Hertfordshire County Council

Hertfordshire Environmental Forum

Hertfordshire Technical Chief Officers Association

Hertfordshire Renewable Energy Study

Renewable Energy Options for Hertfordshire

July 2005

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Report for

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Certificate No. EMS 69090

Certificate No. FS 13881

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Executive Summary

The Government Energy White Paper of February 2003 recognised renewable energy as a major contributor to tackling climate change. In 2004, a review for the East of England Sustainable Development Round Table proposed a target of 14% of the region's electricity to be generated from renewable sources by 2010. In order to achieve this target, each county within the East of England region was assigned a contribution target. The proposed target for Hertfordshire was that 153 GWh of electricity should be produced from renewable resources by 2010, with estimated contributions as follows:

Onshore Wind:	96,000 MWh per year
Biomass:	57,000 MWh per year
Total:	**153,000 MWh per year**

153 GWh represents only 3% of Hertfordshire's predicted electricity consumption

Entec UK Ltd was engaged by the clients, Hertfordshire County Council, Hertfordshire Environmental Forum (HEF) and the Hertfordshire Technical Chief Officers Association (HTCOA), to undertake research to identify the realistic potential for renewable energy development in the county and to explore constraints to this development.

This report sets out the barriers to and potential opportunities for renewable energy generation in Hertfordshire. It addresses the study objectives by illustrating what renewable energy could look like in Hertfordshire, if deployed and to identify what barriers need to be overcome to enable it to happen.

This final report is an updated version of the interim report that was issued for consultation in January 2005. It has been revised to address the specific issues raised by the consultees. This report is accompanied by a report setting out the role that the local planning system might play in the development of renewable energy in the county and a briefing pack which provides more practical information for council officers concerning the types of renewable energy technologies available.

This report concludes that there is the technical potential within Hertfordshire to achieve the levels of renewable energy production proposed in the East of England Sustainable Development Round Table Study. Achievement of the technical levels will, however, be highly dependent upon a range of external factors, such as developer uptake, aviation objections (commercial wind projects), and consumer uptake.

One of the most important factors influencing the uptake is commercial competitiveness (financial viability) and this is strongly influenced by much wider-ranging global political factors, national policy and regulations, grant schemes and the fundamental economic viability of the technologies. Many of these will be beyond the direct influence of stakeholders within Hertfordshire.

However, for the more competitive renewable technologies, such as onshore wind, and to realise the potential of build of new dwellings, planning policy will remain the critical issue for attracting commercial developers. Strong regional and local level planning policies and increased public awareness can play a major part in attracting developers and influencing the deployment of renewable technologies in Hertfordshire. The issue of planning policy is considered in more detail in the sister report produced under this study, "Hertfordshire Renewable Energy Study - Planning Considerations".

The results of the assessment of renewable energy generation potential are summarised below.

Large Scale

Technology	Potential capacity (MW electrical)	Potential electrical output (GWh/year)	Potential total energy output (GWh/year)	CO_2 reduction (tonnes CO_2/year)
WIND	Existing: 0.225	Existing: 0.25	Existing: 0.25	110
Large Wind Turbines	Possible: 10	Possible: 25	Possible: 25	10,800
	Extended: 65	Extended: 163	Extended: 163	70,100
BIOMASS				
Co-firing in large power plant	31	175	175	168,000
Dedicated CHP facility	17	125	285	94,000
Bio-diesel				39,000
Bio-Ethanol				107,000
Animal Slurries and Anaerobic Digestion	2	14	14	6,000
Sewage sludge (90% dry solids) EFW	4	30	30	13,000
MSW EFW	14	104	104	45,000
Small scale biomass-heat facilities	N/A	N/A	35	9,000
WATER : Hydro	Low : 0.1	Low : 0.6	Low : 0.6	260
	High : 2.0	High : 12.3	High : 12.3	5,300

It should be noted that the estimated avoided CO_2 emissions for bio-fuels (Option 3) are higher than would be achieved in practice as they exclude any CO_2 emissions associated with the production of the fuel.

Embedded Renewable Generation - New Dwellings

The following table summarises the potential benefits that might be realised annually by 2021 on completion of the current new dwelling build programme. The table shows the benefits arising if various levels (5%, 10%, 20%) of household energy consumption are required to be provided by renewable sources or improved insulation.

	Fossil Energy Displaced (GWh)			CO_2 Reductions (tonne)		
	Low (5%)	High (10%)	Extended (20%)	Low (5%)	High (10%)	Extended (20%)
	33.4	66.6	132.9	6,149	12,469	24,650

Embedded Renewable Generation - Existing Dwellings

Scenario	Maximum Annual Deployment Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Solar PV				
Existing householders – promotion of current grant schemes	4,900	1 in 20,000	6	3
Existing householders – extended promotion and additional financial support	9,900	2 in 20,000	25	11
Solar Thermal Heating				
Existing householders – promotion of current grant schemes	68,600	1 in 10,000	86	16
Existing householders – extended promotion and additional financial support	137,300	4 in 10,000	340	65
Rooftop Wind Turbine				
Existing householders – promotion of current grant schemes	3,350	1 in 10,000	4	2
Existing householders – extended promotion and additional financial support	6,700	4 in 10,000	17	7

Embedded Renewable Generation – Commercial & Institutional

Scenario	Maximum Potential (MWh)	Target annual penetration	Target annual energy generation (MWh)	CO_2 reduction (tonnes CO_2/year)
Promotion of the current grant scheme to businesses	1,020	0.1% of available roof space	13	6
Additional grant aid to businesses	2,040	1% of available roof space	120	52

Contents

1. Introduction

1.1 This study

The Government Energy White Paper of February 2003 recognised renewable energy as a major contributor to tackling climate change. In 2004, a review for the East of England Sustainable Development Round Table proposed a target of 14% of the region's electricity to be generated from renewable sources by 2010. In order to achieve this target, each county within the East of England region was assigned a contribution target. The proposed target for Hertfordshire was that 153 GWh of electricity should be produced from renewable resources by 2010, with estimated contributions as follows:

Onshore Wind:	96,000 MWh per year
Biomass:	57,000 MWh per year
Total:	**153,000 MWh per year**

153 GWh represents only 3% of Hertfordshire's predicted electricity consumption by 2010. Other county's were assigned much higher targets (up to 17% - Norfolk) as a result of their more favourable resources, location and demographics.

Entec UK Ltd was engaged by the clients, Hertfordshire County Council, Hertfordshire Environmental Forum (HEF) and the Hertfordshire Technical Chief Officers Association (HTCOA), to undertake research to identify the realistic potential for renewable energy development in the county, to explore constraints to renewables development and to understand the options for renewable energy to 2010, 2020 and beyond.

1.2 Objectives

The objectives of the study are to:

- develop a clear understanding of the constraints and barriers to renewable energy project development;
- develop realistic renewable energy targets with broad agreement from the key stakeholders;
- identify locational and technological criteria for assessing proposed projects;
- develop scenarios to aid the understanding of policy options and potential implications for the county;
- develop model policies to inform local development frameworks and development control decisions;
- improve understanding between planners, developers, potential developers and other key stakeholders;

- present clear advice on how to maximise the potential direct and indirect benefits of renewable energy developments; and
- maximise the training potential of this exercise for members and officers in the county.

1.3 Purpose and scope of the report

This report sets out the barriers to and potential opportunities for renewable energy generation in Hertfordshire. It addresses the objectives by illustrating what renewable energy could look like in Hertfordshire, if deployed and to identify what barriers need to be overcome to enable it to happen.

Principally, the report estimates the potential for renewable energy generation in Hertfordshire, that is; how much energy could Hertfordshire theoretically generate from renewable sources? The report also identifies the various constraints influencing the deployment of renewable energy generation in order to inform the County’s deliberation on appropriate targets. In doing so the implications for energy production/ consumption and carbon dioxide emissions are also considered.

The interim report was issued for consultation in January 2005. This final report is an updated version of the interim report, revised to address the specific issues raised by the consultees. Appendix 1 contains a list of consultees and their key responses.

This report is accompanied by a report setting out the role that the local planning system might play in the development of renewable energy in the county and a briefing pack which provides more practical information for council officers concerning the types of renewable energy technologies available.

1.4 The Energy Hierarchy

The Environment Department of Hertfordshire County Council has the stated aim of making “*Hertfordshire the most sustainable county in the country*”. To this end, renewable energy should be seen as one part of a much wider ‘energy hierarchy’. In order of priority a sustainable energy strategy should aim to:

- Reduce energy demand
- Improve energy efficiency
- **Generate energy from renewable resources**
- Use fossil fuels efficiently

Reducing energy demand and improving energy efficiency are fundamental in reducing reliance on conventional fossil fuels and reducing emissions of green house gases, principally carbon dioxide. The Home Energy Conservation Act (1995) requires district and unitary councils to draw up a plan for reducing energy consumption and carbon dioxide emissions in dwellings. It set a target of a 30% reduction in CO_2 emissions from dwellings over the following ten years. The strategy to achieve this target in Hertfordshire is to reduce energy use by improving the energy efficiency of dwellings, this will be achieved through advice, education and raising the public's awareness of what can be done to reduce consumption.

Whilst energy demand reduction and energy efficiency improvements are significant contributors to reducing reliance on fossil fuels there will still be a demand for energy for electricity, heat and transport. The purpose of this study is to consider the options for renewable energy generation in Hertfordshire. Whilst energy efficiency and energy utilisation are not considered in this study, their importance in contributing to a sustainable energy strategy is certainly acknowledged.

1.5 Structure of the report

This document has been structured as follows:

Section	Contents
1	Introduction
2	Setting the Context
	This section of the report provides background on the wider energy issues facing the world and relates these to the policies, legislation, actions and initiatives occurring in the UK at national, regional and county level. The purpose of this section is to set Hertfordshire's situation in the context of the wider energy issues facing the country and the world.
3	The Technologies and Techniques
	There is a wide range of technologies and techniques available for producing renewable energy for electricity, heat and transportation fuels. This section of the report provides a brief overview of renewable energy technologies and techniques, identifying their principal features and suitability for application in Hertfordshire.
4	Constraints and Barriers to Renewable Energy Deployment
	This section of the report provides a general review of the principal barriers that prevent deployment of renewable energy technologies. We have also identified the typical proposals that are adopted by regional and local government for overcoming these barriers.
5	Assessment of Hertfordshire's Renewable Energy Options
	This section of the report builds on the general review of deployment issues presented in Section 4 and considers the specific opportunities for development of renewable energy within Hertfordshire.
6	Conclusions and Recommendations
7	References
Appendix 1	Summary of Consultee Responses
Appendix 2	Windfarm Constraints Map

1.6 Terminology

Throughout this report, we refer to levels of energy production capacity and consumption in various terms such as kilowatts, kilowatt-hours, megawatts, megawatt-hours etc. The following section explains the various terms used and provides an indication of a household's typical energy requirements.

Energy is a basic property of, for example, electricity, coal or petrol that defines its "capacity to do work", such as heat up a saucepan of water or rotate the wheels on a car. Energy is analagous to, for example, mass. Power, however, is a measure of the rate at which amounts of energy are expended and it is usually defined in terms of Watts.

By way of illustration, a lightbulb needs a supply of energy (electricity in this case) in order that the filament can heat up and glow, giving off light. A "100 Watt" light-bulb needs 100 units of energy to be supplied to it every second. If such a light bulb were on for four hours it would consume a total of 400 watt-hours (Wh) of energy. Watts, therefore, measure instantaneous power while watt-hours measure the total amount of energy consumed.

Power generators (such as wind turbines, coal and gas fired power stations etc) are defined in terms of their power; the rate at which they can produce energy. A wind turbine capable of producing at the rate of two million units of energy per second would be termed a 2 million Watt power plant. Such large numbers tend to be abbreviated by using prefixes such as:

Kilo-watt (kW)	1,000 Watts
Mega-watt (MW)	1,000,000 Watts
Giga-watt (GW)	1,000,000,000 Watts

The wind turbine would therefore be termed a 2 MW turbine. These prefixes are similarly also used to define large amounts of energy consumption in kWh, MWh and GWh.

The following data is provided by the DTI and provides an indication of the energy consumption of an average household:

- **Electricity**: an average household (two adults, two children) consumes about 4.7 megawatt-hours (MWh) of electricity every year.
- **Heat**: an average household requires about a further 17.5 MWh of energy for hot water and space heating.
- **Total Household Energy Requirement**: approximately 22 MWh per year.

2. Setting the Context

This section of the report provides background on the wider energy issues facing the world and relates these to the policies, legislation, actions and initiatives occurring in the UK at national, regional and county level. The purpose of this section is to set Hertfordshire's situation within the context of the wider energy issues facing the country and the world.

2.1 Climate change

The release of so-called greenhouse gases into the atmosphere is now widely acknowledged to be a significant contributor to climate change. The most significant source of man-made greenhouse gases is the carbon dioxide released during the combustion of fossil fuels when they are used for generating electricity, producing heat or when used as a fuel for transportation.

The mitigation options available include reducing energy demand (by adopting energy efficiency measures), possible use of carbon sequestration technologies, and using alternative low carbon or renewable energy supplies.

2.2 Kyoto and Europe

In December 1997, representatives of Governments from around the world met to negotiate in Kyoto, Japan, attempting to reach agreement on actions to deal with the most serious environmental problem facing the world: climate change.

The European Union (EU), which had a key-negotiating role at the conference, agreed to push for the basket of greenhouse gases to be extended, and for a 15% reduction of carbon dioxide and other greenhouse gas emissions by the year to 2010. Within this, different targets have been set for EU member states, which range from a 25% reduction for Germany, to a 10% reduction for the UK. The UK has argued that the EU should go further and is committed to reducing carbon dioxide emissions by 20%.

The UN Framework Convention on Climate Change, which resulted from the Kyoto Protocol in 1997, established global targets for the reduction of greenhouse gas emissions.

The current global target is to achieve a 5% cut in greenhouse gas emissions on 1990 levels by 2008-2012. The Royal Commission on Environmental Pollution (RCEP) has suggested that cuts in the order of 60% over 1990 levels within the next 50 years are required.

