplementary Planning Document on Sustainable Design:

- New residential developments of 1-4 units – Code Level 1 up to April 2010, Code Level 3 thereafter.
- New residential development of 5-9 units - Code Level 2 up to April 2010, Code Level 3 thereafter.
- New residential development of more than 9 units - Code Level 3 up to April 2010 (doesn't specify a level thereafter).
- New non-residential development of less than 500 m^2 - 'Very Good' BREEAM
- New non-residential development of more than 500 m^2 - 'Excellent' BREEAM

This approach, incorporating different thresholds based on different scales of development, recognises the economies of scale which can be achieved in larger developments. Such an approach may help to ensure that a district-wide requirement does not place an undue burden on developers.

Alternatively, as encouraged in the PPS1 supplement, particular attention could be paid to the opportunities presented by larger sites. In Dover, they are proposing to require higher standards for larger sites in addition to the district-wide requirements described above. This is based on identified opportunities, as can be seen in the policy summaries below.

Proposed site-specific sustainable construction policies in Dover's Core Strategy

Policy CP 8 regarding Dover Waterfront says that planning permission will be granted provided that:

- The development includes a district heating system, non-residential buildings meet BREEAM excellent standard and residential buildings achieve at least 75% of the sound insulation credits under the Code for Sustainable Homes (p69).

Policy CP 9 regarding Dover Mid Town says that planning permission will be granted provided that:

- A district heating system is incorporated into the development, non-residential buildings meet BREEAM excellent standards and residential buildings should achieve 75% of sound insulation credits under the Code for Sustainable Homes (p72).

Policy CP 10 regarding Connaught Barracks Complex says that planning permission will be granted provided that:

- An energy and water strategy is developed that will be capable of enabling the development throughout its lifetime to meet proposed national stepped requirements for sustainable construction under the Code for Sustainable Homes and the development incorporates a district heating system and achieves at least 80% of the ecology credits using the Code for Sustainable Homes and BREEAM assessments, as appropriate (p76).

Policy CP 11 regarding The Managed Expansion of Whitfield says that planning permission will be granted provided that:

- An energy and water strategy is developed that will be capable of enabling the development throughout its lifetime to meet proposed national stepped requirements for sustainable construction under the Code for Sustainable Homes but enables residential buildings to achieve a minimum Code for Sustainable Homes level 4 with immediate effect from adoption of the Core Strategy, non-residential buildings to achieve BREEAM excellent standard and schools to achieve zero carbon rating (p81).

The outcomes of this study, along with detailed analysis of the Strategic Flood Risk Assessment and other evidence, should enable the identification of instances where similar site-specific requirements could be set.

6.5.3 Specifying different levels of elements of the Code/BREEAM

As can be seen in the Dover policy examples above, policy can also specify different levels of particular aspects of the Code and/or BREEAM. This allows planning authorities to respond to particular area-wide or spatially specific sustainability pressures in the district. Key elements of the Code and BREEAM which may be particularly relevant are discussed below.

Code for Sustainable Homes

- Category 2 of the Code relates to water consumption, with minimum standards specified for each Code level. Water scarcity appears to be a particular issue for the county so a higher level of the Code could be specified for water consumption than other areas (e.g. Code Level 2 across all issues but Code Level 4 on water.) Costs for complying with this Category are as follows:
    - Code Levels 3-4 - £125 per house (<105 litres per person per day)
    - Code Levels 5-6 – £2,625 per house (<80 litres per person per day)
- Category 4 relates to surface water runoff. We know that West Oxfordshire District Council is keen to ensure that new dwellings are resilient to flooding. The council could therefore require that all new developments earn a certain number of credits under this category (in particular, 1 credit under SUR2 would ensure that developments with a medium/high risk of flooding are designed to reduce the impact of flooding on the houses) or just apply the requirements to sites in areas of higher flood risk. There are two categories within this issue:
    - SUR1 – Management of surface water run-off from developments. This issue is designed to ensure housing developments which avoid, reduce and delay the discharge of rainfall to public sewers and watercourses, thus reducing the risk of localised flooding. It includes a mandatory element (that peak rate of runoff into watercourses is no greater for the developed site than it was for the pre-development site). 2 credits are available for using Sustainable Draining Systems (SUDS[58]).
    - SUR2 – Flood risk. To encourage housing development in low flood risk areas or take measures to reduce the impact of flooding on houses built in areas with a medium or high risk of flooding. No mandatory elements. 2 credits available:

[58] Subject to certain criteria being fulfilled – please see CLG (2009) *Code for Sustainable Homes Technical Guide*

- Both credits will be awarded for developments situated in Zone 1 – low annual probability of flooding (as defined in PPS25 – Planning and Flood Risk) – this applies to many of the submitted developments sites in West Oxfordshire;

- 1 credit is available for developments situated in Zones 2 and 3a – medium and high annual probability of flooding – where the finished ground floor level of all habitable parts of dwellings and access routes to the ground level and site are placed at least 600mm above the design flood level of the flood zone. A brief review of the suggested developments sites indicates that there are some that are situated in Zones 2 or 3a, such as those to the west of Carterton and some of the smaller sites to the south of Witney. It is estimated that the cost of achieving this credit would be £16,635 for a 2 bedroom mid-terraced house (in terms of the use of flood resilient materials on the ground floor)[59]. CLG concludes that, "Given the estimated cost, it is quite unlikely this credit would be sought by developers building in high flood risk areas unless it was part of a separate planning requirements."

- Issue 9 relates to Ecology. There are no minimum standards for this issue. However, the council could choose to encourage or require developers to earn a number of credits under this issue. Such a requirement could be applied to Conservation Target Areas. There are 9 credits in total, across 5 areas, which include:

    - ECO2 - Ecological Enhancement (this might involve planting native species or installing bat/bird boxes);

    - ECO3 - Protection of Ecological Feature; and

    - ECO4 – Change in Ecological Value of the Site.

The use of the Code to achieve specific targets in relation to energy and carbon performance is discussed in section 5.4.

BREEAM

For non-domestic developments, the council could consider setting higher standards for particular themes within BREEAM. For example, within Ashford Council's Policy CS10 for non-residential developments, energy, water and materials are considered particular priorities and the policy responds to this by setting higher standards for these themes within BREEAM. The levels are based on the BREEAM ratings of Good, Very Good, Excellent and includes a rating of Maximum. An explanation of the standards is set out below.

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59 CLG (2008) *Cost Analysis of The Code for Sustainable Homes: Final Report*

Table 6.5: Energy, Water and Materials credits in BREEAM[60]

Maximum	Where a Maximum standard is required under Energy, Water or Materials, the development will be expected to meet ALL the credits for that theme under the respective BREEAM method.
Excellent	Where an Excellent standard is required under Energy, Water or Materials, the development is expected to meet 70% or above for the BREEAM credits for that theme.
Very Good	Where a Very Good standard is required for the development under either Energy, Water or Materials, the development is expected to meet 55% or above for BREEAM, and 58% or above for EcoHomes for that theme.

For example, under BREEAM Office assessment there are 13.63 credits available for energy. To meet the Excellent standard this requires that 9.54 (70%+) credits are achieved under that particular theme. The way in which the 9.54 credits are achieved is up to the developer.

It is important to note that BREEAM will need to be updated or replaced as part of the government's ambition for new non-domestic buildings to be zero carbon from 2019.

The recent consultation on the 'Definition of zero carbon' related predominantly to the new definition of zero carbon homes but it also sought views on the definition for new non-domestic buildings. A more detailed consultation is expected to be published in late 2009, and it has been predicted that this will then lead to BREEAM being updated or the development of a new 'Code for Sustainable Buildings' (for non-domestic buildings only).

We would therefore recommend that Council staff reassess and update any policy relating to BREEAM in the future, once policy on zero carbon non-domestic buildings is published by the department for Communities and Local Government (CLG).

6.5.4 Combining sustainable construction and embedded renewable energy requirements

The South East Plan sets a challenging target for sub-regional renewable energy generation. The LDF will need to demonstrate conformity with this target and with the other policies of the Plan which support renewable energy development. Given the very limited opportunities in the district for large stand-alone renewable energy schemes, it is imperative, therefore, that the LDF maximises the opportunities afforded by embedded renewables, i.e. renewable energy generation within non-energy developments.

There are three possible ways of approaching this:

[60] http://consult.ashford.gov.uk/portal/planning/sdcspd?pointId=c134

1. **Include a Merton-style policy**, i.e. a requirement for a percentage of the energy demand for the development to be met through on-site or near-site renewables. Such a policy appears to be required by the PPS1 supplement on climate change (para. 20) and by policy NRM 11 of the South East Plan. Since the adoption of the South East Plan, such a policy is in effect anyway, in advance of similar local policies being adopted.

   The current direction of travel in terms of this type of policy (e.g. Merton, London, Bristol, Milton Keynes, Portsmouth) is to express the target in terms of CO_2 savings from a development rather than a percentage of renewable energy. However, because such an approach would not follow the suggested route of the South East Plan and PPS1, it would need to be very carefully reasoned and justified. This would best be approached on the grounds that expressing the target in terms of CO_2 savings provides greater flexibility for the developer in reducing the carbon footprint of development, and recognises the fact that renewable energy generation is not always the best or most cost-effective means of reducing carbon emissions associated with development.

   However, expressing the policy in terms of CO_2 emissions may make it more difficult to relate the Plan's contribution to the renewable energy generation targets in the South East Plan.

   If the adoption of a Merton-style policy was the route chosen by the council, a decision would need to be taken on the balance between strict conformity with the South East Plan and PPS1 and providing greater flexibility in achieving emissions reductions.

   Many of the same authorities (e.g Merton, London, Bristol, Milton Keynes, Portsmouth) also appear to be moving towards applying the policy to all scales of development, down to single dwellings, rather than setting a threshold (typically developments of more than 10 dwellings or 1000 sq m of non-residential floorspace). Given the preponderance of small-scale sites in the district, the viability of adopting such an approach would need to be carefully demonstrated.

   It is worth noting that additional on-site/near-site renewable energy requirements of this type would effectively be made redundant for most development if, in the longer term, Building Regulation requirements increase as expected towards the 2016 zero-carbon target. Onsite or near-site renewable or low carbon energy generation (incorporated as part of the tightening of Building Regulations to achieve the zero-carbon target) will be necessary to achieve these higher overall CO_2 reduction targets, and will serve the same purpose as specific onsite targets. A Merton-style policy would therefore only be an interim measure.

   Implementation issues would need to be carefully considered if a Merton-style policy were adopted. Because, unlike for Code requirements, there is no independent external verification of proposals, an extra burden is placed on development control officers in assessing applications for conformity with the requirements. This is recognised in the SEERA report *Evidence Base for Sustainable Energy Policies in the South East* (September 2006), which suggests the need for training for planning officers and the establishment of support networks to assist with implementation. Such networks have evolved in London to support the London boroughs who have adopted such policies. Some of the smaller rural authorities who have implemented such policies (such as Uttlesford Borough Council) have utilised energy officers with the skills necessary to appraise applications against such requirements. We understand that such a resource is not available within the Council currently.

A further consideration is that if such a policy were adopted in addition to Code/BREEAM requirements, clear guidance would need to be provided about the relationship between the two, since the Code/BREEAM also includes requirements relating to renewable and low carbon energy. In Chichester District Council's Interim Statement on Planning and Climate Change, developments are required to deliver a 10% reduction in carbon emissions. However, it suggests that proposals that meet Code Level 2 or BREEAM 'good' will be interpreted as fulfilling the emissions reduction requirement without requiring further information or explanation. Whilst this may be a pragmatic approach, this does not necessarily address the issue of renewable energy generation, as discussed further below.

2. **Express the policy requirement in terms of developments reaching a certain level of the Code for Sustainable Homes or BREEAM.** Although to some extent contrary to the PPS1 supplement and the South East Plan, this seems to be the approach advocated by the South East Partnership Board guidance on *Climate Change within Local Development Frameworks*, which states:

   Rather than stipulating a percentage of onsite renewables for new residential development, LPAs should draw upon their evidence base to determine if local circumstances warrant higher standards of the code for sustainable homes or BREEAM.

   Under the first category of the Code for Sustainable Homes (ENE1 – Dwelling Emission Rate), the assessment is against the percentage improvement of the Dwelling Emission Rate over the Target Emission Rate. For example, to meet Code Level 3, a 25% improvement must be achieved, rising to 44% at Code Level 4 and 100%. Developers are able to use a variety of design strategies to achieve this target and may choose to combine reductions in fabric and ventilation heat losses with the use of renewable energy and low carbon technologies[61].

   Although there is no guarantee that renewable technologies will be included, anecdotal evidence suggests that they are likely to be. To inform this study, we

[61] The more the developer improves the energy efficiency of the building, the less renewable and low carbon technologies will be required overall.

contacted the energy officer at Uttlesford District Council, where there is a Code Level 3 requirement for all homes plus a 'Merton-style' rule for 10% on-site renewables. He suggested that the 'Merton-style' rule is surplus to requirements because the Code Level 3 requirement achieves the same outcome. The Government's *Cost Analysis of the Code for Sustainable Homes* (CLG, 2008) suggests that to meet Code Level 3 for houses, developments are likely to incorporate 4 sq m of solar hot water panels. Given that such an installation can produce up to 1,350 kWh/yr[62], that would equate to providing up to 12% of the energy requirements of a dwelling built to current Building Regulations standards[63]. The energy requirements of a Code Level 3 home will probably be significantly lower so the percentage of energy provided would, in all likelihood be higher. It is impossible to say by how much, as Code Level 3 homes are required to have reduced emissions (which could be achieved through zero carbon technologies, which wouldn't actually affect the total) rather than reduced energy demand. However, we can assume that for new houses, a requirement for Code Level 3 or above is likely to lead at least 12% of the dwelling's energy demand being generated on-site.