The EU target for national supplies of renewable energy is being enacted through the so called Renewable Energy Directive (2001/77/EC) which requires 12% of European energy supplies, and 22.1% of electricity, to be sourced from renewable energy by 2010. For the UK the Directive stipulates an indicative target of 10% by 2010.

2.3 UK

The recently released Energy White Paper, which sets out the UK government's energy policy for the coming years, is supportive of measures to reduce CO_2 emissions, including increased renewable energy generation and uptake of energy efficiency measures. The Energy White Paper aspires to 20% renewable electricity generation by 2020 and also endorses the recommendations of the RCEP to reduce CO_2 emissions by 60% from current levels by 2050.

The Government intends that the Renewable Obligation Order (ROO) of 2002 will help deliver the immediate UK target (derived from the EU Renewable Energy Directive) of about 10% of electricity supplies to be derived from renewable sources by 2010. It is estimated that 10% renewables will be equivalent to about 38,000 GWh of electricity and will require construction of a further 6 – 8,000 MW of capacity (depending upon the technologies applied and the load factor they can achieve).

The UK's Climate Change Programme recognises that fossil fuels used for the generation of power, for heating and for transport form the major contribution to greenhouse gas emissions. As a result, the strategy to reduce greenhouse gas emissions forms the heart of the programme. The principal features of the Climate Change Programme are:

- to improve business use of energy, stimulate investment and cut costs;
- stimulate new, more efficient sources of power generation;
- cut emissions from the transport sector;
- improve the energy efficient requirements of the Building Regulations; and
- ensure the public sector takes a leading role.

The Climate Change Programme has, at its heart, the objectives of sustainable development. The UK's Government strategy for sustainable development, "A Better Quality of Life" identifies four objectives that need to be addressed to achieve sustainable development, all of which have implications on the generation and use of energy and the consequent reduction of greenhouse gas emissions. These are:

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

In the document "New and Renewable Energy: Prospects for the 21st Century", the key aims of the Government Policy are given as:

- assisting the UK to meet national and international targets for reducing greenhouse gases and other emissions;
- helping to provide secure, diverse, sustainable and competitive energy supplies;
- stimulating the development of new technologies;

- helping the UK Renewables Industry become competitive in home and export markets; and
- contributing to rural development.

The Government believes that its aims for renewables can be best met within the framework of the competitive market, giving industry the greatest opportunity for technical innovation so that renewables can be made increasingly cost effective. The key elements of the policy are:

- the introduction of a Renewables Obligation (which succeeds the Non-Fossil Fuel Obligation (NFFO));
- the exemption of renewable energy from the Climate Change Levy;
- an expanded support programme for new and renewable energy; and
- a regional strategic approach to planning and regional targets for renewable energy.

2.3.1 The Renewables Obligation Order

The ROO requires electricity suppliers to source increasing proportions of their total supply from renewable sources, up to about 10% by 2010. They can do this by building and operating their own renewable electricity production facilities or by purchasing renewable electricity from other producers. Renewable electricity producers are certified by the electricity regulator, Office of Gas and Electricity Markets (OFGEM), who presents them with Renewable Obligation Certificates (ROCs) for each unit (MWh) of renewable electricity produced.

Electricity suppliers then submit annually the requisite number of ROCs in accordance with their obligation. Those holding insufficient ROCs pay a penalty, or ‘buy-out’, price (currently about £31/MWh and increasing each year) for the shortfall. A ‘recycling’ mechanism results in the penalty payments being recycled back to electricity suppliers in accordance with the number of ROCs they present. If there are insufficient renewable energy production facilities to meet the obligation, then this recycling mechanism eventually results in ROCs becoming more valuable than the buy-out price. This acts as an incentive to new developers and investors to build more renewable energy production facilities.

The ROO does not cover all renewable electricity sources, as permitted by the European Renewable Energy Directive. The Directive permits inclusion of electricity derived from large hydro and energy from waste plants within renewable electricity totals. These are specifically excluded from the ROO scheme, although energy from waste is currently permissible if advanced thermal technologies are employed (such as anaerobic digestion and pyrolysis-gasification). A technical review of the ROO is currently underway which is exploring a number of issues relating to the implementation of the regulations, including the eligibility of electricity produced by conventional energy from waste technologies.

The Government has recently stated its aim to extend the Order to a target of about 15% of electricity supplies by 2015 although this is yet to pass through primary legislation.

2.3.2 Current UK renewable energy production

It is clear that even the current Government target of 10% of electricity supplies from renewable energy sources by 2010 is ambitious given the current levels of renewable energy deployment.

In 2003, some 13,400 GWh of electricity were produced from renewable sources. This is equivalent to 3.9 % of the UK's total net electricity production in 2003.

Table 2.1 UK renewable energy production (end of 2003)

Technology	Installed Capacity (end of 2003)	Proportion of Capacity	Proportion of Renewable Electricity Supply
Onshore Wind	680 MW	19 %	12 %
Offshore Wind	65 MW	2 %	0 %
Large Hydro ‡	*1,390 MW*	*39 %*	*29 %*
Small Hydro (<20 MW)	200 MW	6 %	1 %
Landfill Gas	620 MW	17 %	31 %
Energy from Waste ‡	*300 MW*	*8 %*	*9 %*
biomass Co-firing			6 %
Agricultural Wastes	280 MW	9 %	9 %

‡ : These technologies are ineligible for the ROC scheme.

Whilst 3.9% might seem like a reasonable level by the end of 2003 it should be noted from Table 2.1 that 60% of this renewable output was delivered by large hydro and landfill gas facilities which were in existence prior to the introduction of the ROO. Furthermore, the opportunity for developing further renewable generation capacity from these sources is extremely limited.

- all viable large hydro opportunities have been implemented; and
- landfill gas production is likely to decline over forthcoming years as diversion of wastes away from landfill increases as a consequence of the Landfill Directive.

Delivering a further 7,000 MW or so of renewable energy capacity in the UK by 2010 is a significant challenge.

2.3.3 National Planning Policy

Current national planning policy guidance on renewable energy is set out in PPS22, which requires planning policies at regional and local levels to provide an effective framework encouraging renewable development.

Sustainable development is one of three themes at the heart of the Government's vision for the new planning system (Introduction to PPS1 'Creating Sustainable Communities'). In line with clause 38 of the Planning and Compulsory Purchase Bill, PPS1 stipulates that local plans must be prepared "with a view to contributing to the achievement of sustainable development".

In this context, PPS1 states that:

> *"Policies should reflect a preference for minimising the need to consume new resources over the lifetime of the development by making more efficient use or reuse of existing resources rather than making new demands on the environment; and for seeking to promote and encourage rather than restrict the development of renewable energy resources. Consideration should be given to encouraging energy efficient buildings, community heating schemes and the use of combined heat and power in developments".*

PPS12 'Local Development Frameworks' (LDF) requires Local Development Documents (LDDs) to include a core strategy setting out the key elements of an area's planning framework. This is to consist of a vision, strategic objectives, a spatial strategy, a number of core policies and a monitoring and implementation framework. In terms of delivering the renewable energy/resource efficiency requirements of PPS1 and PPS22, this can be translated into:

- a vision to ensure that development decisions are based on the achievement of sustainable development principles (including the sustainable production and use of energy);
- strategic objectives that encourage resource efficiency and sustainable energy; and
- a core policy that commits the LDF to the delivery of renewable energy resources and to development that maximises energy conservation.

2.3.4 Supplementary Planning Documents

Paragraph 7 of PPS22 states that "more detailed issues may be appropriate to supplementary planning guidance". The following is the guidance quoted in paragraphs 2.42-2.43 of PPS12: Local Development Frameworks:

> *"Where prepared, supplementary planning documents should be included in the local development framework and will form part of the planning framework for the area. They will not be subject to independent examination and will not form part of the statutory development plan. However, they should be subjected to rigorous procedures of community involvement.*
>
> *Supplementary planning documents may cover a range of issues, both thematic and site specific, which may expand policy or provide further detail to policies in a development plan document. They must not however, be used to allocate land. Supplementary planning documents may take the form of design guides, area development briefs, master plan or issue-based documents which supplement policies in a development plan document."*

2.4 Regional

In 2001, all the English regions were asked to prepare targets for the production of renewable energy. At that time, in the East of England, only 0.45% of regional demand was met from renewable sources (the UK figure was 2%).

As part of the national review, during 2003/4 the East of England Region evaluated available resources against two scenarios; a ‘Business as Usual’ and an ‘Extended Case’ (The Renewable Energy & Land Use Planning Study, “*A Report To The East Of England Sustainable Development Round Table : Making Renewable Energy A Reality - Setting A Challenging Target For The Eastern Region*”). Following review with stakeholders, the Extended Case was adopted and the following series of renewable energy targets proposed for 2010.

- To produce 14% of the region’s electricity from renewable sources by 2010 (including offshore wind; 10% if offshore wind is excluded) as a first step towards achieving a more significant percentage in the medium term.
- To produce 1,300 GWh/yr of electricity from offshore wind by 2010.
- To produce 1,700 GWh/yr of electricity from onshore wind by 2010.
- To produce 700 GWh/yr of electricity from biomass by 2010.

The report identified the implications for the region as a whole of meeting these targets:

- Reduction in CO_2 emissions by (9%) 5 million tonnes.
- Development of 350 MW of offshore wind turbines. This figure equates to about 150 turbines.
- Development of 460 MW of onshore wind farms. This figure equates to between 400 and 500 turbines (depending on size).
- Set aside 139,000 extra hectares to energy crops, comprising:
  - 92,000 hectares wood;
  - 20,000 hectares ethanol; and
  - 26,000 hectares bio-diesel.

The report concluded that energy derived from municipal solid waste should be excluded from the Region’s renewable energy targets as a consequence of the opinion expressed by stakeholders that it is not a renewable source of energy.

These regional targets were translated into county targets, with the following proposed for Hertfordshire:

Onshore Wind:	96,000 MWh per year
Biomass:	57,000 MWh per year
Total:	**153,000 MWh per year**

(The biomass estimates presumed contributions from wood energy crops, landfill gas, bio-ethanol and agricultural wastes).

Note that 153 GWh per annum will equate to 3% of Hertfordshire’s predicted energy consumption in 2010. Other counties in the region considered to have more favourable resources and more opportunities to exploit their resources were given significantly higher targets (e.g. Norfolk - 17%).

In December 2004, the East of England Draft Regional Spatial Strategy was published and referred to renewable energy and regional planning policy. The document confirmed that the 14% by 2010 target (including offshore wind) has been adopted in the Regional Sustainable Development Framework. It also confirmed a target for 2020 of 17% renewable energy (excluding offshore wind, or 44% including offshore wind contribution) expressed as a percentage of total electricity consumption in the region.

2.5 County of Hertfordshire

This section sets Hertfordshire's energy consumption in context and provides an overview of the relevant energy-related policy and initiatives within Hertfordshire that are targeting carbon reduction.

2.5.1 Energy Mix

Table 2.2 and 2.3 detail the electricity and gas consumption by domestic and commercial sector for each local authority within Hertfordshire.

Table 2.2 Electricity consumption across Hertfordshire, 2003.

Local Authority	Total sales 2003 (GWh)	Average Domestic Consumption (kWh per metered consumer)	Average Commercial Consumption (kWh per metered consumer)
Broxbourne	361	4,901	63,074
Dacorum	614	4,787	70,128
East Hertfordshire	665	5,502	67,403
Hertsmere	422	5,124	67,901
North Hertfordshire	544	4,929	56,193
St Albans	504	4,918	50,837
Stevenage	405	4,179	113,238
Three Rivers	359	5,208	72,958
Watford	428	4,435	77,783
Welwyn Hatfield	529	4,696	100,815
County Total	**4,831 GWh**	**2,179 GWh**	**2,652 GWh**

Source: DUKES, 2005

Across the county, a total estimated 4,831 GWh of electricity was consumed in 2003. Approximately 45% of this energy was consumed by the domestic sector and 41% by the commercial sector.

(Note that a total of 12,355 GWh of gas was also consumed in the county, approximately 65% consumed in the domestic sector and 35% by the commercial sector. No figures are available for energy consumed in the transport sector.)

Based on these figures from 2003, generating 3% of electricity from renewable resources would mean that 144,930 MWh of energy should be generated from renewable resources per annum. This is a slightly lower than the number expressed in the East of England Sustainable Development study, this is considered to reflect the fact that overall electricity consumption is predicted to be increase with population changes to 2010 and beyond.

2.5.2 Policy

In response to the targets set by the East of England and other energy-related obligations and aspirations, Hertfordshire has initiated several schemes and is undertaking many supportive activities.

The adopted Hertfordshire County Structure Plan 1998 gives priority to energy developments based on renewable energy and supports renewable energy in general, provided schemes are located as closely as possible to the source of material used in the process. A general policy requiring all development to achieve the aims of sustainability provides a focus for integrating energy conservation into design and construction.

Policy ENV8 East of England Plan introduces a specific requirement on Hertfordshire districts to contribute towards regional targets. There is a statutory requirement for the Local Development Documents (LDD) to conform with the East of England Plan. Policy ENV8 states that LDDs should contain policies on renewable energy

The County Plan's waste management policy is based on the waste management hierarchy. The adopted Waste Local Plan sets out locational criteria for the development of waste to energy plants. It also has a policy giving in-principle support to so-called advanced technologies such as anaerobic digestion and pyrolysis/gasification.

The Hertfordshire Waste Strategy confirms the key policy decision not to consider the use of mass-burn waste incineration (beyond existing contractual commitments to utilise available capacity at the Edmondton Energy from Waste plant) as a means of disposing of Hertfordshire's municipal waste. It confirms emerging thermal treatment technologies such as anaerobic digestion and pyrolysis/gasification as potential solutions.

The Hertfordshire Waste Local Plan Policy 20 states that "When considering planning applications for waste reduction facilities (including incinerators), including those handling agricultural and forestry wastes, the County Council will encourage associated proposals for energy recovery."

2.5.3 Other energy-related initiatives

Already within the county of Hertfordshire, a number of energy-related initiatives are underway that are contributing and have the potential to contribute further to reducing carbon emissions from energy consumption.

Table 2.4 Hertfordshire county energy-related initiatives

Organisation and Schemes	Description
The Hertfordshire Environmental Forum	Hertfordshire Environmental Forum (HEF) is made up of the 10 Hertfordshire district and borough councils, formed in 1991 to deal with local and global environmental issues. The Energy Group of the HEF has been established with the aims: • to provide a forum which enables sharing of good practice on energy efficiency initiatives taking place both internally and externally within member authorities; • to facilitate joint working partnerships in relation to the Home Energy Conservation Act • to work with the local Energy Efficiency Advice Centre to ensure residents have access to good quality advice on energy issues • to improve energy efficiency in public buildings • to increase County wide promotional activity and Energy Awareness • to share resources The HEF and the HEF Energy Group play a significant role in promoting energy best practice.
"Warmer Homes, Greener Herts"	A consortium of Hertfordshire local authorities have set up the Warmer Homes Greener Herts insulation scheme, which provides loft and cavity wall insulation to residents at a greatly reduced cost. The scheme has just received additional funding from London Electricity and this is being passed on to the customer through lower prices for installations.
Hertfordshire Solar Club	The Solar Club is designed to provide help and advice on installing solar water heating to householders across Hertfordshire. The club provides training and support for DIY installations and can offer discounts through links with suppliers. The scheme has reportedly received approximately 850 enquiries, and, it is understood from David Thorogood (their Environmental Co-ordinator) that 78 solar systems have been installed. The majority of householders have elected to claim grants for their installations, and pay for a professional to install it. However as grant funding through the Clear Skies comes to an end it is likely that householders will have more incentive to adopt the DIY approach.
Discounted Condensing Boilers	The HEF Energy Group is currently investigating the feasibility of a scheme to provide discounted condensing boilers to households. These boilers are proven to have considerable energy efficiency and therefore cost saving benefits, once installed. Hertfordshire residents can receive a discount of at least £100 on a new condensing boiler through a joint scheme between the Councils and British Gas.
Schools Energy Challenge	The Schools Energy Challenge takes a whole school approach to energy and water management. It involves teaching and non-teaching staff as well as pupils. The Challenge is a partnership between Hertfordshire local authorities, Hertfordshire County Council, the School Improvement and Advisory Service and the participating schools. A comprehensive energy report is compiled for each school taking part in the Challenge, which identifies energy conservation improvements; a copy is given to the school. The schools are given assistance to apply for CREATE grants, these grants provide up to £3,000 per school to implement energy saving measures such as new lighting or heating controls.
Watford and Three Rivers Energy Agency	This organisation was previously known as the Watford Energy Shop. The Agency is able to provide information on various aspects of energy efficiency to homeowners, tenants, schools and businesses. They can deliver energy education, training, consultancy and a variety of environmental projects. The Agency was established as a not-for-profit company with the sole purpose of improving energy efficiency in Hertfordshire. Projects include: the International Energy Project, where Hertfordshire schools were linked up with schools in Germany and Slovakia in order to share information and raise awareness of energy efficiency; the Mobile Energy Efficiency Programme (MEEP) – a

Organisation and Schemes	Description
	converted caravan which demonstrates how a home can save money by being more energy efficient. The ‘Agency’ mainly focus on providing energy efficiency advice, but also plan to promote renewable energy technologies by partnering groups such as Friends of the Earth and Hertfordshire Alternative Technology society on a road show across the county. One of the challenges the Agency faces is funding, staff are not employed specifically on the project but sourced from within the councils and heavily reliant on volunteers.

2.5.4 The Hertfordshire Renewable Energy Study

The Hertfordshire Renewable Energy Study, out of which this report has been produced, commenced in the latter part of 2004. In November 2004 presentations and a workshop were held with prominent Hertfordshire stakeholders to commence the consideration of how renewable energy might be deployed in the County.

During the workshops, participants were invited to consider the barriers to renewable energy deployment and to identify opportunities for overcoming these barriers. The general themes emerging from the workshop are summarised below.

- **Understanding and Awareness**. Understanding of the needs, barriers and the opportunities is poor. Awareness must be increased across the public, members, officers and industry. Need useful performance indicators.
- **Incentives**. Lack of incentive to switch to renewable energy (low energy prices).
- **Leadership by the Councils**. The Councils should take a lead in promoting renewable energy, through policy, planning development control and implementation of schemes with its own property stock.
- **Co-ordination of Initiatives**. Increased co-ordination of effort to promote renewable energy is required across the county.

An interim report was issued to the stakeholders in January 2005 to provide a basis for formal consultation. The interim report provided information on the regulatory background, renewable energy technologies and an appraisal of the potential for their deployment in Hertfordshire.

Soon after the issue of the interim report a second meeting was held with stakeholders to introduce them to the findings of the report and to stimulate debate about the report conclusions and to encourage them to provide feedback on their concerns and interests.

The formal comments received from stakeholders were considered and addressed during March-May of 2005. The responses to the comments have been incorporated into this report; an updated version of the interim report of January 2005.

2.6 Summary

In summary, whilst there are no specific statutory requirements for Hertfordshire to set or achieve renewable energy targets, there is a statutory requirement for LDDs to conform with the East of England Plan. In doing so Hertfordshire and the districts within it need to consider how they can contribute towards the regional renewable energy targets. There is also strong scientific evidence, mounting regulatory pressures and a clear appetite and desire compelling the County to move towards a lower carbon future.

The principal options for reducing energy-related carbon include:

- moving from fossil fuel-based to low-carbon energy production such as that generated from renewables and nuclear power;
- reducing energy demand by improving energy utilisation and energy efficiency; and
- improving land use management.

This report addresses the options for Hertfordshire in relation to renewable energy production for electricity, for heat and for transport.

3. The Technologies and Techniques

There is a wide range of technologies and techniques available for producing renewable energy for electricity, heat and transportation. This section of the report provides a brief overview of renewable energy technologies and techniques, identifying their principal features.

3.1 What is renewable energy

Renewable energy is obtained from energy sources that can keep producing without being depleted (unlike, for example, fossil fuels, of which there is a finite supply). In this context, renewable energy sources also include materials that can be replenished at a rate commensurate with the rate of consumption with no, or little, net carbon dioxide production over the material life cycle, such as biomass materials.

The majority of renewable energy sources ultimately derive from solar radiation and gravitational forces. The effect of the sun upon the weather patterns experienced at the earth’s surface results in the generation of wind, which in turn generates waves on the surface of water masses. Weather patterns also result in evaporation and precipitation of water (as rain) which results in rivers/lakes that can be used to generate hydroelectric power. Tidal and tidal stream energies result from the forces of gravity driven by the sun and moon and the Earth’s rotational energy. Solar radiation can be converted to electrical energy through use of photovoltaic cells. Biomass growth relies on solar radiation for the principal process by which plants grow, photosynthesis.

3.2 Renewable energy production technologies

A brief summary of each of the technologies is provided in Table 3.1

Table 3.1 Renewable technologies summary

Energy source	Energy form	Technology/ resource	Description
WIND	Electricity	Large and Rooftop Wind Turbines[‡]	Wind turbines are designed to convert the wind's kinetic (motion) energy into rotational movement, thereby driving a generator to produce electricity. Large turbines are usually mounted on towers to accommodate the long blades and to enable them to access the higher wind speeds that prevail at height above the ground. Rooftop wind turbines are much smaller and are generally associated with producing electricity suitable for use at source in domestic, commercial and industrial applications, typically producing 200W to 2,000W.

Energy source	Energy form	Technology/ resource	Description
BIOMASS	Electricity, heat or combined heat and power	Energy Crops or Wood-chip/Forestry Residues‡ Agricultural Residues Sewage Sludge Bio-Municipal Waste	Biomass electricity/heat projects rely on thermal processing of the biomass material to release the energy contained within the material. This can occur in a furnace/boiler to produce steam (usually at high pressure) which can then be passed through a steam turbine-generator in order to produce electricity or it can be used as an energy source for provision of heating to industrial processes or buildings. Alternatively, a fuel gas can be produced which can be combusted in an engine that turns a generator to produce electricity. When used to produce electricity via steam, energy remaining in the steam after passing through the turbine can also be used as a source of heat. This configuration is termed combined heat and power (CHP). To be commercially viable, most biomass-electricity schemes are usually of industrial scale producing at least 10-15 MW of electrical power. Their economic viability is greatly enhanced if there is a local market for heat that can allow them to operate in CHP mode. Biomass-heat applications are usually of smaller scale associated with commercial/institutional properties or domestic dwellings, The biomass fuels (usually wood-chip or pellets) would be used as a substitute for conventional fossils fuels such as heating oil or gas.
BIOMASS	Transport fuel	Bio-Fuels (diesel and ethanol)	Biomass material can also be chemically processed to produce liquid fuels suitable for use in transportation. Oil-bearing crops, notably, oil-seed rape are suitable for production of bio-diesel whilst starch and sugar-bearing crops such as beet and wheat can be used for producing bio-ethanol. Bio-diesel can be blended with conventional fossil-derived diesel for use in car engines. Bio-ethanol can be used as a fuel supplement for petrol.
SOLAR	Electricity	Photo-voltaic‡	Solar radiation can be converted into electrical energy using photovoltaic modules normally mounted on roofs or facades of buildings.
	Heat	Passive/Thermal‡	Solar energy absorbed in solar collectors can be used for space heating and hot water. Also solar energy is absorbed from the ground or air and upgraded through the use of heat pumps. Buildings can also be designed with passive solar features that enhance contribution of solar energy to space heating and lighting requirements.
WATER	Electricity	Hydro‡	Hydro-power systems convert potential energy stored in water held at height to kinetic energy (or the energy used in movement) to turn a turbine to produce electricity.
	Electricity	Wave	Wave technologies rely on transforming the hydraulic (kinetic and potential) energy in waves to electrical energy either directly or indirectly through the force of the wave creating movement. This relative movement can then be combined with an appropriate electrical generator to produce electricity. **Due to the lack of significant wave sources in Hertfordshire, this technology is not considered further in this study**.

Energy source	Energy form	Technology/ resource	Description
	Electricity	Tidal/Tidal Streams	The power of tides can be harnessed by building a low dam or barrage in which the rising waters are captured and then allowed to flow back through electricity generating turbines. Energy can also be recovered from tidal streams by placing water driven turbines in the tidal currents. **Due to the lack of tidal resources in Hertfordshire, these technologies are not considered further in this study**.
GEO-THERMAL	Heat	Water Injection and Pumping‡	The extraction of geothermal energy relies on pumping water into the surface of the earth where it is warmed up by the naturally occurring high temperatures prevailing in the rock structures. Dependant upon the density of the energy in the rocks the water may form steam or be returned as water at a higher temperature. The hot water or steam produced can then be used in space heating applications. Where the return water temperature is low heat pumps can be employed to upgrade the heat.

‡ : These technologies are of a nature that lend them to being suitable for deployment by the consumer, embedded at the point of use in, for example, residential and commercial/institutional buildings.

4. Constraints and Barriers to Renewable Energy Deployment

4.1 Introduction

The extent of the deployment of renewable energy technologies and techniques will be highly dependent upon a range of factors, many of which will be beyond the direct influence of stakeholders within Hertfordshire. Estimating the potential deployment of renewable energy is therefore extremely difficult to do with any degree of confidence.

Whilst strong regional and local level planning policies and increased public awareness will play a major part in attracting developers and influencing the deployment of renewable technologies in Hertfordshire, one of the most important factors influencing the uptake is commercial competitiveness (financial viability). This is strongly influenced by much wider-ranging global political factors, national regulations, grant schemes and the fundamental economic viability of the technologies. For the more competitive renewable technologies such as onshore wind, planning policy will remain the critical issue for attracting commercial developers.

This section of the report provides a general review of the principal barriers that prevent deployment of renewable energy technologies. We have also identified the typical proposals that are adopted by regional and local government in an attempt to overcome these barriers. These proposals have been developed on the basis of our knowledge of 'best practice' adopted in other parts of the UK and Europe. The proposals identified in this report set out to encourage stakeholders by considering their practicality and affordability.

The next section of the report (Section 5) considers the specific options for renewable energy generation in Hertfordshire, the specific barriers to deployment of the various options and, consequently, an indication of the level of renewable energy production that might be achievable.

4.2 Overview of the barriers to deployment

The principal barriers to deployment of renewable energy technologies are financial, planning and technological/resource.

4.2.1 Financial

Large-scale renewable energy projects will generally require that debt be sought from lenders (banks) or investors. Even smaller scale projects will also require some form of debt to cover the initial capital investment.

Purchasers, lenders and investors will require to be assured of the commercial viability and cost competitiveness of renewable energy projects, at least over the term of the debt facility which can be 15 to 20 years for large projects.

4.2.2 Planning

The securing of planning consent represents the biggest threat to virtually all renewable energy projects. This is so much so that lenders will rarely lend to projects until planning consent has been obtained.

4.2.3 Technological and Resource Issues

The resources on which any renewable energy project is based must be available in sufficient quantities and consistently over the project's lifetime to enable the basic financial projections to be assured. These issues are addressed in greater detail in Section 5.

Each of the above factors is influenced by many other factors. In the following sections we provide a more detailed appraisal of each of these barriers and the many other factors influencing them.

4.3 Financial barriers

This has been, and is likely to continue to be, the most important factor influencing the uptake of renewable energy, whether from the perspective of a large-scale developer/operator or from that of a householder. For anyone to invest in a renewable energy scheme, one of their primary requirements is that the scheme delivers financial benefits to the investor. Financial benefits will only emerge if renewable energy technologies are competitive with the existing fossil energy sources.

The various factors that influence financial viability are reviewed below from the perspective of private individuals, corporate investors/developers and institutional lenders.