3. **Express the policy requirement in terms of developments achieving specific Code for Sustainable Homes credits for the use of local renewable or zero carbon technologies.** Should West Oxfordshire wish to guarantee that new developments incorporate renewable technologies (in line with PPS22, PPS1 and the South East Plan policy NRM11), one option would be to do this by specifying a particular level of the aspect of the Code covering renewable or zero carbon technologies, i.e. ENE 7. This part of the Code only offers 2 credits (versus the 15 available from ENE1), but credits earned under this issue will also contribute to ENE1. They are earned as follows:

   - Dwellings achieving a 10% reduction in CO_2 from energy supplied from local renewable or local carbon energy sources earn 1 credit.

   - Those achieving a 15% reduction earn 2 credits.

   This would be one way of achieving closer conformity with the specific renewable energy requirements of the South East Plan without specifying an additional Merton-style policy. Since it would be externally assessed and verified, the implementation of such an approach would place less of a burden on development control officers.

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62 Source: Generating the Future (http://www.energysavingtrust.org.uk/corporate/Publication-Download/?oid=179968&aid=440643)
63 Source: CE190 (http://www.energysavingtrust.org.uk/cym/Global-Data/Publications/Meeting-the-10-per-cent-target-for-renewable-energy-in-housing-a-guide-for-developers-and-planners-CE190) and assuming that the regulated energy covers space and water heating (6,835 kWh/yr) and the unregulated covers lights and appliances and cooking (4,371 kWh/yr).

However, we are not aware of other authorities who have adopted this specific approach and we would be concerned that such an approach could be considered overly restrictive for developers.

6.5.5 Phasing of requirements

As in the Dover example, Code/BREEAM requirements could be phased in, with increasing requirements over time. Technologies and construction standards are evolving all the time and, whilst this implies the need for phasing, it also makes it difficult to forecast what will be reasonable requirements in the future.

If a district-wide requirement were set, a case could be made for requiring private housing to achieve equivalent levels to social housing, i.e. Code Level 3 now, Code Level 4 from 2012 and Code Level 6 from 2016. However, if any such policy were adopted, it would be important to make clear that the targets will be monitored and kept under review. It would also need to be recognised that such requirements could be overtaken by changes in national requirements.

6.5.6 Cost implications of complying with the Code

CLG has published a detailed guide to the cost of meeting various levels of the Code, compared to 2008 building regulations[64]. The findings are summarised below.

Table 6.1: Cost of Code for Sustainable Homes levels

Code level	Increased cost	Notes
1	1%	No variation across the different property types or scenarios.
2	2-4%	3% average
3	5-8%	Typically 7%
4	12-13%	
5	23-32%	
6	24-52%	A big range: lower end relates to a flat in best scenario, upper end to a detached house in worst scenario.

The majority of these additional costs relate to the achievement of the energy standard. Please note these costs assume that:

- The properties have gas central heating (for properties off the gas network, the cost of achieving high energy scores will be higher, but there are no hard data on how much higher[65]); and

[64] CLG (2008) *Cost analysis of the Code for Sustainable Homes: Final Report*.
[65] National Housing Federation (2006) *Briefing note – Code for Sustainable Homes*

- It is not possible to use wind turbines (micro, medium or large scale) on any developments. (For sites where medium or large scale wind technologies are suitable, overall compliance costs would be expected to be significantly lower.)

These costs are predicted to come down as the technologies required to meet higher levels of the Code become more mainstream. Thus the cost of meeting Code Level 3 by 2016, compared to building to 2008 building regulation costs, would reduce from 7% to 5%. (However, building regulations are set to progressively tighten, and therefore most of these would be attributable to meeting building regulations as of 2016, rather than Code level 3.)

The costs are broken down by property type: detached house, terraced house (mid and end have very similar results) and flat. And for each property type, it's broken down by four scenarios, as shown below.

Table 6.2: Code for Sustainable Homes scenarios explained

Scenario	Density (dwelling/ha)	Site area	Dwelling types
Small scale	30	0.3	Houses
City infill	180	0.1	Flats
Market town	50	2	Houses & flats
Urban regeneration	160	4.7	93% flats, some houses

In the CLG study, various scenarios were then developed in order to examine cost implications in different contexts, as shown in table 6.3.

Table 6.3: Best, medium, worst case Code for Sustainable Homes scenarios

Property type	Best case	Medium case	Worst case
House (detached or terraced)	• Market town. • Low ecological value. • Low flood risk.	• Market town. • Medium ecological value. • Low flood risk.	• Small scale. • High ecological value. • Medium/high flood risk.
Flat	• Urban regeneration. • Low ecological value. • Low flood risk.	• Market town. • Medium ecological value. • Low flood risk.	• City infill. • High ecological value. • Medium/high flood risk.

The Council have suggested that most development in West Oxfordshire is likely to be houses in a medium case scenario (market town, medium ecological value, low flood risk). The costs (over and above meeting current Building Regulations) for meeting different Code Levels for houses in this scenario are provided below.

Table 6.4 – Costs of achieving different Code for Sustainable Homes (CSH) levels in the medium case scenario (market town with medium ecological value and low flood risk) for detached and terraced houses

CSH Level	Total cost (£)	Cost £ per m^2[66]	Percentage on 2006 Building Regs
Detached house			
1	765	7	1
2	2258	19	2
3	4991	43	5
4	11733	101	13
5	22197	191	24
6	38817	335	43
Terraced house			
1	795	8	1
2	2598	26	3
3	5027	50	7
4	9490	94	13
5	18738	186	25
6	31747	314	42

(Please note, these costs relate to properties with gas central heating. Costs to achieve the necessary energy credits are likely be higher in off-gas areas, though this has not been quantified.)

Unfortunately, there are no costing studies that review the additional cost of 'Merton Rule' policies. The London Borough of Merton, which originally introduced this type of policy, simply based its original 10% renewables target on an estimated average 3% increase in capital costs.

6.5.7 Cost implications of complying with BREEAM

A 1995 report by consultants Cyril Sweett and BRE, 'Putting a price on sustainability'[67], assesses the additional costs incurred in meeting various levels of BREEAM. The report shows the increase in capital costs involved in building a naturally ventilated office in order to achieve a 'Good', 'Very Good' and 'Excellent' BREEAM rating across three locations. The building's environmental performance was assessed using BREEAM Offices 2004.

[66] This is based on UK average build costs. According to the BCIS Quarterly Review of Building Prices, January 2009, average costs in Oxfordshire are close to this average; where the UK mean is 1.00, the average for Oxfordshire is 0.99. These figures should therefore be quite accurate for Oxfordshire build costs.

[67] Cyril Sweett and BRE (2005) *Putting a price on sustainability*.

Table 6.5: Percentage increases in capital costs[68]

Location	BREEAM score (and rating) for the base case	% increase in cost for Pass	% increase in cost for Good	% increase in cost for Very good	% increase in cost for Excellent
Poor location	25.4 (pass)	0	0	2	-
Typical location	39.7 (pass)	-	0	0	3.4
Good location	42.2 (good)	-	-	0	2.5

This data shows that a BREEAM 'Good' rating could be achieved at no additional cost, even in poor locations (the example given is a greenfield site some distance from amenities and transport links). With locations considered as good (the example given is a brownfield site, well located for transport and amenities) it was possible to achieve an 'Excellent' rating for as little as a 2.5% increase in capital cost.

6.5.8 Viability issues and other considerations

Viability

The cost information in section 6.5.6 and 6.5.7 provides the basis upon which the Council could consult with developers and other stakeholders about the possible impacts of different Code/BREEAM requirements. It is important to note that the impacts of increased costs upon development in the district will be affected by a wide range of factors, including housing demand and house price changes, other requirements placed on developers (e.g. affordable housing), technological changes, what neighbouring authorities require, grant funding opportunities and changes in national policy and other regulations.

The Government's consultation on zero carbon homes[69] recognises that house builders will be affected by the zero carbon policy because they will be required to build homes to more demanding energy and carbon standards than is required by current Building Regulations. They will also need to put in place allowable solutions to deal with the residual emissions from homes. This will entail a higher level of cost, although such costs should decline as industry becomes more accustomed to building zero carbon homes. There is some concern that the impact of this additional cost burden will impact small firms disproportionately, since larger firms are more likely to be able to invest in developing the most cost effective sustainability solutions at first, with smaller firms learning from their example over time. However, the 'Small Firms Impact Test' carried out as part of the initial consultation on zero carbon homes concluded that the ability to achieve higher energy efficiency and emission standards is more associated

[68] Please note, there is as yet no cost analysis of meeting 'Outstanding', as this category has only been added recently
[69] DECC, 2008, Definition of a zero carbon home, consultation

with the size, location and type of the development than the size of the firm. Consequently, many LPAs have chosen to require higher standards only on developments over a particular size.

The extent to which additional build cost for developers can be factored into the price paid for the land can be a vital issue affecting viability. A study informing the South West RSS suggests that:

> *"the impact of extra build costs of up to 15% for city infill and market town developments may potentially be accommodated by a reduction in land value of 10-15%. Discussion with stakeholders suggested that this would be a reasonable limit for reduced land value. For large urban extensions, an additional build cost of 10% would require the same 10-15% reduction in land value. However, the figures for a market town development in Cornwall suggest that an extra build cost of 5% might be a more appropriate limit to what could be absorbed by land value in that location."*[70]

House builders may be able to share the increased costs with other sectors and groups, in particular house buyers (if they are prepared to pay higher costs for zero carbon homes), landowners, energy consumers (if house builders are eligible to claim incentives for LZC energy technologies), and potentially from energy services companies (who would seek to recover capital costs of LZC energy technologies from selling the energy produced to the zero carbon home and/or third parties).

There would be implications for industry beyond house builders. In particular, the supply chain would need to adapt by offering products and services meeting the requirements of zero carbon homes, such as more energy efficient building materials and LZC energy technologies.

There would also be an impact on buyers of zero carbon homes, who (depending on the technologies adopted and the commercial arrangements for energy supply) should face lower energy bills than they would if they bought homes meeting today's Building Regulations. Another benefit would be that the living environment should be attractive, in terms of temperature (keeping cool as well as warm, taking into account future climate conditions), ventilation, air quality and noise.

The council will also need to consider the impact of their planning policies on housing supply. In the zero carbon consultation, the Government recognises that there are other regulatory pressures on housing development. These include other regulations introduced by Government (e.g. water efficiency requirements) and costs that are incurred locally (e.g. S106 Planning Obligations and the Community Infrastructure Levy). In general, such costs are paid by the developer but are passed back to landowners in the form of lower land prices.

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[70] Faber Maunsell and Peter Capener (2007) *Supporting and delivering zero carbon development in the South West*

If the aggregate burden of those costs is very high, then they could reduce the amount of land brought forward for development. This would in turn have a negative impact on housing supply.

As part of the original zero carbon consultation process conducted in 2007[71], an analysis was commissioned to simulate the potential impacts on the housing market of instigating the carbon emissions reduction policy outlined in the policy statement. The study suggested that the output of homes would be modestly affected because of the national policy to reduce carbon emissions, with a reduction in output of 0.6% by 2016. Since economics of land development vary from place to place, this impact may not be experienced equally across all regions. It could potentially affect brownfield land more than greenfield land.

To help determine the impact of these different factors on the viability of setting higher standards for new developments, it is important that West Oxfordshire consults with developers and other key stakeholders. More detailed viability testing may also be necessary if the Council decide to pursue requirements significantly in advance of national requirements.

Other considerations

Other considerations also need to be borne in mind in deciding on policy requirements for sustainable construction. There is the potential for such requirements to play a significant role in delivering wider Council objectives, as well as benefiting building users.

Shaping Futures, the Sustainable Community Strategy for West Oxfordshire has a strong emphasis on sustainability, environmental protection and responding to climate change. Setting higher policy requirements for sustainable construction could play an extremely important role in helping to meet such objectives. Such requirements could also contribute in other areas such as improving the accessibility and adaptability of the housing stock and reducing fuel poverty. The introduction of renewable energy and sustainable construction planning policy also has the potential to assist in meeting the objectives for sustainable economic growth contained in the strategy by supporting local suppliers and installers of renewable energy and low carbon technologies. As the planning policies are introduced, this could stimulate demand for related products and services, supporting local employment and the local economy.

The Oxfordshire County Council Local Area Agreement[72], which includes West Oxfordshire District Council, includes the following sustainable development indicators:

• NI 185 - carbon dioxide reduction from local authority operations.

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[71] CLG (2007) *Building a Greener Future: Towards Zero Carbon Development - Consultation*
[72] The Local Government White Paper (2006) emphasised the role of local authorities in mitigating and adapting to climate change. Oxfordshire Partnership Local Area Agreement: 2008-11: www.idea.gov.uk/idk/aio/8516424.

• NI 188 - planning to adapt to climate change.

• NI 175 - access to services and facilities by public transport walking and cycling.

• NI 198 - children travelling to school mode of transport usually used.

• NI 191 - residual household waste per head.

• NI 192 - household waste recycled and composted.

The Council, in partnership with the other Oxfordshire authorities, will have to report and take action in relation to each of these indicators and sustainable construction requirements could play a very significant role.

In addition, the LAA authorities will also have to report on all national indicators, including those that were not included within the LAA. Key indicators relevant to this project include:

• NI 186 - per capita carbon dioxide emissions in the local authority area.

• NI 187 - tackling fuel poverty - people receiving income based benefits living in homes with a low energy efficiency rating.

• NI 193 - municipal waste land filled.

While the Council do not have to meet targets on these indicators, the introduction of strong renewable energy and sustainable construction planning policy will help the Council to make progress in these areas.

West Oxfordshire District Council has also signed the Nottingham Declaration[73] on climate change. By signing the Declaration the Council has pledged to systematically address the causes of climate change and to prepare their community for its impacts. The introduction of strong renewable energy and sustainable construction planning policy will help the Council to make progress in relation to these commitments and will highlight to residents that they are taking a strategic role in relation to sustainability.