4.3.1 Energy cost competitiveness

The cost of energy is probably the most important factor to consider for a purchaser of energy. The ability to achieve this over the life of the plant technology whilst providing the necessary financial return will determine the ability to deploy the plant and technology. The ability to sell the product, in this case energy, in a competitive market place is the essential factor that underpins the financial case for any investment whether, in this case, it be for a large biomass power plant or a small, domestic solar water heating system.

The ability to compete in a market is important, particularly to lenders and investors who require projects to be commercially viable and sustainable, in order to ensure that there is sufficient income to enable the owner-operator to continue to run the project, repay the debt and return a profit for the owner and investors. Renewable energy projects must, therefore, be able to compete with the costs of energy produced by other means, throughout the project lifetime.

A number of factors aid or threaten the cost and competition of renewable energy in the market place. These include:

Competitive Pressures – Regulatory. The regulatory pressures imposed on competing energy production technologies represents a significant opportunity for renewable technologies. Most notably, the impact of the EU Emissions Trading Scheme under which greenhouse gas emission permits are allocated to large energy users and traded. For example these energy users include:

- generators of electricity produced from fossil fuels;

- installations with boilers with an aggregate thermal input of 20MW or greater (this may include large hospitals and university campuses);
- industry (cement, lime, brick and ceramic production);
- production and processing of ferrous metals; and
- pulp and paper production.

The EU Emissions Trading Scheme could have a major impact upon the cost of fossil-based energy and hence aid the competitiveness of renewable energy.

Competitive Pressures – Policy. The Government's stance on nuclear power could also have a very significant impact upon the perceived competitiveness of renewable technologies. The Government states on the DTI web-site that it believes that ambitious progress on renewables and energy efficiency is achievable. However, the Government also recognises that there are uncertainties and that it should not rule out the possibility that new nuclear build might be necessary at some point in the future in order to meet ambitions on carbon emissions. further pressure is expected to bear on the power generation industry over the next 10-15 years as the current fleet of coal-fired power stations and much of the country's nuclear plant reach the end of their economic life.

Any further significant display of commitment to nuclear power by the Government could diminish developers' appetite to pursue renewable energy projects.

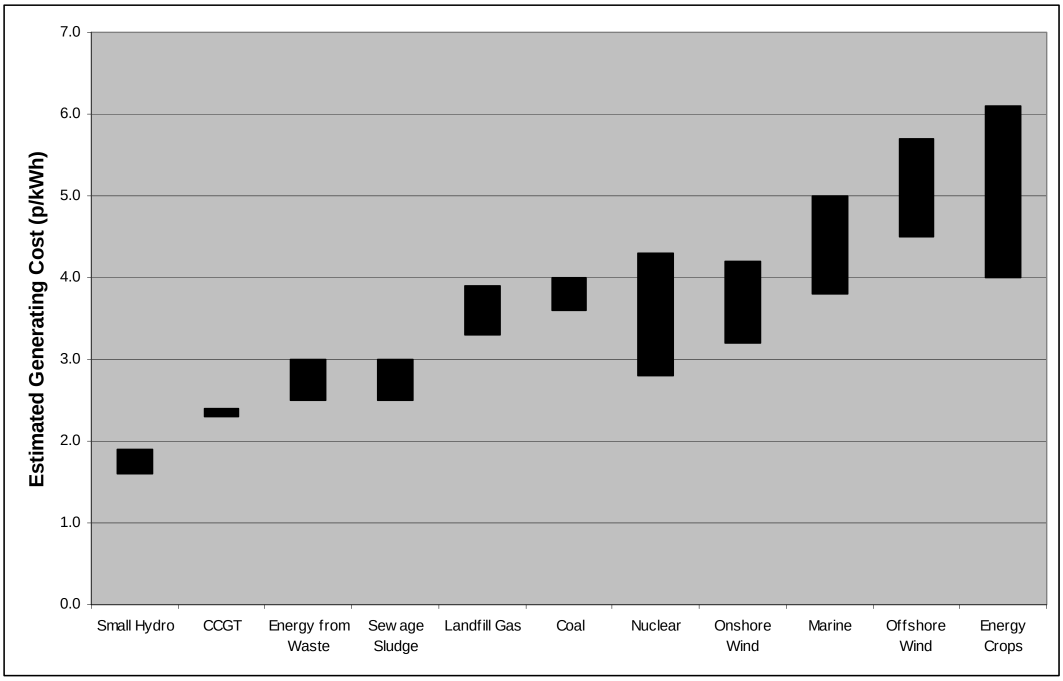
Competitive Pressures – Costs of Generation. A number of studies have been completed in the last year addressing the costs of power generation and the commercial viability of renewables.

One of the most recent and most comprehensive is the International Energy Agency's report, "Projected Costs of Generating Electricity" published in 2005 which provides estimates of generating costs for a range of technologies based on data collected from many countries. The results provided by the UK are summarised in Figure 4.1.

The UK submission to the study was based on a DTI workshop held in 2002 at which assumptions regarding future generation costs were discussed; estimates (and consequently these figures) reflect the views expressed by the industries concerned. Projections for all technologies are subject to uncertainty so a range of costs has been presented. The range is greatest for technologies which are not yet technically proven or reliant on new designs from existing technologies.

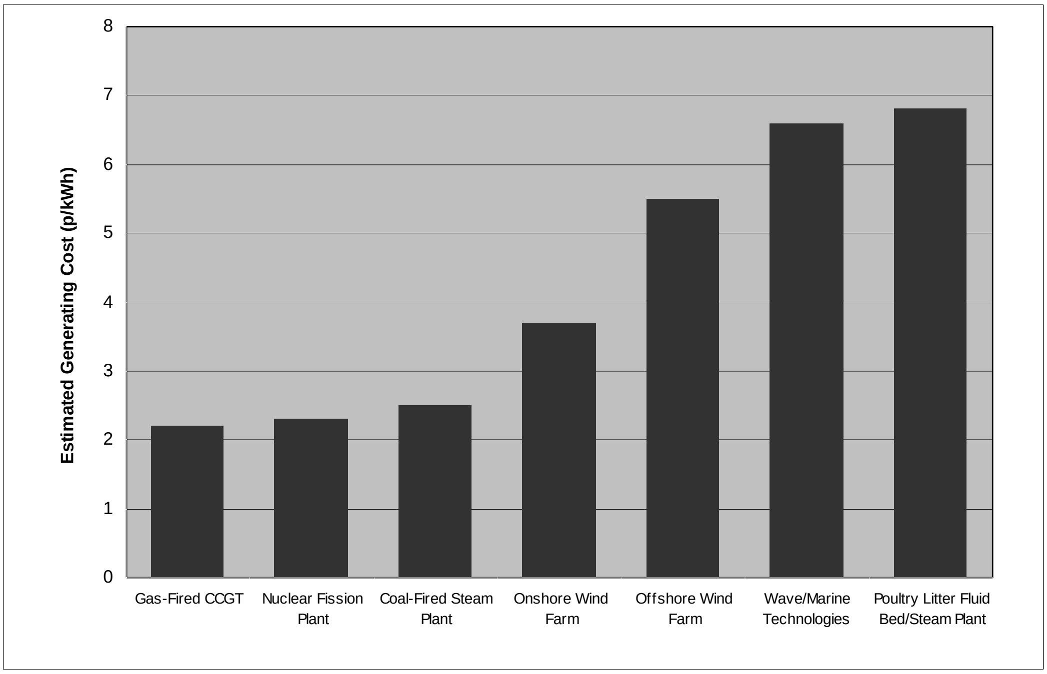
The data excludes the estimated cost of standby generation for intermittent technologies (onshore and offshore wind) and the costs of acquiring carbon emission allowances under the EU ETS.

Figure 4.1 Costs of Generating Electricity (OECD Study 2005)



An earlier study by PB Power for the Royal Academy of Engineering also shows similar estimates for the relative costs of conventional, nuclear and renewable energy generation.

Figure 4.1 Costs of Generating Electricity (Royal Academy of Engineering Study 2004)



It is acknowledged that the above data does not include for the costs of compliance with the EU ETS, the additional costs of standby generation that might be attributable to intermittent technologies such as wind or the costs of nuclear waste storage and decommissioning. Notwithstanding this, broad messages about the competitiveness of renewable technologies can still be drawn from this and other recent analyses.

As can be seen from above, the main commercial challenge to renewable technologies is presented by combined cycle gas turbine (CCGT) plant. This is currently the cheapest form of electricity generation and it is expected to remain so for, at least, the next 10 years despite the prospect of increasing gas costs and the cost of carbon emission allowances.

As part of the DTI's consultation on the Renewable Obligation scheme, two studies were conducted in early 2005 by Enviros and Oxera to consider on what basis renewable technologies might become commercially viable.

The Enviros report, 'The Costs Of Supplying Renewable Energy', included a detailed analysis of the costs of renewable energy production as a function of the amount of such plant installed. The analysis showed that technology improvements and economies of scale should lead to some reductions in certain cost elements for these projects. The analysis also shows, however, that as the penetration of these technologies into the market place increases, the actual unit costs of electricity will rise as new projects would increasingly need to be developed at less favourable sites with, for example, lower wind-speeds, lower landfill gas production etc.

The Oxera study used the Enviros results to determine whether the ROC scheme could be relaxed and what impact the EU ETS might have on the competitiveness of renewable technologies. It concluded that the ROC scheme could not be removed for at least the next decade. Importantly, it also concluded that carbon emission allowance prices would have to be €77/tCO_2 for landfill gas to be competitive with CCGT and in excess of €100/tCO_2, "significantly higher than any currently credible estimates of future allowance prices".

In summary, the commercial viability of renewable energy technologies is strongly dependent upon the continuation of the Renewable Obligation scheme and is unlikely to improve as a consequence of the EU ETS. Moreover, the penetration into the market of the more viable renewable energy technologies (landfill gas and onshore wind) will be limited by the decreasing availability of good sites with sufficient resources.

4.3.2 Project financial risks

The initial capital investment and its impact on project rate of return and payback period can be such a significant barrier to change that grant funding is required to stimulate the market and/or overcome the perceived risk associated with a switch to relatively novel technologies. Funding may be available from a variety of sources for some renewable technologies. The ability to receive such funding includes the availability of funds from specific allocations. In other words the extent of funding given may be dependent on what is left within the fund after previous allocations.

Those that require to borrow in order to procure renewable energy technologies, will also be subjected to the lenders' (usually banks) concerns relating to the uncertainties and risks that might threaten a project's financial viability and ultimately the owner's ability to repay the debt. Typically, a bank (and owner) will want to be assured of all the key factors that underpin the financial case have been identified and quantified and also the risks that may threaten to undermine the financial case have been assessed, managed and mitigated where possible. Table 4.1 identifies the principal risks that are applicable to renewable technologies.

Table 4.1 Typical project finance risks

Risks	Mitigation Measures
Technology supply market maturity	**Technology Track Record** : Lenders, investors and developers will generally require that renewable energy technologies are sufficiently well-proven and that technology suppliers have a sufficient track record in delivering and supporting the on-going operation of renewable energy facilities.
The robustness of the capital and operating costs	**Fixed Price Capital Plant Contracts** : Typically, banks and investors will require that developers engage reputable contracting firms on the basis of fixed price, fully specified supply contracts. **O&M Service Contracts** : Also, contracts for the provision of operation and maintenance services with reputable and capable service providers will be required by lenders.
The ability of the technology to continually meet the target performance levels required to underpin the financial projections	**Performance Contracts** : Such plant supply contracts mentioned above will also be required to contain provisions for adequate reimbursement to the purchaser if target performance is not achieved.
The security of future revenues and energy resources	**ROC Prices and Offtake Contracts** : A significant risk facing renewable electricity projects is the actual price obtained for the ROCs granted by OFGEM for eligible renewable electricity production. Again, banks and investors will most probably require that future revenues be secured by means of power offtake contracts, which may include the sale of ROCs. **Resource Availability Assessments** : Also, banks will require to be assured that resources will not interrupt the ability of the facility to generate revenues. For tangible resources such as biomass they will require that supply contracts be secured for at least the term of the debt (usually 15-20 years). For wind, solar or other similar resources this will need to be demonstrated by credible resource modelling including reference to historical and anticipated meteorological data related to the location and aspect of the energy collector.
Regulatory and policy uncertainties	Lenders and investors will take a view on the likely direction of future legislation and how this might affect the commercial viability and competitiveness of renewable energy projects. Specific uncertainties that threaten renewable energy projects include future Government's support for renewables including the review and changes to the ROO and the provision of grant funding, the level of the Climate Change Levy, tax on fuels including for transport, the future of Climate Change Agreements, agreement of national greenhouse gas emission quotas under the second phase of the EUETS which comes into force in 2008. The overall European and National agreed limits under the second phase of the EUETS. The Government's stance on competing energy sources will also have a huge bearing on the confidence with which developers, lenders and investors will approach the renewable energy market.
Failure to achieve planning consent and operating permits	It is very rare for banks to lend to projects until planning consent and any necessary authorisation under IPC/IPPC has been secured. For this reason, the cost of developing projects falls to the developers.

4.4 Planning

For those technologies that developers and investors consider as competitive and worthy of development, planning is a major hurdle that has to be cleared where some form of ‘development’ is involved. The main factors influencing the planning process are:

- compliance with Central and Local Government Policy, plans and strategy.
- nature and impact of the proposed development on the local area and population; and
- location.

The role of the planning system in a renewable energy strategy for Hertfordshire are considered in more depth in the related report, but some general points can be made from the outset.

4.4.1 Policy context

Local planning policy is very much influenced and directed by national policy. Planning Policy Statement 22: Renewable Energy (PPS22) and its companion guide sets the scene on the subject, but of course is only one of some 25 national planning policy statements and guidance.

The planning system has to look at development proposals in the round and consider, for example, questions of amenity, and visual and environmental impact, as an integral and necessary part of achieving and encouraging ‘sustainable development’. The planning system is familiar with the concept of ‘balancing’ the arguments for and against development proposals by weighing the significance that it is felt should be accorded to particular considerations. There are relatively few ‘presumptions’ against development in the planning system and the great majority of planning applications are considered on their merits.

Renewable energy is no different from other proposals in that any scheme has to address and face up to the disadvantages that might come with development, as well as the advantages that might arise.

However, the planning system not only operates through its regulatory (regard to the development plan and material considerations) and reactive (to other people’s proposals) process of development control, but also through the development plan system. The development plan system at regional and local levels is where local planning authorities and regional planning bodies prepare their own plans. This process does provide some opportunity for local and regional authorities and bodies to influence the policy context of their own areas and provide clarity on planning matters, thereby reducing uncertainty for developers and investors.

However, regional and local plans [known as Regional Spatial Strategies (RSSs) and LDFs] need to conform in general to each other and national policy. PPS22 refers to ‘criteria-based policy at the local level’. These should focus on key local issues relating to both ‘stand-alone’ renewable energy schemes and the development of integrated renewables within developments, and could be supplemented with advice in the form of adopted Supplementary Planning Documents (SPDs) relating both to renewable energy and design issues in planning.

The draft East of England Plan (i.e. the revision to the RSS for the East of England) is currently the subject of consultation (08 December 2004 to 16 March 2005). Draft Policy ENV8 in that RSS sees the LDFs of the local planning authorities, including Supplementary Planning

Documents (SPDs), as elaborating on and supporting renewable energy and energy efficiency policies.

Overarching policies in the core strategy of the LDF will provide the general considerations and criteria that all development will need to have regard to in addressing sustainability objectives and in complying with the proper planning of the area.

A most important aspect of policy formulation is what Government terms as 'front-loading', whereby the local community is informed and involved in the subject and the issues prior to the consideration of individual planning applications. The formal arrangements for carrying this out in each local planning authority will be set out in their Statement of Community Involvement.

4.4.2 The nature and impact of proposals

Planning applications will range from individual householders seeking permission to install domestic-scale equipment and installations, to major development proposals that are designed, for example, to generate many megawatts of electricity.

The issues that are likely to arise at the planning application stage are:

- the extent of the information needed to accompany a particular planning application;
- pre-application procedures and consultation;
- whether an Environmental Impact Assessment is required;
- issues of landscape and visual impact, including possible cumulative effects;
- how possible wider environmental, economic and social benefits should be demonstrated and considered;
- the relationship to the development plan and what material considerations also need to be considered;
- the impact on any listed buildings or areas of building conservation; and
- the appropriateness of development within designated green belt areas.

There may also be issues for the local planning authority over informing and training its own officers and members in respect of particular technologies and their likely impacts in order for the decision-makers and their advisers to be able to make informed judgements.

The local planning authority may also need to address how best to achieve community involvement in arriving at a proper and robust planning decision on a particular proposal.

In dealing with individual applications, either for proposals that would produce renewable energy, or proposals that could incorporate renewable energy features, some further additional questions could arise.

- Energy efficiency -v- renewable energy? (given that the basic objective is to reduce carbon emissions). Could requirements to achieve 10% of energy consumption from renewable sources work against maximising energy efficiency?

Policies will need to be carefully constructed to ensure clarity of purpose and ensure that they complement each other.

- Comparisons against other measures. For example, obtaining an EcoHomes credit is based on at least 10% of either the heat (space and hot water) demand, or 10% of the non-heating electrical demand, or 5% of total energy demand, being supplied from local renewable energy sources. To complicate matters, electricity from a local (i.e. not National Grid) renewable source, which has been designed to supply the building directly, may be included in the calculations as if it were generated within the building. In addition, to measure and verify this requires an accredited SAP assessor. Clearly, planning policies need to have close regard to industry standards and Building Regulations in order to be effective and enforceable. Planning policies should encourage developer's to build homes and buildings to a specification that exceeds the requirements of the building regulations.
- Amenity and visual impact judgements. Whilst many planning considerations can be the subject of objective measurements, a considerable degree of judgement is required, both in terms of the relative impact that a particular proposal will have on such things as amenity and visual impact, and also in terms of the weight that should be properly accorded to the different and often varied considerations that may be relevant.

It should be kept in mind that any planning application that is refused permission can subsequently be made the subject of an appeal to an independent planning inspector at the request of the applicant. Such action requires the local planning authority to defend its decision in front of the independent planning inspector and to make explicit what evidence exists that supports the original refusal by the authority.

4.4.3 Location

Whilst the above points have addressed renewable energy development in general, location is a most important factor which may be of relevance and be able to be referred to in the development plan policies. The East of England Plan, for example, contains draft Policy ENV8 on renewable energy and energy efficiency, plus Appendix C on locational principles and criteria.

Draft Policy ENV8 requires that the LDDs of the local planning authorities "will specify the locational and other criteria by which applications for renewable energy developments will be assessed". In particular, four main areas within the region are identified for different treatment in terms of planning policy application and development control treatment. These areas accord with the guidance as set out in Appendix C of the Plan.

- The sustainable communities plan growth areas.
- Settlements outside the growth areas.
- Non-designated landscapes (outside the above settlements and growth areas).
- Designated landscapes.

In addition, draft Policy ENV8 states that "small-scale and community-based schemes appropriate to local need are most likely to be permissible in areas that are:

- within or close to settlements;
- within suitable landscapes;
- close to the origin of the energy resource; and
- close to groups of buildings (in rural areas)."

4.5 Technological and resource constraints

Clearly, availability of sufficient levels of the primary renewable energy fuel sources is a pre-requisite for any renewable energy option. The significance of the term sufficient should not be under-estimated. Any investor in a large-scale renewable energy project will require assurance that the levels of the renewable resource is available in the appropriate amounts and at an appropriate quality to enable a financially robust project.

Each technology also has its own specific deployment challenges that require to be overcome. These are summarised in Tables 4.2 - 4.8 for each technology option.

Table 4.2 Technological and resource constraints: large scale wind

Technology	Constraints
WIND	**Wind Resources** –
Large Turbines	The energy captured by a wind turbine is directly related to the wind speed and as such this is the first requirement for a successful project. As resource is key to the eventual project value, on-site wind monitoring is almost always employed prior to procurement of the wind turbine/turbines. Typically, a developer will apply for consent to erect a temporary mast of at least 40m in height for monitoring the wind speeds for a period of between 12 and 18 months for a major wind farm development.
	Land Take/Availability –
	Whilst wind farms usually extended over large areas of land, traditional farming is relatively unimpeded; only about 1-5% of the wind farm area is rendered unusable. The land needs to be in an area of sufficient wind speed and be owned by a landowner that is prepared to host the project for an appropriate return. To ensure efficient harvesting of wind resources, it is customary to group several wind turbines within a single ‘farm’. It is important, however, that sufficient spacing is provided between turbines in order to enable them to operate efficiently.
	Terrain and Topography –
	Developers are generally attracted to areas of higher elevation, as these often have the best wind resource. With regard to site design, the steep terrain can limit where both turbines and the necessary infrastructure can be placed. Ground conditions can influence the physical design and the construction time for various wind farm elements, with subsequent cost implications for a scheme.
	Access –
	Modern wind turbines are extremely large structures, with blades of up to 45m (a typical 2 MW wind turbine has 40m long blades that arrive on 47m long lorries). The erection of a 2 MW turbine requires either an 800 tonne mobile crane or a massive crawler crane. The roads to the site must be able to accommodate these vehicles as well as a large number of other construction vehicles. A smaller 1.3MW turbine typically has 32m long blades and would arrive on 40m long lorries. Access arrangements are an important consideration in wind farm development – roads to and across the site must be suitable for turbine deliveries. In some instances (where bends can not be modified or gradients are too steep), access might limit the maximum size of the wind turbines...
	Planning and Environmental Issues -

Technology	Constraints
	Ecology and Ornithology : Though particularly important, ecology is often located in and around designated areas and are avoided by developers, protected species or significant concentrations of ecology may be present at any site. The location of sensitive habitats or species can have a strong influence over the design of a wind farm. **Landscape and Visual Impact**: The landscape and Visual Impact Assessment (LVIA) forms a significant part of the Environmental Impact Assessment for any wind farm development. The LVIA considers the overall effects of introducing wind turbines on the landscape character of the area and the visual effects that would be experienced by local receptors. Any cumulative visual effects with neighbouring wind developments must also be considered. **Hydrology** : Wind farm access roads and foundations could effect local hydrology, which in turn will have an influence on local habitats and water abstraction. **Noise and Shadow Flicker** : The potential for noise generation is a significant factor in determining the generating capacity that can be installed at a potential site. Through the site design and baseline studies completed for the EIA, noise minimisation will often heavily influence the layout design. **Features of Cultural Heritage** : In many cases, archaeological features are relatively small and in a buried or ruined state. It is relatively straightforward for a wind farm to be designed around such features and standard construction practice will ensure that they remain intact. More significant Cultural Heritage features and their related character setting are often protected from developments through planning policy. **Traffic** : Traffic and transportation impacts are limited to the construction and decommissioning phases of the wind farm development. Typically this might last between nine and eighteen months. **Public Access and Amenity** : It is not uncommon for a wind farm to be sited near to public rights of way. **Designated Areas** - Designations are assigned to specific areas in order to help protect them from unsuitable development. There are several designation classifications in existence in the UK, at both a statutory and non-statutory level. Development on a designated area is not viewed in a positive light, hence developers are inclined to avoid such areas. **Grid Connection** – Grid connection is becoming an increasingly significant barrier to the development of many wind farm projects. A connection to the local electricity network that can carry away all the generated electricity from the site at an affordable price is essential for a successful project. **Alternative Land and Airspace Uses** – Typical conflicting land and airspace uses include dwellings, civil aviation, MoD low flying, MoD radar, civil radar, weather radar etc. To minimise the risk of any conflict of interest, a developer will often seek to identify sites that are away from aviation sites.
	Television and Radio Communications – Wind turbines can affect electromagnetic signals, as used by analogue television broadcasting and radio communications. Many options for fixing potential television reception problems are available. Fixed communication links require a line of sight path between the transmitter and receiver. To avoid affecting such links, a wind farm can be designed so that turbines are placed away from the line of sight paths. Alternatively satellite communications or fixed ‘phone’ lines might provide a suitable alternative method of communication. **Programme to Deploy** – Typically a developer would expect a 9 to 30 month programme to develop a project (i.e. secure planning consent and reach financial close) with a further 9 to 18 month programme for construction. These time-scales are dependent upon the scale of the project, the site location and the prevailing public opinion.

Table 4.3 Technological and resource constraints: large scale biomass – electricity/heat

Technology	Constraints
BIOMASS **Energy Crops , Short Rotation Coppice and Wood-chip** **Agricultural Residues**	**FEEDSTOCK** : The majority of issues relating to biomass technologies are concerned with the biomass feedstock. • **Availability of land and Funding**: Grant support is available for the establishment and growing of energy crops subject to certain rules which include being located within a reasonable distance of the end use (10 mile radius for small installations, 25 miles for large installations along with a minimum establishment of three hectares. One off payments are available for establishment. There was a differential between short rotation coppice (SRC) and miscanthus. However, reform of the Common Agricultural Policy (CAP) will make the enhanced rate for SRC redundant from 2005. CAP reform will also lead to replacement of the Arable Area Payments Scheme (AAPS) under which set-aside payments are made. The AAPS will be replaced by a single payment scheme from 2005. The current maximum limit for grant aid is £500,000. Establishment and growing of biomass may be supported through other schemes including the Woodland Grant Scheme or Farm Woodland Premium Scheme. Up to date information is available on the Defra web site at www.defra.gov.uk. • **Robust Fuel Supply Infrastructure**: Uptake of biomass fuelled systems is generally hampered by the lack of a proper fuel supply infrastructure and in part from the lack of a market for the fuel that is available. • **Local Fuel Supply Base**: In order to be economically viable, biomass plants require large volumes of suitable fuel to be available at the lowest possible price; this implies available locally. Local growing is required to receive grant support as identified above. • **Competition for Fuel Supplies**: Large-scale economically viable biomass-electricity/heat projects tend to rely on feedstocks brought in over a wide radius. Competition for feedstocks can drive feedstock prices above economically acceptable levels required for investment in new plants. • **Technology Design to Suit Feedstock**: The conversion technology selected must operate as predicted over the lifetime of the project with the available feedstock taking account of variations in feedstock and operating practice. Most thermal technologies have limited fuel flexibility. • **Fuel Supply Consistency**: There must be sufficient long-term feedstock of the appropriate quality to operate the plant at the designed level over the life of the project. The feedstock quality and consistency must be maintained throughout the entire life of the project. **OTHER CONSTRAINTS:** Other relevant constraints include: **Planning Issues – Transport Logistics:** The economic characteristics of biomass fuel supply are strongly influenced by transport distances and logistics. Consequently, significant planning issues for biomass schemes are fuel delivery (e.g. lorry movements and impacts on local transport infrastructure) and storage requirements (visual impact, land use, etc). **Planning Issues – Environmental Emissions**: Thermal treatment processes are effectively combustion processes and so there tends to be much concern with emissions of pollutants to atmosphere.
	Heat Off-take Infrastructure: Important for CHP applications. Heat off-take systems are best installed prior to development of adjacent sites and facilities as retro-fitting can be extremely costly. Heat off-take agreements can enhance the economic viability of biomass-electricity projects. **Grid connection** is becoming an increasingly significant barrier to the development of many renewable energy projects. A connection to the local electricity network that can carry away all the generated electricity from the site at an affordable price is essential for a successful project. **Availability of Debt Finance**: Financing biomass is currently the biggest single obstacle to development. At best biomass electricity generating projects tend to be marginal. However, in many cases the 'show-stopper' comes from not being able to secure loan capital due to the perceived high technology and fuel supply risks. **Programme to Deploy**: Typically a developer would expect a 9 to 30 month programme to develop a project (i.e. secure planning consent and reach financial close) with a further 12 to 30 month programme for construction. These time-scales are dependent upon the scale of the project, the site location and the prevailing public opinion.