6.6 Supplementary planning documents

Consideration will need to be given to whether there is a need for a supplementary planning document (SPD) covering renewable energy and sustainable construction issues and how this will relate to the interim Oxfordshire-wide guidance being developed. SPD can be used to provide detail and practical advice covering a number of topic areas, such as:

[73] Nottingham Declaration: www.energysavingtrust.org.uk/nottingham.

- sustainable design and construction;
- landscape sensitivity to renewable energy development, particularly wind. This can benefit from a wider than single district overview (Cumbria provides a good example of a landscape sensitivity to wind SPD prepared by all the planning authorities in the county);
- renewable and low carbon energy supply to major development sites (Ashford are proposing a SPD regarding biomass district heating to serve a major development area);
- energy (or sustainability) assessments to accompany planning applications to demonstrate how policy requirements have been addressed;
- descriptive material covering the different renewable and low carbon technologies and some commentary on their application in the district; and
- guidance on small scale "community based" projects.

6.7 Recommendations

The PPS1 supplement on climate change has increased the emphasis on the role which planning policy needs to play in helping to deliver renewable, decentralised and low carbon energy, and more sustainable construction. However, national and regional policy and guidance, and local practice, is rapidly evolving and contradictions exist which make planning policy development difficult for local authorities.

For example, the South East Plan includes an expectation that local planning authorities will set 'Merton-style' rules for embedded renewable energy in new developments, whereas the most recent guidance issued by the South East Partnership Board discourages the setting of such requirements. Similarly, the PPS1 supplement encourages local planning authorities to only set higher standards for sustainable construction for specific areas or sites whereas the most recent regional guidance promotes district-wide standards, something which many local planning authorities appear to be pursuing.

The announcement of new and higher targets in the UK Low Carbon Transition Plan and Renewable Energy Strategy will mean that delivering significantly higher levels of decentralised, renewable and low carbon energy will become ever more pressing and urgent. It is to be hoped that the announcements for new national and regional planning policy in these areas (due in late 2009) will remove the current contradictions and provide greater clarity to local planning authorities to enable such targets to be delivered. In the light of the evolving national policy and the current economic uncertainties it will be important for the Council to keep this policy area under review.

In the current policy context and based on the findings of the study, our recommendations for the Council's planning policy are described below.

- Contributing to the regional targets for carbon emissions reductions set out in the South East Plan should be included as an objective for the Core Strategy or as a statement within it. This will help to set the context for the policies on energy and sustainable construction.

- A climate change policy should be adopted setting out at a strategic level how development in the district can address both mitigation and adaptation issues.

- Policy on energy should be included in the Core Strategy, and should include a simple three-step energy hierarchy (lean, clean, green).

- Given the crucial role which biomass will play if the district is to make a significant contribution to renewable energy targets, consideration should also be given to specific encouragement for the use of biomass within the energy policies as part of a strategic approach to the development of biomass as a fuel source in the district (see section 7.4).

- Although the South East Plan encourages the setting of district-level renewable energy targets, there is currently too much uncertainty about the major opportunities for renewable energy generation in the district for a reliable target to be set. Instead, the Core Strategy should make reference to the need to deliver the regional renewable electricity target and the new electricity and heat targets contained in the UK Renewable Energy Strategy and which will be fed in to the next revision of the South East Plan. In addition, the Council should make the case for sub-regional studies across the South East which examine the spatial variations in capacity to contribute to energy generation targets.

- A policy should be included in the Core Strategy which expresses clear support in principle for renewable and low carbon energy developments. The policy should also provide clear criteria for assessing applications for such developments. The criteria should draw on the guidance included in policy NRM16 of the South East Plan, and also include reference to he key issues in the district, including:

    - impacts on landscape and biodiversity designations;

    - visual impacts on local landscapes;

    - impacts on the historic environment;

    - impacts on residential amenity; and

    - highways and access issues.

- Because of the limited and uncertain opportunities available for large scale onshore wind in the district, the Core Strategy should avoid providing too much spatial guidance on these opportunities and should instead state that, whilst there is some potential for large scale wind turbines, the development pattern is likely to be one of scattered single turbines or small clusters. In line with the new UK Renewable Energy Strategy, the Core Strategy should particularly encourage community ownership of wind schemes.

- Particularly given the stretching electricity and heat targets which are likely to feed in to the next revision of the South East Plan, the potential for larger scale Combined Heat and Power (CHP) or District Heating (DH) schemes on larger sites in the district should be clearly highlighted. If any of the options for major development highlighted within this study as warranting further investigation for CHP/DH are taken forward in to the Core Strategy, feasibility studies for CHP/DH should be conducted to assess whether development on the sites could reasonably be required to include CHP/DH.

- Given the importance of the role of Combined Heat & Power (CHP)/District Heating (DH) in delivering renewable and low carbon energy in the district, we recommend that:

    - All non-domestic developments above 1000 sq m floorspace should be required to include a feasibility assessment for CHP and DH, including consideration for biomass.

    - All residential developments in off-gas areas for 50 dwellings or more should include a feasibility assessment for biomass CHP and DH.

- The carbon reduction objectives of the 'Merton-style' policy for embedded renewable electricity in new developments which are encouraged in the South East Plan could be achieved more easily and effectively and with wider benefits through the adoption of Code for Sustainable Homes/BREEAM requirements. Code level 1, for example, requires a minimum carbon emissions reduction of 10%, Code 3 a minimum of 25% and Code 5 a 100% reduction. The use of such requirements is easier for local planning authorities to implement, provides greater flexibility to developers and would help to deliver a wide range of other local policy objectives (see section 6.5.8). Subject to consultation with developers and other key stakeholders, which is particularly important given the current economic climate, we recommend that:

    - The Council bring the requirements for all new dwellings in line with the existing requirements for publicly-funded homes, i.e. Code Level 3 with immediate effect, Code Level 4 from 2012 and Code Level 6 from 2016.

    - On the larger sites, where CHP/DH schemes are feasible, Code Level 4 should be required with immediate effect.

- In addition, all new non-residential developments over 1,000 sq m should be required to meet BREEAM Very Good or equivalent with immediate effect.

- Depending on which of the major sites are taken forward within the Core Strategy, Code/BREEAM requirements should also be utilised to address site-specific issues and opportunities such as water scarcity, flood risk or ecology, as well as the energy opportunities summarized in section 5. This would include, for example, the inclusion of the flood resilience requirement for some of the sites to the west of Carterton and the smaller sites to the south of Witney where there are flood risk issues.

7. Implementation

As more local authorities implement planning policies which require new developments to be constructed in accordance with the Code for Sustainable homes, BREEAM and 'Merton'-style renewable energy/carbon emissions targets, the need for monitoring and enforcement of these policies has become increasingly apparent.

In particular, PPS1 'Planning and Climate Change - Supplement to Planning Policy Statement 1' highlights that planning authorities are required to monitor and review the implementation of their policies and respond promptly and effectively if the expected outcomes are not being delivered (paragraph 34).

This section discusses some of the key implementation issues associated with planning policy for renewable and low carbon energy and sustainable construction, including:

- reviewing planning applications;
- monitoring outcomes;
- strategic delivery mechanisms; and
- developing a strategic approach to biomass.

7.1 Reviewing planning applications

The Code for Sustainable Homes and BREEAM are quality assured systems and monitoring and certification are integral parts of the assessment process. The use of the Code/BREEAM as a basis for setting requirements for sustainable construction places the burden for assessing the performance of schemes on the applicant. Buildings constructed to these standards must be assessed by qualified and registered assessors, and the results of these assessments are recorded and collated by the Building Research Establishment.

The Code or BREEAM levels are assessed by means of both a design stage assessment (to give an interim certification level) and a post-construction assessment. Once both assessments have been completed, a final code certification will be awarded stating the level achieved.

The certification levels achieved (interim and final) are provisional until they are confirmed by the Building Research Establishment (BRE). Upon submission, BRE carries out quality control checks to ratify the level awarded by the assessor.

The design stage assessment would need to be submitted with the application for detailed consent, with the policy requirements attached as a condition to the permissions granted. West Oxfordshire District Council officers would then need to check the post-construction assessment certificate to ensure that prescribed planning policy standards have been met.

Should the Council decide to implement additional specific requirements using the Code for Sustainable Homes, e.g. relating to carbon reduction, renewable/low carbon energy, ecology, water use or flood resilience, officers will need to ensure that the credits relating to these aspects of the Code have been included and awarded within both the interim and post-construction certificates.

To ease the burden of evidencing compliance for smaller developments, the Code/BREEAM certification requirements could be relaxed for developments of less than say 5 dwellings or 1000 sq m of non-residential floorspace. For such developments, Uttlesford Borough Council do not require Code/BREEAM certification but simply the SAP and SBEM calculations (which evidence compliance with the carbon aspects for residential and non-residential developments respectively and which could be appraised by Building Control officers), along with details of other relevant sustainability features incorporated in to the design.

Ensuring compliance with other aspects of policy in this area (such as the application of the energy hierarchy and the assessment of stand-alone renewable energy schemes) is likely to require upskilling on the part of development control officers. This will particularly be the case should the Council adopt a Merton-style policy for renewable energy generation. Appendix E includes details of training courses, toolkits and other materials that officers can use to help inform their decisions.

7.2 Monitoring outcomes

The post-construction assessment certificates will provide the Council with the means of monitoring the achievement of Code/BREEAM requirements.

Where renewable energy and low carbon technologies have been installed as part of the Code/BREEAM requirement, additional monitoring may be beneficial. Any renewable energy and low carbon technologies installed as part of a 'Merton-style' policy requirement would certainly require monitoring to ensure compliance.

There are a number of mechanisms to monitor and certify that the renewable energy and low carbon technologies incorporated within a development are fulfilling the council's planning policy requirements. Clearly to ensure compliance with policy recommendations this needs to be done on an on-going basis and in a way which is consistent and not prohibitively complicated or costly to the local authority.

West Oxfordshire District Council could consider specifying within the renewable energy and sustainable construction planning policy that developers take on this cost. Since this is an emerging issue, there are very few local authorities who have included this requirement within policies. It is therefore difficult to determine what level of additional cost would be placed on developers.

There are a number of different monitoring systems available and these generally involve fitting some form of data logger to the renewable energy technology to record the heat or electricity produced. This data can then be downloaded from a fixed data logger, or more commonly sent via a wireless data logger, to a central database. This is then used to collate and analyse the results over the lifetime of the installation.

There are pros and cons with each approach.

Fixed data loggers:

- Access to a property would be required unless the system is installed outside of the building in a secure container.

- This data will need to be collected, although this can be by a non-technical operative, and this could be on a site basis (e.g. data from a large number of homes in one time period).

Wireless data loggers:

- Requires no operative to collect data.

- Developer will have to set aside additional budget for a suitable modem, network contract and call charges.

It is also important to note that with both type of system, developers will need to recompense building residents. This is because a mains power supply must be installed for the data acquisition system and will cost in the region of £30 per year[74].

Further information can be found in the Energy Saving Trust publication *Monitoring energy and carbon performance in new homes*.

Several companies are now in the process of producing both the protocols and the technical systems required to monitor the output of renewable energy systems in order to ensure compliance with 'Merton style' policies. For example, the London Borough of

[74] Annual consumption is in the region of 10-30 Watts depending on the renewable energy and low carbon technologies being monitored.

Merton is working with Metropolis Green[75] to develop a Planning Obligation that will require developers to install data loggers and pay a fee to monitor technologies in situ.

7.3 Strategic delivery mechanisms

While individual technologies on single dwellings will be applied to many developments across West Oxfordshire, the Council should also seek to encourage site-wide or town-wide, strategic energy facilities such as Combined Heat and Power or District Heating schemes. This could be implemented either by developers on large development sites (potentially as part of 'allowable solutions' where requirements cannot be met on-site) or by West Oxfordshire District Council itself. In addition, funding from new developments could be utilised to deliver improvements to existing developments and mechanisms will be needed to manage such activity.

There are a number of finance mechanisms that local authorities can use to fund strategic energy facilities or improvements to existing housing. These include:

- Section 106 agreements (S106);
- The Community Infrastructure Levy (CIL);
- Energy Service Companies (ESCos); and
- Carbon offset funds.

An overview of these mechanisms is provided below.

7.3.1 Section 106 agreements

Section 106 (S106) of the Town and Country Planning Act 1990 allows Local Planning Authorities (LPAs) to enter into a legally binding agreement (or 'planning obligation') with a landowner in association with the grant of planning permission. This obligation is termed a section 106 agreement and is a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They are increasingly used to support the provision of services and infrastructure, such as highways, recreational facilities, education, health and affordable housing.

Section 106 agreements are a commonly used tool and have been used by a large number of LPAs (including the London Boroughs of Merton and Croydon) to require that developers meet 'Merton-style' policies for renewable energy generation or carbon reduction.

75 www.metropolisgreen.com/.

However, it has been suggested that this type of agreement will to some extent be replaced by the Community Infrastructure Levy (CIL).

7.3.2 The Community Infrastructure Levy (CIL)

The Community Infrastructure Levy (CIL) was introduced in Part 11 of the Planning Act (2008). Local authorities will be able to charge the CIL on most types of new local development and use the money raised to provide the local or sub-regional infrastructure needed to support local growth. In addition to new roads, schools and hospitals, money raised could also be used to fund sustainable energy measures.

It is also important to highlight that the government is considering including CIL as an 'allowable solution', as set out in the 'Definition of zero carbon' consultation. The consultation document explains that after energy efficiency and carbon compliance standards have been met, residual carbon emissions will still need to be addressed in order to meet the zero carbon home standard (100% carbon reduction, including regulated and unregulated emissions). The government has proposed the use of 'allowable solutions', which will be a range of solutions from offsite renewable energy to carbon offsetting, which could be linked with the CIL.

Please note that local authorities will still be able to enter into negotiated planning obligations using section 106 of the 1990 Town and Country Planning Act (section 106 agreements) alongside use of the CIL. In addition, the 2009 Budget announcement delayed the implementation of the CIL until 2010[76].