Table 4.4 Technological and resource constraints: large scale biomass [sewage sludge/bio-municipal solid waste (MSW)] – electricity/heat

Technology	Constraints
BIOMASS	The majority of issues relating to Sewage Sludge and particularly Bio-MSW projects relate to the public concerns regarding the feedstocks.
Sewage Sludge **Bio-MSW**	**Long Term Feedstock Supply Contracts**: These are essential to provide the necessary assurance to investors of the commercial viability of such projects. Typically 50-75% of revenues to energy from waste projects derives from gate fees. **Technology Design to Suit Feedstock**: The conversion technology selected must operate as predicted over the lifetime of the project with the available feedstock taking account of variations in feedstock and operating practice. Most thermal technologies have very limited fuel flexibility. **Fuel Supply Consistency**: There must be sufficient long-term feedstock of the appropriate quality to operate the plant at the designed level over the life of the project. The feedstock quality and consistency must be maintained throughout the entire life of the project. **Waste Management Policy**: Waste management strategies produced by Local Authorities identify the means by which MSW will be treated and disposed. The issue of final disposal by incineration is often contentious and frequently ruled out by Local Authorities. **Planning Issues – General**: Energy from waste projects have had a notoriously difficult history with planning. There have been many significant projects that have foundered as a consequence of planning issues. It has also become quite common for such difficult planning applications to be referred to Public Inquiry. Such costs and delays have put off investment. **Planning Issues - Environmental Emissions**: Thermal treatment processes are effectively combustion processes and so there tends to be much public concern with emissions of pollutants to atmosphere and potential odours. Any facility would need to operate within EU and UK regulations and under the appropriate IPPC permit. **Planning Issues – Transport Logistics**: The economic characteristics of biomass fuel supply are strongly influenced by transport distances and logistics. Consequently, significant planning issues for biomass schemes are fuel delivery (e.g. lorry movements and impacts on local transport infrastructure) and storage requirements (visual impact, land use, etc). **Heat Offtake Infrastructure**: Important for CHP applications. Heat off-take systems are best installed prior to development of adjacent sites and facilities as back-fitting is extremely costly. Heat off-take agreements can enhance the economic viability of biomass-electricity projects.
	Grid connection is becoming an increasingly significant barrier to the development of many renewable energy projects. A connection to the local electricity network that can carry away all the generated electricity from the site at an affordable price is essential for a successful project. **Availability of Debt Finance**: Financing energy from waste projects biomass is currently the biggest single obstacle to development, at best biomass electricity generating projects tend to be marginal. However, in many cases the 'show-stopper' comes from not being able to secure loan capital due to the perceived high technology and fuel supply risks.

Table 4.5 Technological and resource constraints: biomass transport fuels

Technology	Constraints
BIOMASS : Bio-Fuels (diesel and ethanol)	**Availability of Vehicles/Engine Technology**: Bio-diesel can be accommodated as a blend in fossil-derived diesel with no requirements for engine modifications. Bio-ethanol can be used as a supplement in petrol engines but may require some modifications to engines. **Bio-Fuel Delivery Infrastructure**: Widespread uptake of bio-fuels will require the development of a nation-wide fuel delivery infrastructure. If bio-diesel is blended at port facilities, then movement of the blended fuel by tanker is relatively straightforward. Bio-diesel blend is already becoming more available on petrol station forecourts. Bio-diesel is stable in nature, and should be able to

Technology	Constraints
	use existing infrastructures. **International Trade Constraints/Duties on Bio-Fuel Feedstocks**: The feedstocks used for bio-fuel production are commodities traded worldwide and are therefore influenced by international trade agreements. The UK Government announced a new duty rate for biodiesel of 20p per litre below the rate for ordinary ultra low sulphur diesel (ULSD) in July 2002. This reduced the effective duty rate for pure biodiesel to 25.82p/litre. The 20p per litre duty reduction applies to the volume of biodiesel in the blend, assuming bio-diesel comprises 5% bio-fuel then the new duty equates to a net reduction of approximately 1p/litre. As a result of the duties on bio-fuels, the commercial arrangements for feedstock supply are consequently more complicated than other biomass materials, particularly when considered against the relatively long project investment time-scales of 8-20 years. On the other hand, the commercial arrangements for biofuel feedstocks are easier than for biomass as they come from more traditionally grown field crops (such as oil seed rape), and therefore less incentive is required to encourage farmers to change crops. **Feedstock Sources/Costs**: It should be noted that imported biomass feedstocks are currently more economically attractive than indigenous supplies; palm oil is being imported for the proposed Teesside Bio-diesel facility (the quality of bio-diesel produced from palm oil is arguably of a lower quality than that produced from rape seed oil). Whilst indigenous supplies remain expensive, access to import facilities will be essential for supporting bio-fuel projects. **Availability of land**: Support is available for the establishment and growing of certain energy crops. CAP reform will lead to replacement of the AAPS under which set-aside payments are made. The AAPS will be replaced by a single payment scheme from 2005. Up to date information is available on the DEFRA web site at www.defra.gov.uk. Energy crops may be grown on land which also qualifies for set aside payments. **Feedstock Supply Consistency**: There must be sufficient long-term feedstock of the appropriate quality to operate the plant at the designed level over the life of the project. The feedstock quality and consistency must be maintained throughout the entire life of the project in order to ensure that the stringent product bio-diesel quality standards are maintained. Maintaining these standards is imperative if bio-diesel is to be marketed as a direct replacement for regular diesel. **Robust Bio-Fuel Supply Infrastructure**: Uptake of biomass fuelled systems is generally hampered by the lack of a proper fuel supply infrastructure and in part from the lack of a market for the fuel that is available. **Technology Design to Suit Feedstock**: The conversion technology selected must operate as predicted over the lifetime of the project with the available feedstock taking account of variations in feedstock and operating practice. **Planning Issues – Transport Logistics:** The economic characteristics of biomass fuel supply are strongly influenced by transport distances and logistics. Consequently, significant planning issues for biomass schemes include fuel delivery (e.g. lorry movements) and storage requirements (visual impact, land use, etc). **Availability of Debt Finance** Financing biomass is currently the biggest single obstacle to development, at best biomass electricity generating projects tend to be marginal. However, in many cases the 'show-stopper' comes from not being able to secure loan capital due to the perceived high technology and fuel supply risks.

Table 4.6 Technological and resource constraints: biomass small-scale heating

Technology	Constraints
BIOMASS : **Small scale heating applications using wood**	**Feedstock Supply**: Many of the issues relating to feedstocks for the larger scale biomass electricity/heat schemes are not an issue for small-scale schemes. Grant support is available as described for the large biomass schemes. Markets have emerged and are in the process of maturing for feedstocks for small-scale schemes. Distribution networks are being established and it is now possible for purchasers to obtain fuels

wastes and pellets	fairly readily. **Feedstock Costs** : As there is still a fairly significant haulage effort required to distribute from centres of production to facilities, fuel costs are still relatively high in relation to conventional heating fuels such as natural gas and heating oil. Such systems do become worthy of consideration for sites with no access to mains gas. **Fuel Supply Consistency**: There must be sufficient long-term feedstock of the appropriate quality to operate the plant at the designed level over the life of the project. The feedstock quality and consistency must be maintained throughout the entire life of the project.

Table 4.7 Technological and resource constraints: hydro

Technology	Constraints
WATER : Hydro	**Resource Availability**: It should be noted that sites with less than 2m of head tend to be relatively very expensive. The most cost-effective sites are likely to be refurbished mills especially if they can be incorporated within a larger development where the energy can be used on site. **Traffic in construction**. The extent of necessary civil engineering works to impound water, divert flow and lay pipes and foundations will affect the vehicle movements during the construction of a scheme. Most low-head sites will make use of the existing characteristics of watercourses, and will have minimal need for additional civil engineering. **Visual amenity in operation**. The visual impact of a low-head hydro scheme will be very case specific. The size of buildings and civil engineering works associated with low-head sites tends to be small, in keeping with the relatively small amount of energy that is available in low-head sites. Buildings and associated works may be constructed sensitively (in terms of design, materials, screening etc), but their position relative to the river is largely fixed. **Ecosystem impacts**. There may be instances in which a new hydro scheme could risk interfering with sensitive ecosystems or rare species. Such risks may be higher in a national park or semi-wilderness area, and lower on an existing weir in a lowland river. Input from wildlife or ecology experts may be required as part of an environmental impact assessment.

Table 4.8 Technological and resource constraints: building technologies

Technology	Constraints
WIND : Rooftop Wind Turbines	**Wind Speed** – Knowledge of the local wind resource is critical to designing a wind energy system and predicting output. For domestic installations a good source of information on local wind speeds is the NOABL database. **Planning issues** such as visual impact, noise and conservation issues also have to be considered. System installation normally requires permission from the local authority. **Grid Connected or Stand-alone** - Small-scale wind power is particularly suitable for remote off-grid locations where conventional methods of supply are expensive or impractical.

Technology	Constraints
SOLAR : Photo voltaic **SOLAR : Thermal**	**Building Situation**: Typical criteria for domestic dwellings or other buildings: • Free from planning restrictions such as being in a conservation area. • Spatial orientation i.e. facing south. • All solar systems must be deployed so that they are substantially protected from shadows cast by adjacent buildings, trees or other obstructions, and maximise a southerly orientation. **Heating Requirements**: An appropriate energy demand curve i.e. as smooth as possible, with as constant an energy demand throughout the day as possible. • Visual amenity in operation : • Active solar thermal collectors for houses may comprise around 3-4m² of collectors, usually mounted on the roof and providing heat to a fluid circulated between the collectors and a water tank. In most systems, only the collectors are visible, looking similar to dark roof lights. Some modern designs are flush with the roof. Larger scale systems (e.g. in industry, leisure centres) would use banks of collectors. • Photovoltaic installations can take a variety of forms as 'panels' added to an existing surface or roof covering, or they can become part of the fabric of a building e.g. as external wall cladding, roofing systems, or built in to glass facades or roofs. PV cells are available as solar 'slates' which mimic the appearance of natural slates. An installation on a house roof might be less than the total roof area, or could form the entire roof. **Planning Issues**: Solar systems could present a potential problem in areas of visual sensitivity (e.g. special landscapes, conservation areas). Note however that products (such as solar PV 'tiles') have been developed which will greatly reduce visual impact. Ground and air source heat pumps can be employed to upgrade solar heating of the ground or air, hence recovering renewable energy. These installations are normally free from planning consents but are subject to building regulations. **Skills Base**: Installation of the various building-related technologies is generally within the capabilities of skilled tradesmen, albeit appropriately trained. There is a general lack of awareness within the industry about such technologies, demand is relatively low and consequently the availability of appropriate installers is still low.
GEOTHERMAL	Geothermal technologies are highly dependant on the nature of the geology and temperature of the rocks concerned. The nature of these dictate the energy available, the method of extraction and the form in which the energy is made available through the transport medium which is normally water or steam. The majority, if not all such installations will be subject to planning consent and extraction licenses.

4.6 Opportunities for overcoming deployment barriers

Local Government, along with environmental entrepreneurs, is in a strong position to pursue initiatives with the objective of 'championing' good practices and overcoming barriers preventing deployment of renewable energy technologies. Table 4.9 identifies the opportunities and proposals for addressing and possibly overcoming the barriers described in the previous sections. These proposals should be viewed as a suite of options that, if applied in part, might support achievement of an amount of renewable energy generation at the lower end of the ranges identified in Section 5. To achieve the higher end of the ranges of renewable energy production would require such proposals as these to be implemented to some degree **and** for favourable commercial competitive pressures and national support to continue to be given to the stimulation of renewables.

The proposals have been developed on the basis of our knowledge of best practice in other parts of the UK and Europe. The proposals offered in this report set out to encourage consideration of their practicality and economic viability and to stimulate debate amongst stakeholders on further measures that might be employed to improve the uptake of renewable energy. The relevance of any such proposal to Hertfordshire should be considered; availability of local biomass supplies could still prove to be a significant barrier to the applicability of these proposals.

Table 4.9 Typical options for overcoming deployment barriers

Possible Response Proposals
Public Buildings: Local Government Councils and other public bodies own a large number of public buildings that may be heated with out of date boilers that could be due for replacement over the coming years. While wood fuelled heating systems (fuelled by waste wood products or sustainably grown wood crops) struggle to compete with gas in economic terms, they fair much better against oil. There may therefore be an opportunity for the local councils to take the lead in heating council buildings with wood fuel, although it should be noted that not all wood fuelled technologies are able to meet the same emissions standards as modern conventional boilers. As these buildings are likely to become exemplars, it is important that the technologies employed are able to meet the same standards. One possible vehicle for implementing a significant number of wood fuelled heating systems in council buildings would be to employ the Energy Services Company (ESCO) model. Under such a model, an ESCO would take ownership and responsibility of the customer's plant (in this case housed within council buildings) and then charge for each unit of heat used. **Development of Technological Centres of Excellence**: Such centres could provide a single point of contact and a comprehensive service to the renewables industry by maintaining the quality of information, feedstock, advice, engineers, training, research and development related to renewable technology in the region. In particular the centre would aim to develop the skill base required for the installation and maintenance of small scale renewable energy technologies (in accordance with ENV8, Draft East of England Plan). Such a centre might use the facilities and technologies show cased by RES' Kings Langley offices and the BRE Integer Millennium House at Garston. **Promotion of Community Heating Schemes** (New Private and Social Housing Schemes): The opportunities for adopting renewable energy heating systems as the primary heat source within new build housing should be investigated with volume house builders and small private house builders. Local authorities and social housing providers in Hertfordshire could seek to identify existing housing developments that are due to have their heating systems upgraded together with new build developments. Feasibility studies should be carried out to determine the viability of installing, for example, wood fuelled heating systems into these developments. The work should focus on developments that are using oil/or electricity as the heat feedstock as wood fuel will struggle to compete with gas on economic grounds. **Flagship Projects**: have a demonstrable effect on raising the profile of new technologies and increasing public awareness. Projects such as the Delabole centre in Cornwall sees a significant number of visitors each year, as does the wind turbine at Swaffham. The Integer Millennium House (featured as the 'BBC Dream House'), in Garston provides an excellent example of a sustainable home; as well as energy efficiency measures, it incorporates solar PV, solar thermal, ground source heat pump and small scale wind turbine. If Hertfordshire could develop a renewable energy, wood fuelled heating project with a sufficiently high profile, similar interest might be stimulated. Such a large project could also help to kick start the wood fuel supply chain in the County.
Industrial Estate District Heating Scheme : New industrial estates and business park developments present a further opportunity to install district heating schemes or CHP systems fuelled by wood. Work should be undertaken with regional partners such as the Government Office of East of England, local councils and private industrial estate owners to identify existing and new developments that could utilise these technologies. Detailed feasibility studies to assess the commercial viability of a number of industrial estates for conversion to biomass fuelled heating systems should be undertaken. These would provide economic and technical models for the installation of biomass fired district heating schemes that could then be considered for wider development.