7.3.3 Energy Service Companies (ESCos)

While site-wide renewable energy and low carbon technologies can be used to deliver low cost carbon reduction solutions, these systems need to be financed and maintained by a competent body. Energy Service Companies (ESCos) are a potential solution to this.

Energy services address the fact that people in their homes or places of work need energy to provide particular services – heating, lighting and powering appliances. Consumers are not necessarily interested in the actual energy that they consume, simply that their home is heated or cooled adequately and that their appliances function.

There are a number of different types of energy service schemes, including preferred supplier partnerships and energy clubs. An 'energy supply scheme' is of particular relevance to this project however. After creating an energy supply ESCo, including obtaining the relevant finance and supplier licenses required, organisations can begin to supply power directly to householders, commercial organisations and public bodies.

[76] www.planningportal.gov.uk/england/professionals/en/1115316678349.html.

It is also important to note that the consultation on the definition of zero carbon has also designated ESCos as an 'allowable solution'. In practice, this driver could stimulate the market for ESCos across West Oxfordshire.

However, developers may not wish to use an ESCo model to assist them in financing site-wide renewable energy and low carbon technologies or strategic energy facilities within developments. This is due to the need to manage and operate the ESCo after completing the development. However, we are aware of some local authorities taking initial steps to develop an overarching ESCo which can take on the management of district heating/CHP schemes from private developers.

We would therefore recommend that West Oxfordshire District Council considers setting up an ESCo to operate and manage decentralised energy systems operating across the area once developers have completed sites. ESCos can also promote further energy efficiency actions on an ongoing basis.

In addition, research[77] suggests that ESCos can be used to ensure that renewable energy technologies, such as PV systems on individual dwellings, continue to generate their maximum energy generation potential once the developer has completed the site. Therefore the Council should also consider setting up an ESCo to manage smaller-scale decentralised energy systems operating within the district.

Further information on ESCos, including publications and consultancy support, is available from the Energy Saving Trust[78].

7.3.4 Carbon offset funds

A carbon offsetting scheme can be used to help reduce emissions from both new and existing developments where standards cannot be met on-site.

While many consumer and business orientated carbon offset schemes support international projects abroad, local authorities can promote local carbon offset schemes. Such schemes use funds to develop local projects and may find it easier to demonstrate to investors that actual carbon savings are being made. For example, funds can be used to develop locally based strategic energy facilities, which can be a very visible use of this financing stream.

Larger scale projects will require more upfront investment and will therefore require larger amounts of money to be raised. Projects will also take longer to come to fruition. Schemes such as those adopted by Milton Keynes and Ashford Borough Councils (discussed below), which put an obligation on developers to pay into a carbon

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[77] Munro, D. (2009) *How to keep domestic PV systems working in the long term*, Energy World, February 2009, p 10-11.
[78] Energy services support: www.energysavingtrust.org.uk/business/Business/Local-Authorities/Your-Sustainable-Energy-Strategy/Energy-Services-Packages.

neutrality fund, may raise larger amounts of money due to the large growth forecasted in their areas.

However, several smaller scale local carbon offsetting schemes operating in England demonstrate the advantages of taking smaller scale actions. For example, Eastleigh Borough Council (discussed below) was keen for its offsetting scheme to remain competitive with the consumer based alternatives that local residents may wish to invest in. The Council is therefore using the funds raised to operate an insulation programme for loft and cavity wall insulation. Supporting the installation of measures such as insulation also helps Councils achieve targets such as those set in their Local Area Agreements (LAA) including NI 186[79].

Examples of operating offset funds

Several Councils are introducing offsetting schemes as part of sustainable planning policies. These include Eastleigh Borough Council, Ashford Borough Council and Milton Keynes Council. Such schemes can be used to support carbon neutrality in new build developments or in existing properties, and the funds raised can be used in a number of ways, as discussed below.

Milton Keynes City Council

Milton Keynes Council has agreed an aim to achieve carbon neutral growth. The city is forecast to grow substantially in the future, which will inevitably increase carbon dioxide emissions across the area. The Council therefore requires developers working on projects of a certain size to reduce emissions as far as possible on site and to offset all unavoidable emissions. Residential developments with more than five dwellings and all developments over $1000m^2$ must meet specified levels of the Code for Sustainable Homes or BREEAM standards and generate a specified percentage of renewable energy on-site. These new developments are also expected to be carbon neutral overall i.e. there is to be no net increase in emissions as a result of energy used to run the new buildings. Developers that cannot achieve this through the use of technologies on-site must pay into a carbon neutrality fund. The Council currently imposes the requirement to pay into this fund using a section 106 agreement.

Under the Council's 'D4' planning policy, developers must pay £200 for every tonne of carbon dioxide their development will emit in its first year of use. This figure is to increase annually based on the building cost inflation. For a new house, achieving carbon neutrality should currently cost around £400.

Money raised by the carbon neutrality fund is used to reduce carbon emissions from other local sources. Funds support the generation of renewable energy and the installation of energy saving measures in existing homes. Initially money raised was

[79] NI 186 - a percentage reduction of the per capita carbon dioxide emissions in the local authority area. This requires the Council to take actions to reduce carbon dioxide emissions across the area, including those emissions from housing.

also used to pay for tree planting but the Council has recently shifted the focus onto energy saving applications. The money received from ten new developments reportedly totals £250,000 so far, enough to insulate 1,000 existing homes. Ultimately the Council expects to be able to raise around £800,000 a year but this will depend on the type and size of developments as well as variations in the national economy.

As well as offsetting carbon dioxide emissions, the actions supported by the fund are allowing Milton Keynes Council to reduce fuel poverty locally, create jobs, stimulate the local economy and develop an experience and technology base locally for low carbon technologies.

Having the ability to pay into this fund enables the construction of developments that cannot easily or affordably comply with the Council's carbon neutrality policy on-site. Growth should, therefore not be held up by the existence of a sustainable planning policy.

Ashford Borough Council

As with Milton Keynes Council, Ashford Borough Council is classified as a major growth area, and has introduced a number of policies designed to ensure this growth can be as sustainable as possible. Ashford also wants to achieve zero carbon growth. Policy CS10 – Sustainable Design and Construction[80] expects all major developments to "*incorporate sustainable design features to reduce the consumption of natural resources and to help deliver the aim of zero carbon growth in Ashford".*

Major residential developments are defined as those with ten or more dwellings or which are greater than 0.5 hectares in area; major non-residential developments are those with more than '1000m^2 gross external floorspace'; the policy also covers all developments with an area over 1 hectare. These dimensions were determined using the thresholds for the suggested inclusion of renewable energy included in the draft South East Plan.

Developers must achieve certain standards of energy and water efficiency, use sustainable construction materials and facilitate waste reduction. The Council has specified which level of the Code for Sustainable Homes or the Building Research Establishment's Environmental Assessment Method (BREEAM) new developments should meet. Developers must also reduce CO_2 emissions by a specified percentage through the use of sustainable energy technologies on-site. Overall each new development is required to be carbon neutral, with any remaining CO_2 emissions being offset via payments into a carbon offsetting fund.

Both Milton Keynes and Ashford Councils' policies set on-site renewable energy and efficiency targets that strengthen over time so that carbon emissions from new

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[80] Ashford Borough Council's Local Development Framework: www.ashford.gov.uk/ashfordgov1.1/pdf/Housing%20Background%20Document.pdf.

developments will reduce gradually. The requirements that developments meet certain carbon emission reduction levels through activity on site, means developers will be unable to rely solely on carbon offsetting to achieve carbon neutrality.

Eastleigh Borough Council

In contrast to Milton Keynes City Council and Ashford Borough Council, which are using offsetting to enable new developments to achieve carbon neutrality, Eastleigh Borough Council, in Hampshire, is using its own offsetting fund CarbonFREE (Carbon Fund for Reducing Emissions in Eastleigh) to enable existing buildings to achieve carbon neutrality. The Council intends to become carbon neutral by 2012. It will be reducing the emissions from its own buildings and activities as far as possible between now and that time, but has chosen to create a carbon offsetting scheme as well, to allow it to compensate for unavoidable CO_2 emissions. Existing schemes were not trusted to achieve real carbon dioxide savings; the Council also wanted to support local action to tackle climate change, so it opted to set up its own local scheme.

The Council is investing £50,000 a year into CarbonFREE, and is also helping local householders and businesses to calculate their carbon emissions and allowing them to pay into the fund as well. For the 12 months from December 2008, local bus companies will also donate 1p from every bus ticket sold on Thursdays in the Borough into the fund. This initiative is expected to raise as much as £6,000 before December 2009.

Money raised is used to fund the installation of insulation in local households and community buildings – particularly where householders are ineligible for existing national insulation schemes. These measures were chosen for support because they are cost-effective and the Council wanted CarbonFREE to remain competitive with existing schemes. As well as reducing carbon emissions, this scheme is helping the Council meet targets set for national indicators 186 and 188 as agreed in its LAA.

Prior to creating its own carbon offsetting scheme, Eastleigh Borough Council carried out market research to investigate local residents' likely willingness to pay to offset their carbon emissions. While only 2% of those asked claimed to be paying into offsetting funds already, 36% said they would be interested in principle in doing so. Of the interested individuals, 26% said they would be willing to pay £10 or more per tonne of CO_2 saved.

CarbonFREE meets the best practice criteria for offsetting schemes as defined by the Government's Quality Assurance Scheme[81].

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[81] The UK Government's Quality Assurance Scheme for Carbon Offsetting: http://offsetting.defra.gov.uk/ which helps raise awareness about carbon offsetting and awards a quality mark to approved schemes.

Should West Oxfordshire District Council decide to investigate carbon offset funds further, we would recommend that consideration be given to whether:

- The focus of the offset fund is to finance energy efficiency or renewable energy and low carbon technologies;

- The focus of the offset fund is for new or existing properties;

- The fund would finance small- or large-scale projects;

- The fund would be used to support local businesses to reduce their carbon emissions; and

- The value of pounds per tonne of carbon dioxide (£/tCO_2).

7.4 Developing a strategic approach to biomass

If the Council are to achieve significant levels of renewable energy generation in the district, biomass will play a critical role. However, as discussed in section 4.3.6 and 4.4.5, efforts are needed to stimulate demand and develop the supply chain for both new and existing buildings.

The Council has recently commissioned TV Energy to undertake a project to stimulate woodland management activity across the district. The West Oxfordshire Woodfuel Project will benefit both the local environment and economy, whilst producing renewable, low carbon energy.

The project's objectives include increasing the amount of renewable energy generated from woodfuel, which in turn will reduce CO_2 emissions across the district, stimulating the sustainable management of local woodland, increasing the landscape, biodiversity and commercial value of woodlands in West Oxfordshire and revitalising the local forestry economy.

The project's aims are to establish a Woodfuel Partnership in West Oxfordshire, thus promoting the installation of wood fuelled boilers in the local area, by establishing local, sustainable supply chains that promote the domestic firewood market.

As part of the project, TV Energy has organised a series of meetings with Council representatives, local suppliers and installers. This will help to co-ordinate the approach that is taken in the area. Since this project is only in its early stages, the project team have been unable to provide any more information on the outcomes of this project.

Linked to the findings and recommendations in sections 4.3.6, 4.4.5 and 6.7, it is essential that a strategic approach to biomass is taken by the Council to ensure that a working supply chain is established. This will include building upon the activities described above, but could also include assessing the feasibility of using biomass in the Council's own buildings and promoting biomass to developers who are planning on building locally. Whilst we would not recommend that the Councils' planning policies be overly prescriptive, generally promoting biomass or insisting that biomass should be considered could prove advantageous in the long term.

A description of Barnsley Metropolitan Borough Council's best practice approach can be found below.

Barnsley Metropolitan Borough Council's strategic approach to biomass

An example of good practice in this regard is Barnsley Metropolitan Borough Council. In conjunction with the Forest Partnership and the regional development agency, Yorkshire Forward, Barnsley Metropolitan Council is nurturing a growing market for wood fuel. Beginning with the first biomass boiler at a restored farm house, demand for wood fuel has grown as more biomass boilers are installed.

The Council has adopted a 'Biomass implementation policy' – the first of its kind from a local authority. Adoption of the policy meant that all new heating systems (both for major refurbishment and new build developments) in public and commercial buildings should favour biomass over other fuel types.

The Biomass implementation policy (2004) states:

'…that a presumption be made in favour of Biomass Heating being used for all new installations in public and commercial buildings, or where a major refurbishment is being undertaken, subject to a value for money assessment (c.f. Whole Life Costing analysis) being done against other forms of heating in each case'.

Since adoption of the policy, the Council has embarked on one of the largest biomass heating programmes in the country, which in turn has increased demand for wood fuel and helped to stimulate a local biomass fuel market.

By taking a strategic move on biomass, the Council has rewarded the area with a thriving market for biomass fuel production and transformed a wasteland site into a Royal Society for the Protection of Birds (RSPB) wetland which provides a sustainable and plentiful supply of wood fuel.

Further information on the approach taken by Barnsley Metropolitan Borough Council can be found on the Energy Saving Trust website[82].

[82] www.energysavingtrust.org.uk/business/Business/Resources/Publications-and-Case-Studies.

7.5 Conclusions

This section has drawn together aspects relevant to the implementation of planning policies requiring renewable/low carbon energy and sustainable construction. This is a key topic. PPS 12 paragraph 4.44 requires that LDF Core Strategies are deliverable, flexible and are able to be monitored.

It is clear that a degree of upskilling on the part of development control officers and members will be required. The nature of this will depend to some extent on how far the authority relies on evidence of compliance provided by assessments required through Code/BREEAM and Building Regulation requirements.

There are often concerns that renewable and low carbon equipment will not be installed properly and fully commissioned, or that it will not be maintained and periodically replaced to ensure that the required CO_2 savings and contribution to renewable energy targets are achieved in the longer term. There are technical ways of ensuring ongoing compliance by the use of data loggers, but these must be required at the outset or imposed by condition.