Possible Response Proposals

New Housing Renewable Technologies : New domestic developments are an ideal place to install integrated renewable energy devices and passive solar design features. Some councils are encouraging both passive solar design and renewable energy considerations with new submissions, though this is still mainly down to the discretion of the developer involved and varies with different local plans.

Though cases of developments going beyond the present regulations are increasing, the majority still do not. No statutory requirements demand that renewable energy devices are included in new dwellings, so it is still rare for renewables to be integrated into submitted designs.

Planning officers should also actively encourage consideration of integrating energy efficiency and renewable energy technologies in to submission designs, when involved in consultation meetings with developers.

Public Awareness Campaigns: Whilst public awareness of energy efficiency measures is improving, awareness of renewable energy options is still low. The Local Authorities could consider awareness campaigns, perhaps in collaboration with the various relevant organisations and agencies charged with responsibility in this area, with the objective of stimulating uptake of schemes amongst residents of the existing housing stock.

5. Assessment of Hertfordshire's Renewable Energy Options

The extent of the deployment of renewable energy technologies and techniques in Hertfordshire will be strongly influenced by many factors which makes estimation of the potential deployment of renewable energy difficult.

This section of the report builds on the general review of deployment issues presented in Section 4 and considers the specific opportunities for development of renewable energy within Hertfordshire.

For the purposes of this study, we have considered the potential deployment from a number of perspectives in order to provide some indication of the range of potential production capacity, energy output and carbon savings that might be achievable. The detailed assessment of the potential for each of these technologies is provided in the following sections.

5.1 Large scale wind

There is currently one commercial scale turbine in operation within Hertfordshire, located at the Renewable Energy Systems (RES) Office near Kings Langley. This refurbished Vestas V29 225kW wind turbine has a hub height of 36m and a rotor diameter of 29m. According to Energy World (October 2004), this turbine is expected to produce 250 MWh annually.

Future wind farm developments look a distinct possibility for Hertfordshire. East Hertfordshire Council has recently approved a proposal to erect a 40m meteorological mast to monitor wind speeds at a site near Aspenden.

5.1.1 The wind farm lifecycle

It is important to understand the wind farm lifecycle when considering the potential for developments within an area.

Table 5.1 Wind farm life cycle

Phase/Activities
Site Identification: Taking into account a number of considerations, the developer seeks to identify a suitable site for a wind farm. The considerations made when identifying a wind farm site are based upon those considered by the relevant planning authority during the consenting phase, as well as the commercial viability of the site. These considerations can loosely be categorised into 'environmental' and 'technical', both of which are discussed in the next section. Commercial considerations are made in light of the technical and environmental considerations, though will also include other aspects. As well as consulting policy, it is possible that a developer may wish to consult with the relevant planning authorities with regard to potential sites during this stage.

Phase/Activities
Acquisition: Upon identifying a suitable site and gaining the interest of the relevant landowners, it is normal for a developer to negotiate an exclusivity agreement. These agreements may provide the developer with permission to access the site and erect temporary equipment to assess the viability of the site. Increasingly, this process has been taking the form of a competitive tender between rival developers.
EIA and Site Design: Following the acquisition of a suitable site, planning and development begins. This stage varies depending on the proposed size of the development. Depending on the sensitivity of the site and the opinion of the local authority, a wind farm with an installed capacity below 5MW may be submitted for consent without a full environmental impact assessment (EIA). In such a case, it is usual for the planning application to be complemented by an environmental report, the scope of which would be agreed with the local authority prior to any work being carried out. For larger developments requiring an EIA, (but less than 50MW in capacity), the application is made to the local planning authority. The scope of the EIA is usually agreed with the local authority following a formal scoping process. The end result of an EIA is the production of an Environmental Statement (ES). Developments planned to be over 50MW in capacity need to be submitted to DTI. Before completion of the necessary EIA, a formal scoping process will take place with the DTI, including the local planning authority as a statutory consultee.
Site design work is usually completed in parallel to the environmental studies, so that the environmental data can be used to inform the site design and minimise environmental impacts. Site design work will also include further investigation of the technical considerations made during the site identification stage. The site design will be submitted with the ES to form the planning application. During this stage, the developer and their representatives will engage with a range of both statutory and non-statutory consultees, including the local planning authority and local communities.
Consenting: The consenting process begins on submission of the proposed plans and the necessary supporting material. Though wind farms are submitted under the same conditions as equivalent developments, it is not unusual for this process to take longer than the statutory requirements.
It is a realistic possibility that a wind farm application may be called in to be determined by the ODPM or be subject to a public inquiry. Under such occurrences, the consenting process will be further lengthened.
Construction: Following consent, a wind farm may be constructed. The actual physical construction of a wind farm is preceded by a period of detailed design work, site investigation, procurement, contracting, financing and the sorting out of any remaining legal issues. Depending on the how much of this work has been completed or prepared in the previous stages, this could take up to a few years to complete. The length of construction period is very much dependent on the size of development.
Operation: Upon completion of construction, the wind farm is fully operational and can supply electricity to the grid. A wind farm is typically designed for an operational life of around 20 years.
De-Commissioning: Once the operational lives of the turbines making up a wind farm have been reached, they are de-commissioned and removed from the site. Upon reaching this point, it is possible that a developer may wish to 're-power' the site, by installing new turbines. This is in effect a new development subject to consenting, taking the process back to the acquisition stage. If re-powering is refused consent or is not the desired option, restoration work is carried out on the site in accordance with the original planning consent.

5.1.2 Environmental considerations in the context of Hertfordshire

Designated areas

At least one example of all of the main statutory environmentally designated areas exists within Hertfordshire. In general these are relatively small in size and do not exclude large areas from potential development. There are no National Parks within Hertfordshire, though part of the Chiltern Hills is designated as an Area of Outstanding Natural Beauty (AONB). This area is close to the north west county boundary. It is unlikely, under present planning conditions, that a developer would seek to site a wind farm in such areas.

Green Belt land covers a significant area of Hertfordshire that might be suitable for commercial renewable energy projects. Renewable energy developments are not precluded from green belt land; PPS22 states that developments should not be excluded if it can be demonstrated that the wider environmental benefits outweigh any harm by reason of inappropriateness.

Landscape and visual

As terrain is relatively flat, the visual influence of a wind farm sited in Hertfordshire is likely to exist in most of the surrounding area. The Hertfordshire Structure Plan (1998) designated approximately 40% of the county Landscape Conservation Areas, defined as areas where particular regard should be given to the setting, siting, design and external appearance of developments within such areas. Though this factor alone is unlikely to deter a wind farm developer, it is likely that some of the designated landscapes within the county will influence the design process of a wind farm.

Ecology and ornithology

This would need to be investigated on a case by case basis. According to the Hertfordshire Biological Records Centre, Hertfordshire is historically a breeding ground for stone curlews (and other farmland bird species). Stone curlews are listed in the EC Birds Directive and protected under Schedule I of the Wildlife and Countryside Act, 1981. The presence of Stone Curlews and any other breeding or migratory bird species, and the potential impacts of a wind farm development would be considered through the EIA process.

Hydrology

Hertfordshire, being relatively dry and having relatively few watercourses, would be viewed upon favourably by a wind farm developer, though this would still be a consideration for an EIA.

Noise and shadow flicker

The population centres of Hertfordshire are obviously not suitable for wind farm construction due to noise. The entire districts of Broxbourne, Stevenage, Three Rivers and Watford are completely unsuitable for wind farms for this reason, though it may be possible that 'merchant' schemes, consisting of single turbines, could be applied to larger industry areas. The proximity of dwellings is also likely to severely limit turbines in several other districts.

The districts of North Hertfordshire and East Hertfordshire are the most sparsely populated areas and hence have the largest amount of land unconstrained by noise issues.

Features of cultural heritage

Archaeological features and feature of cultural heritage interest are likely to be found across most of the county. There are over 170 Scheduled Ancient Monuments recorded, however it is likely that any planned wind farm developments could be designed to avoid these.

Public access

A large network of public footpaths and bridleways cross the county and it is most likely that a proposed site would be near to one of these paths. From a health and safety perspective, public access can remain unrestricted around an operational wind farm. The visual impacts associated with public rights of way would be considered through the Landscape and Visual Assessment of the EIA.

5.1.3 Technical considerations in the context of Hertfordshire

Terrain, topography and land-use

The topography across the county of Hertfordshire is generally low lying with relatively gentle gradients. Hertfordshire contains three main upland areas; the southern upland area, the north-east upland area and the western uplands. They are divided by gentling undulating lowland areas. The underlying geology comprises chalks and boulder clays. Neither topography nor geology are considered likely to present a physical constraint to wind farm development.

Approximately 70% of the land area in Hertfordshire is, used for agricultural purposes (DEFRA, 2001). Wind energy developments are frequently constructed on agricultural land, often reducing ecological impacts and allowing relatively straightforward site access and construction.

Resource

Traditionally, wind farm developers have generally considered that a site must have an average annual wind speed of 7m/s or greater at hub height to be economically viable. This is one of the main reasons why wind farm development activity has mainly concentrated in areas considered to have a good wind resource, such as Cumbria, Cornwall and Scotland. Development companies have historically largely ignored lower wind speed areas with a resource predicted to be lower than 7 metres/second. However, the present and potential future returns under the Renewables Obligation coupled with continued technology improvements has meant that lower wind speed areas, such as Hertfordshire, may become more viable and could be considered by developers.

Assuming that a wind farm site within Hertfordshire had an average wind speed of 7 metre/second at hub height, each installed MW of capacity would produce approximately 2.5 GWh of electricity each year.

Electricity grid

The electricity network in Hertfordshire serves a population of over one million residents. This fact, coupled with the county's proximity to London has meant that a good electricity distribution network is in place. Consequently, it is likely that suitable wind farm sites would be able to find relatively straightforward connection points. Network use charges are also likely to be low due to the relative proximity of such a large population.

Television and radio communications

Hertfordshire has a well-developed network of fixed link communications, which naturally connect the main population centres. However, there are still plenty of potentially suitable areas away from fixed link paths. It is noted that wind farm development in North Hertfordshire will have to make full consideration of the Metley Hill Radio-Communications Agency, Baldock Radio Station.

Civil aviation and military interests

The position of both Luton, Stansted and Heathrow airports with regard to wind farms would be a key issue to resolve should a scheme be planned for Hertfordshire. The Civil Aviation Authority (CAA) requires that a wind farm developer consult with any major aerodrome that is within 30km of a proposed site. The majority of Hertfordshire is located within a 30km distance of each of these airports (see Appendix 2). This could potentially be a major issue for developers.

The Operations Projects and Capacity Manager at Stansted Airport was contacted regarding the impact of wind turbines on aviation radars, he stated

> *"Any turbine which is within line of sight of the airport radar has the potential to adversely affect the airports radar systems (and indeed other navigational aids and communications equipment depending on the circumstances)… Given the height of wind turbines is often in excess of 100m and there is limited high terrain in the vicinity of Stansted Airport which might 'shield' the turbines from the radar it is possible many proposals may well be of concern. It would be wrong however to dismiss all schemes without due consideration. Each case needs to be considered on its own merits based on the specific circumstances which apply. It would also be worth pointing out that as part of our consultation process BAA will consult with all relevant parts of NATS Services Ltd, the airport's air traffic service provider."*

Existing infrastructure

Existing infrastructure will be identified through individual site assessments. It is likely that a developer would come across some infrastructure (gas, electricity, water, roads etc) that would need to be considered during the site design, but it is unlikely that these could not incorporated in the site design.

Access

The good network of motorways, trunk roads and A-roads throughout Hertfordshire would mean that it would be relatively straightforward to transport wind turbine components to within at least 5km of most of the county. Access to sites along minor roads would need to be assessed on a case by case basis, though the lack of steep gradient routes and minimal bridges means that it is likely that suitable access can be achieved to most potential wind farm sites.

5.1.4 Potential wind farm sites within Hertfordshire

By taking into account the environmental and technical considerations made when siting a wind farm, we have assessed Hertfordshire geographical information system (GIS) data to identify areas that are likely to attract wind farm developer interest.

Areas that would be unsuitable for commercial scale wind energy developments were initially identified by discarding all areas designated for international or national nature conservation (SSSIs, SPAs, SACs, RAMSAR sites, national nature reserves) and all AONBs. Areas within 500m of all major settlements (as defined by HCC) were also discarded. Consideration was given to areas designated for local nature conservation, designated Landscape Conservation Areas and radio communication links, although these constraints were not considered to be definitive, and these areas remain 'open' as potential areas for wind energy development.

Following initial GIS analysis, a paper based mapping exercise was undertaken, identifying areas with potential for wind farm development through a review of 1:25,000 scale maps. This review involved consideration of individual properties, topography and areas of woodland.

As a starting point, nearly 50 locations were identified as potentially having space for at least one turbine (based on a modern 2MW turbine). On this crude basis alone, Hertfordshire has the theoretical capacity to support a wind generation in the order of several hundred mega-Watts.

Each site was categorised according to its potential size (area and potential generating capacity that might be accommodated) and its probable attractiveness to a developer (based on the presence of any non-definitive constraints - e.g. fixed communication links, local nature reserves etc.). A summary of the results is shown in Table 5.2. The table provides an indication of the number of sites potentially available for development in Hertfordshire. The sites have been categorised in terms of development attractiveness (from high to low) and capacity.