The Council has access to a wide range of mechanisms that can be used to assist in delivery. These include Section 106 Agreements used by some authorities to require the installation of specific on-site renewable and low carbon energy equipment. The Community Infrastructure Levy, to be brought into effect in 2010, could be used to raise funds to pay for infrastructure including for example helping to cover the costs of district heating networks that are developed over long periods of time and function most effectively if they supply a range of varied land uses and activities.

Delivery will require not only funds but also new organisations, particularly to facilitate the creation of decentralised energy systems operating across the district. Energy Service Companies (ESCos) are a potential way forward and some local authorities have taken steps to set up a district-wide ESCo to take on the management of district heating/CHP schemes from private developers. This study recommends that West Oxfordshire District Council also considers taking this approach.

While it is always important to achieve maximum energy efficiency and use of on-site renewables there will often be situations where the full requirements of policy cannot be achieved on site. This is likely to become a more frequent occurrence as higher level standards are brought into effect. The Government recognise the importance of this issue in consulting on off-site 'allowable solutions'. Some local authorities already have policies in place to ensure that where required standards cannot be met on-site the developer pays into a local carbon offsetting scheme used to reduce carbon emissions elsewhere in the district, e.g. local energy efficiency and small scale renewable projects. The important point is to ensure that the funds raised by carbon offsetting are used locally. Milton Keynes and Ashford Councils have pioneered the creation and use of their own local carbon offsetting funds. Eastleigh Council is investing in its own carbon offsetting scheme which is designed to assist local householders and businesses to reduce their carbon emissions. Experience to date can be drawn upon if West Oxfordshire District Council decides to consider the use of a carbon offsetting scheme, and a series of questions to be used in scoping the next stage of work has been set out above.

Biomass is seen as having a critical role in increasing levels of renewable energy generation in the District. The scope of work on the biomass resource in West Oxfordshire is summarised and it is recommended that West Oxfordshire and Cherwell District work together on this subject.

Other topics relevant to Implementation and Delivery are included within the Appendices:

Appendix A sets out the scoring system used in assessing projects against the requirements of the Code for Sustainable Homes

Appendix B describes the relevant small scale renewable energy technologies, setting out opportunities and other considerations, barriers to implementation and likely costs and payback periods. The following technologies are included in Appendix B: solar photovoltaics, solar thermal/hot water, ground and air sourced heat pumps, micro-hydro electric, biomass – wood burning stoves and boilers, wind, and CHP.

Appendix C provides information on various energy-from-waste technologies, which have not been addressed in detail in this report since they would need to be addressed at a County level.

Appendix D provides information on installers and suppliers of renewable and low carbon energy equipment.

Appendix E signposts a number of organisations and reports relevant to planning officers and developers which will assist in keeping up to date with new developments.

Appendix A: Scoring system for Code for Sustainable Homes

The Code Level achieved is based on a points scoring system. In simplistic terms, the higher the total number of points, the higher the Code Level. Points are based on credits that are available in a number of Environment Impact Categories.

During the assessment, credits are awarded in each category. These credits are then subjected to an Environmental Weighting Factor which in turn gives the point score for each category, i.e. relative importance to meeting the standards. Adding up the point score for each category gives the total point score, which in turn confirms the Code Level achieved.

The Environmental Impact Categories and their Environmental Weighting Factors are as follows:

Table A.1: Code for Sustainable Homes Environmental Impact Categories and their Environmental Weighting Factors.

Environment Impact Categories	Environmental Weighting Factor (%)	Number of credits	Points value of each credit
1 - Energy & CO_2 emissions	36.4	29	1.26
2 - Water	9.0	6	1.50
3 - Materials	7.2	24	0.30
4 - Surface water run-off	2.2	4	0.55
5 - Waste	6.4	7	0.91
6 - Pollution	2.8	4	0.70
7 - Health and wellbeing	14.0	12	1.17
8 - Management	10.0	9	1.11
9 - Ecology	12.0	9	1.33

- To achieve a Code rating, there are first four minimum standards that have to be met regardless of what Code Level is sought, as follows:

- Embodied Impact of Construction Materials: at least three of the five key building fabric elements must achieve a relevant Green Guide rating (from the 2007 version of 'The Green Guide' of A+ to D);

- Surface water run-off: the run-off rates post development will be no greater than the previous conditions for the site;

• Household waste storage: adequate provision must be made for waste and recycling storage and handling in accordance with the provisions of the Code; and

• Construction-site waste management: a Site Waste Management Plan must be produced and implemented for all sites where the cost of construction is more than £300,000.

Once these have been met, then to achieve the required Code Level, the following total point scores must be met or exceeded *PLUS* minimum standards for CO_2 emissions and water consumption must be met.

Table A.2: Code for Sustainable Homes levels and points required.

Code Level	Total point scores	Min. % reduction in: DER TER	Max. potable water consumption (l/person/day)
1	36	10%	120
2	48	18%	
3	57	25%	105
4	68	44%	
5	84	100%	80
6	90	'Zero carbon house'	

Provided the minimum standards on CO_2 and water have been met for a particular Code level, the remaining non mandatory credits are therefore tradable, giving developers flexibility in how to meet a particular level of Code.

In addition to the above requirements, the Code is phasing in a mandatory requirement for the Lifetime Homes standards to be adopted.

The aim of Lifetime Homes is to provide homes that are accessible and easily adaptable to meet the changing needs of current and future occupants. The scheme involves the incorporation of 16 design features that together create a flexible blueprint for accessible and adaptable housing in any setting. These include, for example, the width of doors, the inclusion of wheelchair accessible toilets and capacity to have a stair lift retrofitted. Compliance with all 16 is required to satisfy the Lifetime Homes credit under the Code for Sustainable Homes.

Currently it is mandatory for Code 6 dwellings to satisfy the Lifetime Homes Standards. In 2010 this will be the case for all dwellings at Code 4 Level or above. In 2013 this will also be the case for Code 3 dwellings.

Appendix B: Review of small-scale technologies

Some of the renewable and low carbon energy technologies that could be used to meet new developments' heat and power demands in the district are described below. Brief descriptions are supported by further information on the specific opportunities and potential barriers for each technology locally.

The following energy technologies are reviewed here:

- solar photovoltaics;
- solar thermal/solar hot water;
- ground and air source heat pumps;
- micro-hydro electric;
- biomass – wood burning stoves and boilers;
- wind; and
- CHP.

Solar photovoltaics

Solar photovoltaic (PV) cells convert daylight into direct current (DC) electricity. They comprise one or two layers of a semi-conducting material, usually silicon. When photons from light hit the surface of the PV cell, electrons are released from the semi-conductor material. If the cell is connected into a circuit, these electrons can be used to create an electric current. The greater the intensity of light hitting the cell, the greater the electrical output of this process.

There are three main types of solar cell:

- Monocrystalline cells: thin slices of silicon cut from a single crystal; some of the most efficient available; typical efficiency of 15%.
- Polycrystalline cells: thin slices of silicon cut from a block of multiple silicon crystals; typical efficiency around 12%.

• Thin film cells: a very thin layer of semiconductor atoms on a glass or metal base; typical efficiency of 7%.

These differences in cell efficiencies mean that additional lower efficiency cells are needed to produce the same output as higher efficiency cells.

PV cells can be connected together to form a module and several modules can be connected together to create a PV array. An inverter must also be installed to convert the direct current (DC) electricity generated by the cells into useful alternative current (AC) electricity. An array can supply electricity to a building it is attached to and, when more power is generated than can be used locally, excess power can be exported to the national grid.

The ideal size for a domestic PV array depends on a number of issues, including: how much power is needed, the type of cell used, available roof space and the budget. Typical new build domestic systems, with the capacity to generate 1.5–3kWp (kilowatts peak) can take up around 10–15m^2 roof space. According to information provided for the Low Carbon Buildings programme, a 2.5kWp system should meet about half a typical household's electricity demand (assumed to be 4,010kWh/yr). This would save about £230 from the average electricity bill per year.

PV systems are suitable for use in the UK, as they can still produce power when clouds obscure the sun's light. However, they must be located where objects such as buildings or trees will not overshadow them.

Opportunities and considerations

• Generate electricity close to the point of use;

• Excess output can be sold to the National Grid;

• Operate in combination with other low carbon or renewable energy technologies;

• No emissions at the point of use;

• Low maintenance requirements as they contain no moving parts;

• Easy to incorporate into the fabric (roof and walls) of new buildings;

• Where they are incorporated into a new roof, the cost of solar tiles (often more expensive than panels) is partially offset as fewer roof tiles must be purchased; solar tiles can also be coloured to blend in with the rest of the roof;

• Operate best where they face due south (and developers should consider building orientation to maximise PV output), but a tilted array will work satisfactorily in a wide range of orientations:

- PV systems can be used on a roof or wall facing within 90 degrees of due south, where there is no significant overshadowing;

- On a vertical surface (i.e. a wall), they must face somewhere between south-east and south-west;

- South-facing PV arrays in the UK will give optimal output if tilted at an angle between 30 and 40 degrees from horizontal (again, developers should consider roof angle to maximise PV output); however, arrays can operate at any angle between vertical and 15 degrees off horizontal;

- East- or west-facing arrays are more efficient with a shallower tilt;

- Considered a permitted development, but may require separate planning permission in certain protected areas;

- Output will drop as soon as the sun goes behind a cloud.

Barriers

- Shading should be avoided – even minor overshadowing can significantly affect electrical output;

- Dirt on the surface of a module can reduce output by up to 10%, so regular cleaning is required. Panels can be designed to be self cleaning (i.e. via rainfall);

- Back-up electricity supply will be required when the system is not generating (in low-level light conditions or at night, for example); and

- Roof must be structurally sound and able to withstand the weight of a PV system.

Cost

Capital costs for PV systems can be relatively high, compared to the other technologies discussed here. Costs are falling, however as the technology and manufacturing techniques used develop.

A typical new-build domestic system – with an output around 1.5–3kWp – can cost around £5,000 per kWp. It can take between 35 and 50 years for a system to pay for itself through reduced electricity bills.

Overall costs can be reduced where PV systems are installed as part of a new roof, as installation costs can be minimised – no extra scaffolding is needed, for example, and installers are already onsite.

PV installations are eligible for Renewables Obligation Certificates[83] (ROCs). In addition, it is likely that feed-in tariffs for exported electricity will be introduced in the future, which will further reduce payback periods.

Please refer to Appendix D for further information on installers that operate locally.

Solar thermal / solar hot water

Solar thermal or solar hot water (SHW) systems are usually roof mounted and have similar site requirements to PV systems. However, they require a water tank to be installed, which is capable of receiving water warmed by the solar thermal panels. Panels contain a fluid (usually a water/antifreeze mixture) that absorbs the sun's heat. The heated liquid is then passed through a coil in a hot water storage cylinder, where it heats water for use in a building. The water in the cylinder may then be supplied directly, or heated further (if required) by a boiler or electric immersion heater.

The two main types of SHW collector are:

- Flat plate systems – which comprise an absorber plate with a transparent cover to collect the sun's heat; and

- Evacuated tube systems – which comprise a row of glass tubes, each containing an absorber plate and feeding into a manifold which transports the heated fluid.

Evacuated tube collectors are more expensive than flat plate systems as they are more complex in design. However, they are more efficient and may therefore be more appropriate where roof space is limited.

Opportunities and considerations

- Excellent potential in urban and rural environments;

- One of the most advanced micro generation options in the UK;

- No emissions at point of use;

[83] The Renewables Obligation (RO) was introduced in April 2002 and imposes an increasing legal requirement on energy suppliers to provide electricity from renewables. The RO is the main mechanism through which progress will be made towards the UK's renewable electricity targets and is the main support scheme for renewable electricity projects in the UK.
A Renewables Obligation Certificate (ROC) is a certificate issued to an accredited generator of eligible renewable electricity generated within the UK and supplied to customers within the United Kingdom by a licensed electricity supplier. Suppliers unable to meet their target must pay for any deficit in their renewables capacity through a system of ROCs. These are traded between those organisations/individuals that have obtained ROCs through generating energy and those organisations that have a deficit of ROCs.

- In the summer, a typical SHW system can meet 80-100% of the hot water demand of a typical house. Over a year systems can supply 50-60% of this demand – a back-up boiler will therefore be required in winter;

- High-efficiency boilers or immersion heaters will be needed to provide 'top up' heating of the domestic hot water supply. This is particularly important to prevent Legionella forming (a risk where household water supply is not heated to 60°C at least once a day);

- As with PV modules, solar hot water panels work best when located in direct sunlight on a sloping roof. Developers should consider building orientation to maximise output of solar thermal systems. However, roofs facing anywhere within 45 degrees of due south will provide a significant contribution to hot water demand;

- As with PV, panels should not be overshadowed by buildings or trees;

- Low maintenance requirements as they contain no moving parts; and

- Panels do not generally require separate planning permission as they are considered a permitted development.

Barriers

- Output significantly reduced in winter and by shading; and

- Requires an additional hot water source to maintain hot water supply in the winter and to prevent Legionella.

Costs

A typical 4m^2 new-build domestic system, costing £1,000 to £4,000, will save 1,000–2,000kWh per year. Installation costs can be reduced where systems are installed as part of a new building and planned in from the design stage.

While solar thermal installations are not eligible for ROCs, it is likely they will be eligible for the forthcoming Renewable Heat Incentive[84] (RHI).

Please refer to Appendix D for further information on installers that operate locally.

[84] As set out in the Government's Heat and Energy Saving Strategy (HESS) consultation, the Renewable Heat Incentive (RHI) will be developed to ensure that the generation of renewable heat is promoted. Domestic properties are likely to receive payments as a lump sum up front, which potentially could help to offset developers' costs. Further information: www.berr.gov.uk/energy/sources/renewables/policy/renewableheatincentive/page50364.html.

Ground source heat pumps

Ground source heat pumps move heat from the ground into a building that needs heating – such as a dwelling or office space. The Earth absorbs heat from the sun in the summer, and stores some of this over the winter. This means that, about 1-2 meters below the Earth's surface, a temperature of around 11-12°C is maintained throughout the year. This heat can be used to meet low-level heating demands, using a ground source heat pump (GSHP).

A GSHP comprises a pump attached to a ground loop, buried vertically in a bore hole, or horizontally in a trench. A water/antifreeze mixture within the ground loop collects heat energy from the Earth as it moves around the system. The warmed liquid is then pumped through a heat exchanger, so warm air or water can then be supplied to a building via a distribution system. As GSHPs produce hot water at a lower temperature than a conventional boiler, a suitable heating distribution system must also be installed. Under floor heating is the most appropriate solution, and is easiest to install in new build developments, where the cost and disruption of installation will be minimised. In existing buildings, over-sized radiators can be installed instead. It is easiest, and least costly, to plan to include this technology in a new building as early as possible in the design process.

The pump that keeps the liquid moving around a GSHP requires electricity to run, which can be relatively carbon intensive. However, heat pumps use this electricity very efficiently. For every 1kWh of electricity used, a GSHP can produce around 3Wh of heat. This relationship is called the coefficient of performance (CoP). Higher CoPs may indicate more efficient GSHP systems but operating conditions are also taken into account. Overall, it is the difference in temperature between the source of heat (in this case the ground) and the environment to be heated, which determines the efficiency of a heat pump. The smaller this difference is, the higher the CoP will be. In its 'Generating the Future' report, the Energy Saving Trust (EST) assumed that the CoP for a typical GSHP in the UK was 3.16[85].

Heat pumps can be designed to supply all of a typical dwelling's heat requirements, and work best in well-insulated properties. This is another reason why they are more appropriate for use in new buildings (which can be built to a high standard of thermal insulation), rather than existing /refurbished buildings (where insulation alone can be costly or impractical). Heat pumps will usually only pre-heat domestic hot water, however, so a separate hot water heating system will be required (for example an immersion heater).

Opportunities and considerations

- Can be scaled up to deliver district heating, or down to supply just one building;

[85] Energy Saving Trust (2007) *Generating the Future: An analysis of interventions to achieve widespread microgeneration penetration*'

• Can provide all of a property's space heating requirements;

• Work best with under floor heating systems in well insulated new build properties – which have relatively low heat demand, which minimises the collector area required;

• Electricity is required to drive the pump, thus they are not 100% renewable. However, electricity-generating renewable technologies, such as solar PV, can be used to offset the emissions from the electricity used;

• Horizontal systems are more suited to rural locations as they require space for a trench to be installed (to meet the space heating demand of a detached new build house, a trench of around 40-50m is needed); and

• Vertical systems are suitable for smaller sites but require 15-20m boreholes to be dug, the cost of which might be prohibitive. Vertical systems are suitable for smaller sites but require 15-20m boreholes to be dug, the cost of which might be prohibitive. A geotechnical site specific survey will be required to reduce the uncertainty associated with ground conditions, with particular focus on aquifers. The British Geological Survey has an on-line service offering simple, or more detailed, GeoReports that provide information on local ground conditions relevant for ground source heat pumps. For example, an online GSHP report suitable for single dwelling applications currently costs £50. Larger schemes, with multiple boreholes, will require a trial borehole and/or a thermal properties field test.

Barriers

• Sufficient space is required for horizontal ground loops, whereas vertical systems need an area of land where bore holes can be drilled.

Costs

The EST report 'Generating the future'[86] gives the typical domestic new build upfront cost of a GSHP to be £5,580.30 (in 2007). Information given for the Low Carbon Building Programme puts the cost higher than this, suggesting that a typical 8kW system can cost between £6,000 and £12,000. Installing a suitable distribution system, e.g. under floor heating, will add to this, though costs can be minimised where developers include such systems in their plans from the earliest design stage.

While GSHP installations are not eligible for ROCs, it is likely they will be eligible for the forthcoming RHI.

Please refer to Appendix D for further information on installers that operate locally.

[86] Energy Saving Trust (2007) *Generating the Future: An analysis of interventions to achieve widespread microgeneration penetration*'.

Air source heat pumps

Air source heat pumps take heat from the air outside a building and use it to supply heating to a building – such as a dwelling or office space. There are two types: air-to-air and air-to-water.

In an air-to-air system, heat from the outside air is used to heat air that can be circulated inside a building using fans. In an air-to-water system, heat from the outside air is used to warm water for use in a suitable distribution system. As ASHPs produce hot water at a lower temperature than a conventional boiler a suitable heating distribution system must also be installed. Under floor heating is the most appropriate solution, and is easiest to install in new build developments, where the cost and disruption of installation will be minimised. In existing buildings, over-sized radiators can be installed instead. It is easiest, and least costly, to plan to include this technology in a new building as early as possible in the design process.

As with ground source heat pumps, ASHPs need electricity to run, which can be relatively carbon intensive. However, heat pumps use this electricity very efficiently. For every 1kWh of electricity used, an ASHP can produce around 3kWh of heat. This relationship is called the coefficient of performance (CoP). Higher CoPs may indicate more efficient ASHP systems but operating conditions are also taken into account. Overall, it is the difference in temperature between the source of heat (in this case the external air) and the environment to be heated, which determines the efficiency of a heat pump. The smaller this difference is, the higher the CoP will be. In its 'Generating the Future' report, the EST assumed that the CoP for a typical ASHP in the UK was 2.8[87]. This is close to, but slightly lower than, the CoP for a GSHP.

Heat pumps can be designed to supply all of a typical dwelling's heat requirements, and work best in well-insulated properties. This is another reason why they are more appropriate for use in new buildings (which can be built to a high standard of thermal insulation), rather than existing/refurbished buildings (where insulation alone can be costly or impractical). Heat pumps will usually only pre-heat domestic hot water, however, so a separate hot water heating system will be required (for example an immersion heater).

Opportunities and considerations

- Excellent potential in urban environments – especially as they do not take up much space;

- As the system is fitted externally, space must be available to install it on an outside wall;

[87] Energy Saving Trust (2007) *Generating the Future: An analysis of interventions to achieve widespread microgeneration penetration'*

- Electricity is required to drive the pump, thus these systems are not 100% renewable. However, electricity-generating renewable technologies, such as solar PV, can be used to offset the emissions from the electricity used;

- Work best with under floor heating systems in well insulated new build properties – which have relatively low heat demand; and

- Cheaper and easier to install than GSHPs, with a similar CoP.

Barriers

- Potential noise issues; and

- Not currently permitted development because of visual impact and noise concerns, so separate planning permission will be required.

Costs

The EST report 'Generating the future'[88] gives the typical upfront cost of an ASHP to be £5,315 (in 2007). Information given for the Low Carbon Building Programme puts the cost higher than this, suggesting that a typical 5kW system can cost between £6,000 and £8,000. Installing a suitable distribution system, e.g. under floor heating, will add to this, though costs can be minimised where developers include this in their plans from the earliest design stage. These costs seem to compare relatively well with typical GSHP costs.

While ASHP installations are not eligible for ROCs, it is likely they will be eligible for the forthcoming RHI.

Please refer to Appendix D for further information on installers that operate locally.

Micro hydro electric

Kinetic energy from moving water can be used to drive an electricity generator, just as it has been used in the past to drive water mills. Hydro electric plants can be very large – generating hundreds of megawatts – or very small. Micro hydro schemes generally have a capacity under 100kW. Average domestic systems are between 1kW and 5kW in size, while commercial systems are above 25kW in size.

Where a development is located next to a suitable water source, micro hydro systems could be used to supply electricity to individual households, although it will be more cost-effective to connect a system to several buildings.

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[88] Energy Saving Trust (2007) *Generating the Future: An analysis of interventions to achieve widespread microgeneration penetration*'

There are a number of environmental impacts associated with hydro systems. This includes the visual and noise impacts of the hydro turbine, which can be mitigated relatively easily. The main issue relates to the river's ecology. To reduce ecological impacts, systems should be designed to restrict the proportion of the total flow diverted through the hydro-turbine.

As the Environment Agency controls all water courses in England and Wales, permission in the form of a licence is usually required to remove water from a water course. Advice on reducing ecological impacts is also available.

Output from a hydro electric plant is proportional to the rate of flow of the water source being used and the height the water falls from - its 'head'. Seasonal variability in rainfall affects power output, but well designed systems can provide a consistent and very reliable electricity supply.

It is important to highlight that the predicted impacts of climate change in the South East may result reducing the viability of micro-hydro electric systems. This is due to a number of factors including increased water scarcity (more water being taken from the water table to sustain the growing population in the South East) and decreased rainfall in summer.

Opportunities and considerations

- Generate electricity close to the point of use;
- Excess output can be sold to the national grid;
- No emissions at point of use;
- A 1-5kW system can provide all the electricity demands of an average household;
- High efficiencies and can be more reliable than PV or wind technologies as output varies more gradually than with PV or wind installations (where output can drop to zero as soon as the sky clouds over or the wind drops);
- Relatively small maintenance costs; and
- Costs and savings are entirely dependent on the site.

Barriers

- A suitable water source is required. The Environment Agency controls all water courses in England and Wales and permission in the form of a licence is usually required to remove water from a water course (even if only temporarily);

• Separate planning permission will be required as micro-hydro systems are not considered permitted development (exceptions may apply in certain cases where an existing scheme is being refurbished); and

• Cost is site specific and can be high, especially if a lot of ground preparation is needed.

Costs

Costs are very site specific. A 100kW low head system (<5–20m) can cost between £115,000 and £280,000; while a 100kW high head system (20–100m) can cost between £85,000 and £200,000. Preliminary site assessments are necessary and can be expensive.

Hydro-electric installations are eligible for Renewables Obligation Certificates (ROCs) and feed-in tariffs, which will help reduce payback periods.

Please refer to Appendix D for further information on installers that operate locally.

Biomass – wood burning stoves and boilers

A general definition of biomass encompasses all living (or recently living) material. There are two types of biomass that can be used as a fuel:

• Wood biomass; and

• Non-wood biomass.

Wood biomass includes forestry residues from managed forests, tree surgery waste, waste materials from the timber industry and energy crops grown and harvested specifically for the purpose of being burnt to produce energy. Wood biomass is most often burnt to produce heat and electricity (in an engine).

Sources of non-wood biomass include municipal solid waste (MSW), food waste from the catering industry, agricultural waste and animal waste (from abattoirs for example). Non-wood biomass is usually used to produce biogas, for example through the process of anaerobic digestion. Biogas can then be burnt to generate heat and electricity (in an engine).

For the purposes of this section of the report, we will only consider wood biomass-burning technology.

Wood biomass systems differ from the other technologies described in this report in two main ways. Firstly, wood fuel can be stored and used as and when it is needed. Secondly, wood biomass systems do emit carbon dioxide at the point of use. However, wood biomass from sustainable sources (such as managed woodland) is still considered a renewable fuel. This is because the plants from which it is made would have absorbed a roughly equal amount of carbon dioxide when they were growing as will be emitted when the biomass is burnt. If plant material harvested for biomass is replaced by new trees and plants, these will absorb even more carbon dioxide from the atmosphere as they grow, and carbon neutrality could be achieved.

Carbon dioxide emitted as biomass is harvested and transported needs to be taken into consideration, however. This should be minimised where possible, making local biomass sources more sustainable.

Biomass can be burnt either in a wood stove to provide space heating for one or a few rooms, or in a biomass boiler, to provide space heating and hot water for a whole building.

- Wood stoves - wood stoves generally have an output between 5-7kWth, and are used to provide direct space heating. Back boilers can be fitted to some systems to provide hot water. Several new designs can be used in smokeless areas (see below).

- Biomass boilers – should be used where energy needs exceed 15kWth. Such systems can provide both space and hot water heating, and can be fully programmable. They are used to supply multiple dwellings in some applications and can even be scaled up to deliver district heating in suitable high density developments.

Clean Air Act

The Clean Air Act (1993) gives local authorities the power to designate certain areas smoke control areas[89]. This legislation made it an offence to emit smoke from any building's chimney, a furnace or fixed boiler in any designated areas. It is also an offence to use 'unauthorised fuel' in a smoke control area, unless the appliance in which it is to be burnt is deemed 'exempt'.

The Act also gives powers to the Secretary of State for Environment, Food and Rural Affairs to identify smokeless fuels and exempt appliances that can be used in smoke control areas in England. Exempt appliances have passed tests to confirm they can burn an unauthorised or inherently smoky solid fuel without emitting smoke. Local authorities are responsible for enforcing this legislation in smoke control areas.

If developers intend to locate projects in a smoke control area, any appliances, including biomass boilers and stoves, used must hold an exemption certificate. A list of the appliances that are exempt from smoke control area restrictions can be found on the UK Smoke Control Area website[90]. Many devices hold exemption certificates, so we do not foresee any problems for developments located in such areas.

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[89] UK Smoke Control Areas: www.uksmokecontrolareas.co.uk/locations.php.
[90] Exempt appliances: www.uksmokecontrolareas.co.uk/appliances.php?country=e.

Opportunities and considerations

- Can be considered carbon neutral;

- Can create employment opportunities in the fuel supply chain;

- Can bring wider environmental benefits such as increased biodiversity;

- Some systems can meet the entire heating and hot water requirements of a home, office and other large non-domestic buildings;

- Fuel can be stored and used when needed;

- Three main types of wood biomass fuel exist: wood pellets, woodchips or logs. Pellets have twice as much energy density compared to logs and four times the energy density of woodchips. They therefore require less storage space. However, the number of wood pellet suppliers in the UK is still relatively small and woodchips tend to be less expensive;

- Stoves and boilers can be fed automatically or require fuel to be inserted manually;

- Ash needs to be cleaned out of the system regularly;

- Large biomass boilers are suitable for large buildings and community heating systems, although an auxiliary backup boiler may be required in larger developments to cope with peak demand; and

- A suitable flue and sufficient air flow is required.

Barriers

- Woodchips, pellets or logs need to be stored in a dry space close to where they will be used. Woodchips have a lower energy content compared to pellets and logs and therefore require larger storage spaces;

- Regular fuel supply required, this should come from a local, sustainable source where possible; and

- Access will be required for fuel delivery.

Costs

Costs depend very much on the size and type of system installed, as well as the fuel chosen. Information given for the Low Carbon Buildings Programme puts the cost of a 20kW boiler that burns wood pellets at £5,000 to £14,000 (for installation, flue and commissioning). A less costly alternative would be a manual log feed system of the same size. A stand alone stove costs around £2,000-4,000 installed.

Certain biomass installations are eligible for ROCs. It is also likely installations will be also eligible for the forthcoming RHI.

Unlike with most of the other technologies described here, running costs must also be considered for biomass installations. These will increase as the quality of the wood biomass increases and as distance from the supplier increases, however it should be noted that costs can be lower or comparable to fossil fuel based energy sources, especially in areas off the gas network.

Please refer to Appendix D for further information on installers that operate locally.

Wind

Wind turbines convert the kinetic energy of a moving body of air (wind) into direct current (DC) electricity. They must be installed with an inverter to convert this DC electricity into useful alternating current (AC) electricity. If turbines are to operate off the national grid, they also require a battery for energy storage. If they are connected to the grid, excess power can be sold for use elsewhere.

The UK enjoys about 40% of Europe's total wind resource. However, we currently only meet around 0.5% of our energy needs using wind power. We are therefore not yet fully exploiting this opportunity to cut carbon dioxide emissions.

Generally one megawatt hour of wind-generated electricity reduces carbon dioxide emissions by between 1,200 and 1,600 tonnes a year. The output of a wind turbine depends on the square of the rotor diameter. So doubling the rotor diameter quadruples a turbine's output at any given wind speed. Wind speeds also increase with height. Turbines need to be installed in sites with good average wind speeds and which are not obstructed by nearby buildings, trees, or other obstacles. Hence turbines are generally thought to perform better in rural, rather than urban settings.

Wind power is an economically viable form of electricity generation at the large scale and has been shown to be so at the medium-scale in many cases. However, some early trials suggest that, at a smaller-scale, and particularly in urban environments, only small quantities of electricity can be produced, meaning payback may take a long time and some turbines might never pay for themselves. Due to the predominantly rural nature of the district smaller-scale turbines may be more economically viable – a Carbon Trust study suggests that the output of turbines in rural locations might be up to four times greater than in urban situations[91].

There are three types of wind turbine: roof-mounted and mast-mounted turbines (which can be small enough to supply individual households) and the larger units that are found in wind farms.

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[91] Carbon Trust (2008) *Small-scale wind energy; Policy insights and practical guidance*.

Roof-mounted turbines (micro/small-scale)

A range of designs of building-mounted turbines is available, including horizontal and vertical axis systems. These are often attached to a building's roof. Developers should ensure that whichever part of the building turbines are to be attached to is able to withstand their weight, as well as the potential vibrations that can result from their operation.

A number of trials are currently being carried out to investigate the actual financial and carbon savings that can be achieved through the use of roof-mounted turbines. As yet, there are insufficient data to make accurate estimations of their potential output. This depends on turbine size, location, wind speed and the presence of any obstructions nearby.

The cut in speed for small-scale turbines is 5m/s. In built up areas, the presence of other buildings, trees and similar objects disrupts the airflow, compromises wind speed, and can create unpredictable turbulence. Roof-mounted wind turbines are therefore generally better suited to more rural off-grid locations, where their output can be more regular. However, site-specific studies, including the collection of accurate wind speed data using anemometers, should always be conducted before any investment is made.

Mast-mounted turbines (medium-scale)

Similar concerns about the location and potential output of medium-scale, mast-mounted turbines apply as for roof-mounted systems. Instead of attaching an individual turbine to the roof of every building within a development, a smaller number of larger-scale mast-mounted turbines could be installed. Each of these would be capable of providing electricity to several buildings.

This approach would be more cost effective, since capital and installation costs would be shared between several buildings. This could reduce costs by between £1,000 and £5,000 per building (depending on the size of the turbines).

Mast mounted (large-scale)

Larger-scale wind turbines can be installed onshore or offshore. Onshore turbines usually have an installed capacity of up to about 2MW each. Offshore turbines are larger (around 3-5MW) and designed to cope with the harsh conditions at sea. Onshore wind is currently the most economical option as this is the most advanced technology, but it is anticipated that a mix of onshore and offshore turbines will be needed in future. The cut in speed for large-scale turbines is 6m/s.

According to the British Wind Energy Association (BWEA), a 20-turbine wind farm needs about 1km^2 of land, but only around 1% of this space is needed for foundations, access roads and electrical infrastructure to be installed. The remaining area can be used as agricultural land or for natural habitat. When turbines are decommissioned, the total area of land can be returned (as near as is practical) to its original state. The BWEA recommends that local authorities consider decommissioning when they grant planning permission for wind farm developments.

Medium- and larger-scale wind turbines can be directly connected to particular new developments via a private wire network, and the electricity they produce supplied only to buildings within those developments. To take one example, a well-located 600kW turbine could be expected to generate enough power to supply 300 households' electricity demands. As wind turbines generally perform better further away from buildings, this can increase private wire network costs. Such networks may therefore become prohibitively expensive at some sites around the district.

Larger wind farms do not, however, have to be directly connected to developments. Electricity generated can be supplied directly to the National Grid, where it can be used to 'offset' some of the emissions that new developments generate via their use of National Grid electricity. For example, the five 1.3MW capacity wind turbines that make up the Westmill community wind farm in South Oxfordshire supplies enough electricity to power around 2,500 homes every year. They are not, however, connected to any specific development.

It is important to note that the Code for Sustainable Homes does not allow 'offsite' options such as those described above. As described in section 2 it is widely expected that this criteria will be removed following the definition of zero carbon consultation. If 'offsite' or 'allowable solutions' are permitted, care must be taken to ensure this green electricity is only counted once – i.e. the electricity generated replaces the power from a particular development only, and is not sold to customers elsewhere.

Opportunities and considerations

- UK has the largest wind resource in Europe;
- Can generate electricity close to the point of use;
- Excess output can be sold to the National Grid;
- An operate in combination with other low carbon or renewable energy technologies;
- No emissions at the point of use; and
- Wind speeds increase with height and higher outputs can be expected in unobstructed locations free from too much turbulence. Rural sites might be more suitable. A site-specific assessment of wind speeds at a site over a period of time is, however, the only way to predict output accurately;
- Output will fall as soon as the wind drops.

Barriers

- Less suitable in urban areas;
- Not currently permitted development because of visual impact and noise concerns, so planning permission will be required;
- Planning issues in conservation areas and at sites in close proximity to air fields; and
- Regular maintenance is required due to moving parts.

Cost

Small systems up to 1kW to cost around £1,700, although in the past, some domestic systems have been on offer for as little as £1,500. Information given for the Low Carbon Building Programme puts the cost of larger 2.5-6kW systems at £11,000-£19,000.

As a wind turbine's output depends heavily on its setting and local wind speeds, so does the payback period for this technology – in terms of financial savings and carbon emissions. Several organisations, including the Energy Saving Trust, are currently conducting field trials and expects the results from this work to provide data on general cost and carbon dioxide savings in the near future.

Please refer to Appendix D for further information on installers that operate locally.

CHP

Combined Heat and Power (CHP) is can be used to provide energy to anything from a single home to a large industrial plant, or even a whole city. Unlike conventional power plants, CHP units are sited close to where their energy output is to be used. (CHP or district heating networks covering whole developments are covered in section 4.4. below).

The main design criterion is that, to make the investment worthwhile, there must be a need for both the heat and electricity produced by the CHP unit.

In the home, a microCHP unit resembling a gas-fired boiler will provide both heat for space and water heating, as does a boiler, but also electricity to power domestic lights and appliances. Micro-CHP is best suited to larger homes (>3 bedrooms) or old houses with solid walls, were it can potentially deliver carbon savings of 5-10 per cent, with typical reductions between 200kg and 800kg of CO_2 each year. However, the currently available systems appear to offer limited benefits for smaller and newer houses.

For commercial buildings and small industrial spaces, a factory-assembled, 'packaged' CHP system is appropriate. Here, an electricity generator, heat exchanger, controls and either an engine or a turbine is packaged together into a CHP unit that can be connected to the heating and electricity systems of the building.

Some building types, particularly those that need a lot of energy, or operate around the clock, are particularly suitable for CHP - leisure centres, hotels, hospitals and many others. CHP systems can, with the addition of a chiller, supply cooling for air conditioning systems as well as heating - such an arrangement is often called a 'trigeneration' system.

Homes and buildings fitted with CHP are usually also connected to the mains electricity grid, and may also retain back-up boilers, so that they are never short of an energy supply, during maintenance of the CHP plant, for example, or during periods of unusually-high energy loads.

Industrial CHP plants tend to be designed and built individually to fit the industrial process they serve. These CHP plants are based on gas turbines, steam turbines or engines, together with electricity generators and control systems. The very largest CHP plants rival traditional power-only plants in size and deliver huge quantities of energy - but at a much higher efficiency

Some industrial processes are particularly well-suited to CHP, those that use lots of heat and operate around the clock - the manufacture of paper, chemicals, food and drink products, as well as refineries, are among those that can benefit most from CHP.

Opportunities and considerations

- Can generate electricity close to the point of use;

- Excess output can be sold to the National Grid;

- An operate in combination with other low carbon or renewable energy technologies; and

- No emissions at the point of use.

Barriers

- System must be sized for heat and electrical demands;

- Back up system required; and

- Regular maintenance required.

Cost

A typical small domestic system for a three bedroom house costs approximately £3,000[92]. Carbon savings of 5-10% (200-800kg of CO_2) per annum are possible, resulting in a cost of £660 per tonne of carbon saved.

In small commercial applications with high and consistent heating or hot water demands all year round (residential care homes, leisure centres etc), micro-CHP can provide heat outputs in the range of 50-500MWh per year, depending on site requirements and system sizing. Associated costs expected to be £1,000 - £10,000[93]. Trials have shown that carbon savings in the range of 2-20 CO_2 per annum are possible (15-20% compared to a modern condensing boiler).

[92] Source: Energy Saving Trust.
[93] Carbon Trust (2007) *Micro-CHP Accelerator, Interim report*.

Appendix C: Energy from Waste technologies

Energy from waste (EfW) provides a double environmental benefit - firstly, the diversion of waste from landfill and, secondly, the recovery of energy, displacing fossil fuel alternatives and reducing CO_2 emissions. As well as offering a cleaner waste management option for local authorities, energy from waste technologies provide a sustainable energy supply.

Although the responsibility for waste management and related facilities is placed on Oxfordshire County Council, there could be some opportunities for West Oxfordshire District Council to make provisions for local use of waste resources when planning their LDF.

The EC Waste Framework Directive defines waste as: *"any substance or object...which the holder discards or intends or is required to discard."*

There are a number of ways to obtain energy from a variety of waste sources, including municipal and agriculture waste streams.

Landfill gas production and incineration are described in relatively simple detail below as they are quite large developments and would depend on the local district councils working together with Oxfordshire County Council to develop larger-scale waste strategies. More detail is given on anaerobic digestion as this can be scaled down more easily and used to process waste from smaller developments or commercial units such as abattoirs.

Landfill gas

In a landfill, biodegradable waste will decompose, producing a methane-rich gas known as landfill gas, which is a very potent greenhouse gas. This can be captured and burnt to generate heat and power, however this is not the most efficient or sustainable use of the biodegradable fraction of waste. In addition, EC legislation[94] is directed at reducing the amount of biodegradable municipal waste sent to landfill – this will also reduce the amount of landfill gas that can be produced in future.

Incinerators

Incinerators can also be used to obtain useful energy from waste and are used to burn large volumes of waste (from which recyclables can be removed). This produces bottom

[94] The EU Landfill Directive (Council Directive 99/31/EC of 26 April 1999 on the landfill of waste) entered into force on 16 July 1999. Member states had to implement the legislation no later than 16 July 2001. The Directive is intended to prevent (or reduce as far as possible) the negative environmental impacts of landfills, by introducing stringent technical requirements for waste and landfills.

ash, particulates and flue gases as well as heat. The heat from this process can be supplied to nearby buildings – for example hospitals – or industrial processes, or used to generate electricity via a steam turbine system. For this reason, incinerators are sometimes called 'energy recovery' plants. Flue gases can be cleaned to reduce pollution, but will still result in the emission of CO_2 to the atmosphere. The ash that remains after incineration can be quite toxic, but takes up only 5-10% of the space required to store the original waste.

The SELCHP (South East London Combined Heat and Power) energy recovery plant processes 420,000 tonnes of waste collected from residents in Lewisham, Westminster, Greenwich and Bromley every year to produce enough electricity to supply 48,000 homes. It was originally intended also to distribute heat, via a heating network to nearby buildings, however this has never been implemented, and so the heat produced is not currently used.

Three similar electricity-generating facilities exist around Hampshire, where landfill space is expected to run out in the next few years. The three facilities combined use more than 420,000 tonnes of waste a year to generate enough electricity to power 37,000 homes.

Around 80% of Coventry and Solihull's waste is also incinerated, in a plant that has burned rubbish since 1975 and generated electricity since 1992. The incinerators in this area have a combined capacity of 11MW.

Incinerators can meet with strong opposition in the communities in which they are planned for construction however.

Anaerobic digestion

Anaerobic digestion (AD) is a natural process by which biodegradable, organic matter is broken down in the absence of oxygen.

Waste needs to be sorted before it enters a digester, to remove as much non-biodegradable matter as possible and to ensure recyclable materials can be salvaged. Remaining waste is often then shredded to increase its surface area.

The first stage of the AD process is chemical, as complex organic molecules are broken down into simpler structures, such as sugars.

Acidogenic (acid-producing) bacteria then break these down even more in the first of three biological steps, to produce volatile fatty acids (even simpler molecules), as well as ammonia, carbon dioxide and hydrogen sulphide. Volatile fatty acids are then digested by bacteria to produce carbon dioxide, hydrogen and acetic acid, through a process called acetogenesis.

Methanogenesis is the final stage of the process, wherein methanogens (another kind of bacteria) produce methane, carbon dioxide and water from the remainder of the biodegradable material in the digester. It is important to maintain pH levels around 5.5-8.5 and a constant temperature of between 30 and 60ºC to provide the optimal conditions for these processes.

The methane- and carbon dioxide-rich biogas produced at the end of this process can be captured and burned to generate heat and power, used as a transport fuel or even piped into the wider natural gas supply (after some further processing). Biogas is typically 60% methane and 40% carbon dioxide. By-products at the end of the AD process include water and non-biodegradable digestate material (both solid and liquid), which can be used in agriculture.

AD is deemed a renewable technology since communities will always produce the organic waste materials that can be used to feed the anaerobic digestion process. Food waste and animal manure are two important sources of this organic waste.

Small anaerobic digesters on farms currently represent the biggest use of this technology in the UK. It can, however, be used much more widely. A report prepared for Friends of the Earth[95] estimates that AD could be used to generate 1.45TWh of power in the UK – about 0.36 per cent of total electricity generation – using source-separated domestic waste.

A National Grid report from early 2009[96] estimated that the UK produces 1.4billion cubic meters of renewable gas at present. This could be used to meet around 1% of the country’s total gas demand. Most of this is used to generate electricity, but it could also be injected into the national gas grid and used in heating applications.

As well as generating electricity and making good use of an otherwise wasted resource, AD can also be used to help tackle some of the main drivers of climate change. Anaerobic digestion can help reduce:

- Fossil fuel use;

- The production of methane-rich landfill gas;

- The need for chemical fertilisers to be manufactured, as digestate liquor – a by-product of the process – is a very effective fertiliser; and

- The distance waste must be transported for treatment, as smaller AD units can be installed nearer to developments, where they can process waste directly.

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[95] Hogg, D. (2006) *A Changing Climate for Energy from Waste? Final Report from Friends of the Earth.* Eunomia. Available at: www.foe.co.uk/resource/reports/changing_climate.pdf.
[96] The potential for renewable gas in the UK (January 2009) www.nationalgrid.com/NR/rdonlyres/E65C1B78-000B-4DD4-A9C8-205180633303/31665/renewablegasfinal.pdf.

The UK Government is keen to encourage the use of anaerobic digesters, having recently announced the winners of a £10million demonstration programme[97], which will see five projects developed throughout the country. The Government wants to use AD to help limit the UK's greenhouse gas emissions and reduce the amount of biodegradable waste sent to landfill. While still in its infancy, the market for biogas is growing, as is demand for digestate liquor and solid digestate (which can be used to improve soil condition). Even where no use can be found for solid by-products of the AD process, the volume that will require landfilling will be much reduced, compared to the original waste that was processed.

Opportunities and considerations

- Anaerobic digestion produces fewer greenhouse gas emissions than most other forms of waste disposal.

- AD can make efficient use of waste streams that must be treated.

- AD units can be sized to suit their situation and application.

- Wetter waste is easier to process, due in part to the fact it can be more easily pumped. However, it takes up more space than drier waste.

- Biodegradable waste must be separated from normal waste – the process is most efficient if this is collected separately from other waste streams.

- Woody materials cannot normally be digested, as they have a high lignin content. Most anaerobes – the micro-organisms that break down the organic matter – cannot decompose lignin, which has long hydrocarbon chains. Substances with shorter hydrocarbon chains, such as sugars, are easier and quicker to decompose.

- Animal waste and human sewage produce less biogas by volume as most of the energy from this organic matter has already been used efficiently by the animal which produced the waste.

- Pre-processing is needed where mixed waste streams contain a lot of other materials, such as plastic and metal. Mechanical biological treatment (MBT) of waste includes two processes – the first removes non-biodegradable, recyclable matter mechanically, the second digests biodegradable waste biologically.

- The cheapest and simplest system to use is an anaerobic digester that processes whole batches of waste at a time (as opposed to a continuous system, through which waste keeps moving). Batch systems can create unpleasant odours locally, however.

[97] www.defra.gov.uk/environment/waste/ad/demo.htm.

- Both high and low temperature systems can be used. The former are more stable and, although the latter can produce biogas more quickly, they require more energy to operate.

- Biogas may require further treatment before it can be used as a fuel.

- Waste water and digestate materials will also need further processing and testing for toxic content before they can be released back into the wider environment.

- Discussions will be needed with the County Council, which has responsibility for waste management.

- Electricity generated through the use of landfill gas, biogas from anaerobic digestion and incineration can be considered clean and receives Climate Change Levy Exempt Certificates (LECs) for the power generated.[98] Electricity generated through the use of landfill or sewage gas, or biogas from anaerobic digestion, is considered renewable and receives Renewables Obligation Certificates[99].

Feasibility in area

As the County Council has responsibility for waste management, West Oxfordshire District Council would need to develop a strategic vision to promote development of sustainable energy from waste technologies in this area. Waste could be collected from new and existing developments, both domestic and non-domestic, including the food industry and abattoirs.

For use in an anaerobic digester, it is most efficient if biodegradable waste is separated out from other rubbish before it is collected. Non-household waste streams, such as food waste from retailers, can be particularly rich in biodegradable material and are a good source of 'fuel' for anaerobic digestion. Sewage waste could also be collected and used to produce biogas – a plant is planned to begin operation in Manchester[100] in 2011, which will inject the biogas produced into the national gas grid.

Biogas does require cleaning/upgrading so it meets UK gas pipeline specifications (which require almost pure methane to be used) before it can be injected into the national gas grid. Where it can be used in this way, however, the necessary

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[98] The Climate Change Levy (CCL), introduced in the UK in April 2001, is a charge on non-domestic electricity supply. Consumers in industry, commerce, agriculture, public administration and other services must pay the levy on top of the cost of the electricity they use. Levy Exemption Certificates (LECs) are awarded to generators of renewable electricity, which is exempted from the charge. LECs are used to exempt non-domestic consumers who agree a contract with a renewable electricity supplier from paying all or a portion of the CCL, depending on how much renewable power they buy. Exempt sources of power include landfill gas generation, anaerobic digestion and waste incineration, as well as biomass, wave power, wind turbines and some CHP schemes.

[99] Licensed electricity suppliers in the UK must source a certain percentage of the electricity they supply from renewable energy technologies. They can prove that they have done this by submitting Renewables Obligation Certificates (ROCs – which they receive as they buy eligible electricity from accredited generators) or by paying into a buy-out fund. Money raised from the buy-out fund is redistributed to suppliers in proportion to the number of ROCs they presented.

[100] www.renew-reuse-recycle.com/showarticle.pl?id=2050.

infrastructure for transporting and burning the gas already exists, reducing the overall costs of using a renewable heat resource. There are no important technical or safety barriers to the use of this technology. Cleaned biogas (biomethane) is already used in the United States and several European countries to provide renewable heat.

Where biogas is burned in an onsite generator, electricity can be exported to the National Grid and heat supplied directly to nearby buildings via a distribution network. New build projects provide the ideal opportunity to install district heating networks as the necessary pipes can be installed at the same time as other services, such as drainage. This reduces overall costs.

Appendix D: Renewable energy and low carbon technology installers and suppliers

Installers

The Low Carbon Buildings Programme website provides information on renewable and low-carbon technology suppliers and installers here: www.lowcarbonbuildings.org.uk/info/installers/. Installers are categorised according to the area(s) that they operate in and by technology.

In addition, details of installers are available from the Green Book Live website: www.greenbooklive.com/search/search.jsp?partid=10013. Installers are categorised according to the area(s) that they operate in and by technology.

Please note there are a large number of installers who operate in the South East, but who are based elsewhere in the UK.

Due to the number of installers quoted as working in the South East and the changing nature of this sector, this information has not been included within this study. The most up to date information on installers can be found online. (Choose a particular technology (solar thermal, micro wind, etc.) from the drop down menu and specify a particular region, i.e. South East).

Biomass suppliers

Information on biomass suppliers can be found on the Log Pile website: www.bigbarn.co.uk/logpile/indexen.php.

Appendix E: Resources for planning officers

There are a number of resources available from a wide range of organisations to assist both Council staff and developers to keep up-to-date with changes to national policy and sustainability standards.

Planning Renewables

Provides support and guidance to local authority officers and elected members when dealing with planning applications for renewable energy developments.

Further information on the services offered can be found online here: www.planningrenewables.org.uk.

The Energy Saving Trust

Practical help

The Energy Saving Trust's Practical help advisory service offers a free enquiries service that is specifically for local authorities and housing associations. The team will undertake to answer any query regarding sustainable energy or sustainable road transport within a maximum of three working days. The service publishes detailed briefings on legislative drivers for both new and existing housing and offers free presentations on a wide variety of sustainable energy topics.

T: 0844 84 888 30

E: practicalhelp@est.org.uk

Housing programme

The Energy Saving Trust's housing programme has published a large range of documents on energy efficiency and renewable energy technologies. Details of these publications are available from the website: www.energysavingtrust.org.uk/business/Business/Building-Professionals.

For example, the housing programme has developed technical guidance on designing and building new homes that meet the energy requirements of the Code for Sustainable Homes. These guides address energy efficiency measures to meet, and in some instances, exceed minimum measures set down in code levels 3, 4, 5 and 6 of the Code for Sustainable Homes.

In addition, Energy Saving Trust's 'Best Practice house' provides information on refurbishing houses and building new homes to the Energy Saving Trust's 'Best Practice' and 'Advanced Practice' standards. This tool can be found online: www.energysavingtrust.org.uk/business/Business/Building-Professionals/Helpful-Tools/Best-practice-house.

There are a number of publications on whole renewable energy technologies. These documents can be downloaded from the Energy Saving Trust publication database: www.energysavingtrust.org.uk/business/Business/Resources/Publications-and-Case-Studies.

Technical assistance for industry professionals is also provided through a helpline, email service and attendance at exhibitions. Call 0845 120 7799 for further information.

New-build outreach programme

There are four main streams of support. Developers and house-builders can access two out of the four streams:

- **Strategic and technical support**: assistance with strategic decision making and design.
- **Monitoring and evaluation**: support in assessing energy performance of homes in design, building and post occupancy stages.
- **Marketing assistance**: to promote high performance homes to relevant stakeholders.
- **Honest broker service**: to support relationships with local authorities (planning) and the supply chain.

Call 0845 120 7799 for more information or email housing@est.org.uk.

Energy services support

The Energy saving Trust offers expert advice and support for those wishing to set up energy services schemes including affinity deals, community-based energy services and residential combined heat and power (CHP). Free consultancy is available, as well as a helpline and on-line resources. Further information is available from the Energy Saving Trust website: www.energysavingtrust.org.uk/housingbuildings/servicepackages/.

The Association of Environment Conscious Builders

The Association of Environment Conscious Builders' (AECB) CarbonLite Programme can provide the tools and knowledge to create low-energy buildings in line with existing and future legislation covering both domestic and non-domestic buildings.

Available to all AECB members, the CarbonLite Programme is a practical step-by-step guide aimed all those practitioners involved in the design, construction and use of low-energy, low-CO_2 emissions buildings. The programme is designed to be clear, informative and impartial, and outlines the reasons behind the need for more sustainable building practices, as well as providing wide-ranging yet detailed guidance on the ways in which this change is best achieved. Further information is available online: www.carbonlite.org.uk/carbonlite/.

National House-Building Council (NHBC)

The National House-Building Council's (NHBC) independent research institution - the NHBC Foundation - was established in January 2006 in partnership with the BRE Trust. Focusing on the new homes industry it facilitates research and development, technology and knowledge sharing, and the capture of industry best practice.

The NHBC Foundation has developed a programme of research projects designed to address key issues within the industry where there is a current 'information gap'.

The launch project for the Foundation was the creation of a web-based resource tool on Modern Methods of Construction (MMC) which is available online: www.homein.org.

A list of other published projects can be found online: www.nhbcfoundation.org/Projects/tabid/54/Default.aspx.

This includes:

- A Guide to Modern Methods of Construction.
- Conserving Energy and Water, and Minimising Waste.
- Climate Change and Innovation in House Building.
- Ground Source Heat Pump Systems.
- Modern Housing.
- A Review of Microgeneration and Renewable Energy Technologies.
- Site Waste Management.
- The Merton Rule.
- Community heating and combined heat and power.
- Zero carbon homes - an introductory guide for house builders.

Greater London Authority (GLA)

While focussed on urban development, the Greater London Authority's (GLA) toolkit for planners, developers and consultants, 'Integrating renewable energy into new developments', helps to provide planners and developers with:

- An overview of the renewable energy technologies and their costs; and

- An understanding of planning requirements and methods for meeting them.

This resource can be downloaded here: www.london.gov.uk/mayor/environment/energy/renew_resources.jsp.

Building Research Establishment (BRE)

The Building Research Establishment has developed a series of training courses on the Code for Sustainable Homes and BREEAM. Further details can be found online here: www.breeam.org/events.jsp.

Sustainable Homes

Sustainable Homes offer a number of training courses, including those on the Code for Sustainable Homes. Further details can be found online here: www.sustainablehomes.co.uk/training.aspx.

Renewable energy trade associations

Technology	Organisation	Website
Photovoltaics and solar thermal	The Solar Trade Association (STA)	www.solar-trade.org.uk
Wind	The British Wind Energy Association (BWEA)	www.bwea.com
Hydro	British Hydropower Association	www.british-hydro.org
Biomass	Biomass energy centre	www.biomassenergycentre.org.uk
Ground and Air Source Heat Pumps	Heat Pump Association	www.heatpumps.org.uk/
	UK Heat Pump Network	www.heatpumpnet.org.uk/