Table 5.2 Classification matrix of potential wind farm sites by size and constraint level

			Development Attractiveness			
	Size Classification	**Capacity (MW)**	**High**			**Low**
Wind Farm	Cluster	1 – 5	0	1 – 3	4 – 7	1 – 3
Wind Farm	Small	5 – 11	4 – 7	1 – 3	8 – 10	4 – 7
Wind Farm	Medium	12 – 20	4 – 7	1 – 3	4 – 7	1 – 3
Wind Farm	Large	20+	0	0	1 – 3	1 – 3

Key

No. Sites	
0	white
1 – 3	light grey
4 – 7	dark grey
8 – 10	black

As a rule of thumb, 100 ha will support 10 – 15 MW of wind energy capacity, excluding any stand off requirements for noise or other site specific constraints.

Areas of greatest potential

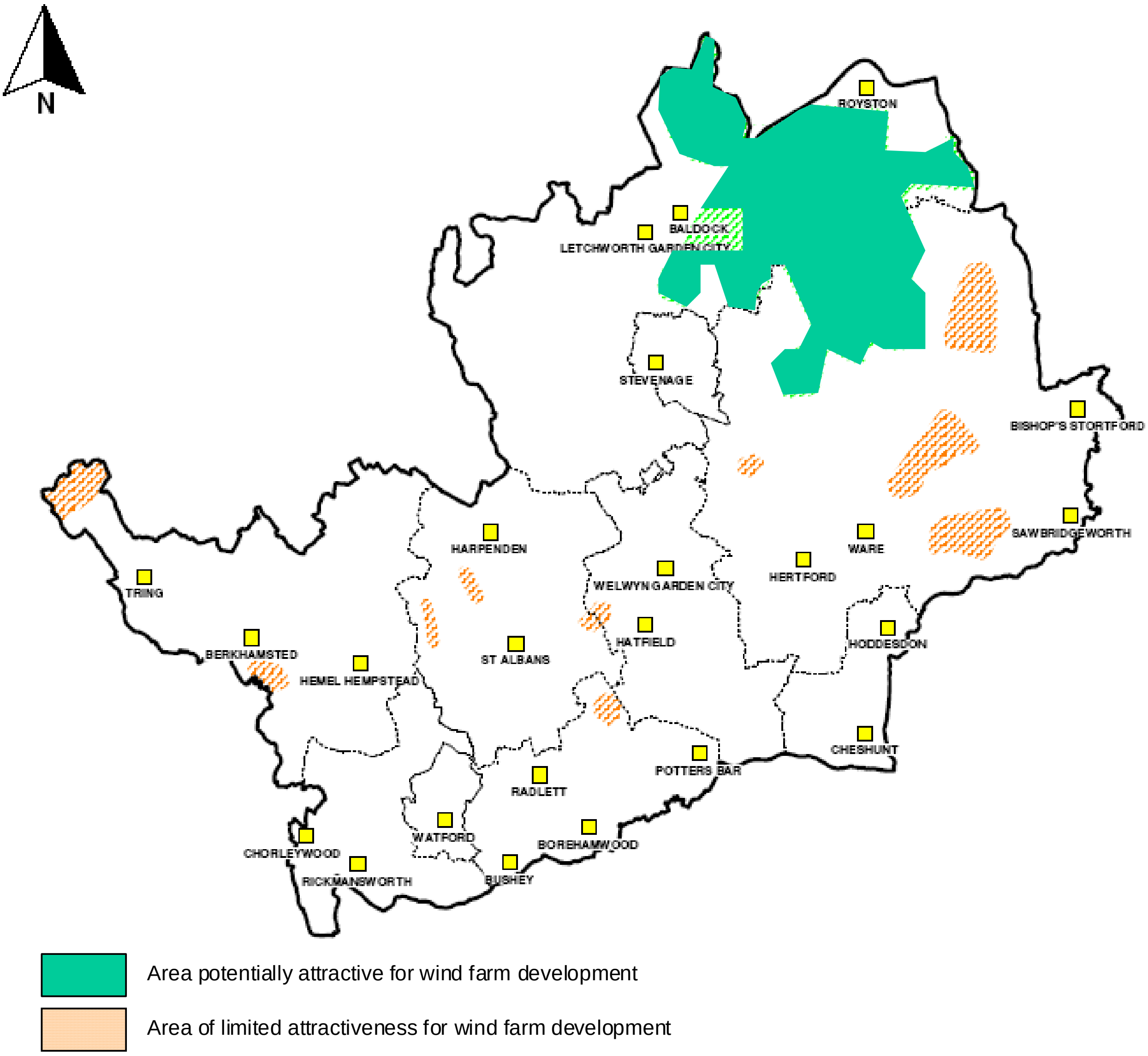
The north east of the county is likely to be the most attractive to wind farm developers. With its sparse population, this area has the highest area of land unconstrained by noise. The location of windmill sites also suggests that the wind resource may be sufficient in places. This area is also more than 15km from both Luton and Stansted airports.

Other areas of the county may have a degree of attractiveness to wind farm developers, though the proximity of a major airport would be a particularly concern.

Figure 5.1 shows the location of the areas considered to be the most attractive to wind farm developers.

A map of constraints, used to identify the potential sites is included as Appendix 2.

Figure 5.1 Wind Farm Development Potential in Hertfordshire



Merchant wind schemes

There is currently a developing market for 'merchant' wind schemes in the UK. These schemes often involve the erection of a single turbine to supply electricity direct to a specific user. When an excess amount of electricity is produced, electricity is exported to the grid. The turbine at the Kings Langley office for RES is a good example of such a scheme.

Though this study has not looked at any specific sites in detail, it is clear that there is such potential at several locations in Hertfordshire. Merchant schemes are normally planned for sites with a relatively high electricity consumption, either owned by a single user or as part of a commercial estate with several businesses. Projects in the UK have used varying sizes of turbines, from 20kW up to 2MW in size. As well as providing for on-site electricity needs, the use of renewable energy would allow the user to claim the ROCs and also climate change levy exemption certificates (LECs). Installing a turbine on the premises of a company can also bring public relations opportunities, often seen in a positive light.

5.1.5 How Hertfordshire could influence wind farm development

Developing a wind farm site is still considered to be relatively risky. A large amount of money needs to be spent by a developer up front before consent can even be applied for. In order to minimise this risk, a developer will seek to gather as much information about a site before committing a significant spend. One of the first things that a developer will look at when considering a site is the planning policy for the location and any other relevant documentation that could indicate particular issues surrounding a site.

Developing policy and supporting documents that can guide a developer to or even away from a specific area can aid the site identification process. This would be best achieved by developing such policy in relation to the realistic likelihood and type of scheme that would be possible in the policy area. Using the results of the wind farm potential assessment, a summary of the type of developments that could realistically be sited in each planning authority area is presented in Table 5.3. (The size categories referred to correspond to the size categories identified in table 5.2).

Table 5.3 Potential for commercial wind energy development

District	Negative Development Influences	Positive Development Influences	Potential Largest Development Scale
Broxbourne	Highly populated area		Merchant scheme
Dacorum	Chiltern Hills AONB	Sparsely Populated	Small wind farm
	Proximity to Luton Airport		
East Hertfordshire	Proximity to Stansted Airport	Sparsely Populated	Medium wind farm
Hertsmere	Highly populated area		Small wind farm
North Hertfordshire	Proximity to Luton Airport	Sparsely Populated	Medium wind farm
St. Albans	Highly populated area		Small wind farm
	Proximity to Luton Airport		
Stevenage	Densely populated area		Merchant scheme
Three Rivers	Densely populated area		Merchant scheme
Watford	Densely populated area		Merchant scheme
Welwyn Hatfield	Highly populated area		Small wind farm

5.1.6 Scenarios

By considering the potential for commercial wind farm sites within Hertfordshire, along with both positive influences and potential barriers, a range of scenarios can be envisaged for the future. These are shown in Table 5.4.

Table 5.4 2010 Wind energy development in Hertfordshire

Scenario	Development Influences		Operational Wind Farm Projects Achieved	Total Installed Capacity (MW)	Potential Annual Energy Yield (GWh)*
Business As Usual (Existing)	+ve	Renewables Obligation	RES Kings Langley	0.225	0.25
	-ve	The opinion of Luton & Stansted airports remains unknown			
	0	Planning policy does not provide specific guidance to developers			
			Total	**0.225**	**0.25**
"Possible Case "	+ve	Renewables Obligation	RES Kings Langley	0.225	0.250
	-ve	The opinion of Luton & Stansted airports is un-favourable	A cluster/small wind farm in North Hertfordshire	5	12.5
	+ve	Network charges are favourable in the south east compared to other areas	A cluster/small wind farm in East Hertfordshire	5	12.5
	0	Planning policy does not provide specific guidance to developers			
			Total	**10.225**	**25.25**
Extended Case	+ve	Renewables Obligation	RES Kings Langley	0.225	0.25
	+ve	The opinion of Luton & Stansted airports does not limit schemes of a sufficient distance	Two medium/small wind farms in North Hertfordshire	30	75
	+ve	Network charges are favourable in the south east	Two medium/small wind farms in East Hertfordshire	30	75
	+ve	Planning policy provides specific guidance to developers	Other developments based on cluster wind farms or merchant schemes in other districts	5	12.5
	+ve	Local planning officers gain experience of dealing with wind farm applications			
			Total	**65**	**163**

Key:

+ve = Positive development influence

0 = Neutral development influence

-ve = Negative development influence

* = Assumes 2.5 GWh of electrical generation per MW of installed capacity (except for Kings Langley)

5.1.7 Summary

Though not traditionally thought of as a wind farm area, Hertfordshire does have sites that could attract developers. The stimulation of wind farm development by the Renewables Obligation has allowed developers to look at areas considered to have a lower wind resource, such as Hertfordshire, where competition for sites is not as fierce as other areas.

Positive development influences that may attract developers to Hertfordshire can be summarised as:

- availability of more sparsely populated areas in the north and east of the county;
- well developed distribution grid infrastructure; and
- lower electricity network charges, due to the relative proximity of a large population.

Potentially negative development influences do exist which may act as barriers to development. By far the most critical of these from a developer's point of view, is the proximity of both Luton and Stansted airports to potentially suitable sites. The opinion of an airport authority can have a significant bearing on the determination of a planning application and hence represents a significant risk for a development. Proximity to airports can be a 'show-stopper' for a wind project. Nevertheless it is reassuring to note that the airport authorities acknowledge that each development should be considered individually on its merits.

All of the districts within Hertfordshire are able to support modest schemes, of some description, however it is clearly the districts of North Hertfordshire and East Hertfordshire that have the greatest development potential.

Table 5.5 Summary of large scale wind potential

Scenario	Capacity	Production Output	Estimated Avoided CO_2 Emissions (tonnes/year)
Business as Usual (Existing)	0.225 MW	0.25GWh/year	110
Possible Case	10 MW	25 GWh/year	10,800
Extended Case	65 MW	163 GWh/year	70,100

Wind energy based in Hertfordshire could potentially provide enough electricity to meet the proposed figure of 153 GWh suggested in the earlier East of England Sustainable Development Round Table study. To generate this much electricity, just over 65 MW of wind energy capacity would need to be installed. This is equivalent to around 30 large modern wind turbines. If three to four medium scale wind farms in Hertfordshire were developed, which might technically be achievable, the 153 GWh of renewable electricity could be provided by wind energy alone.

However when considering targets, it should be noted that this is the theoretical, technical maximum wind generation potential. In reality it is likely that the achievable wind generating potential will be much lower as a result of site specific constraints such as aviation, ecological, noise and landscape constraints.

5.2 Biomass

5.2.1 Overview of biomass options

For the purposes of this study we have evaluated the prospects for a number of biomass options that are representative of the scale required to be economically viable. These various options are considered in the following sections.

Table 5.6 Biomass options considered

Option	Assumptions
1. Biomass for co-firing in large power plant	100,000 tonnes/year (11,000 ha of land) of biomass material for use as a co-firing fuel in large combustion plant. Annual Output = 175,000 MWh/year (electrical). (Assumed 35% conversion efficiency (thermal to electricity)
2. Biomass for dedicated CHP facility	100,000 tonnes/year (11,000 ha of land) of biomass material for use in a dedicated CHP facility. Annual Output = 125,000 MWh/year (electrical) + 160,000 MWh/year (used thermal capacity) [Assumed 25% conversion efficiency (thermal to electricity), and 50% utilisation of residual heat].
3. Biomass production and production of transportation fuels	Use of 11,000 ha of biomass material for use in bio-fuel production. Note that the commercial viability of these schemes is highly questionable. **Bio-diesel** Annual oilseed rape requirement : 33,000 tonnes of seed Potential Annual Output : 15 million litres /year **Bio-Ethanol** Annual crop requirement : 44,000 tonnes of wheat + 292,000 tonnes of beet. Bio-ethanol - Potential Annual Output : 46 million litres /year
4. Animal Slurry Wastes in Anaerobic Digestion	Facility processing 150,000 tonnes/year of animal slurries to produce 2 MWe using anaerobic digestion (similar to the Holsworthy Biogas facility in Devon). 30 dairy farms, 10 mile radius. Capacity = 2 MW electrical. Annual Output = 14,000 MWh/year (electrical)
5. Sewage sludge (90% dry solids) EFW	Energy from waste facility processing 30,000 tonnes per year of dried sewage sludge. Estimated Annual Output = 30,000 MWh/year (electrical)
6. MSW EFW	Energy from waste facility processing 100,000 tonnes per year of post-recycled municipal solid waste. Annual Output = 104,000 MWh/year electrical.
7. Small scale biomass-heat facilities	Multiple small-scale facilities producing heat for use in schools, hospitals, and domestic dwellings. Presumed 20 medium size facilities of 200 kW capacity and 200 residential scale facilities of 20 kW capacity and 50% capacity factor.

Option	Assumptions
	Wood Pellet Consumption : 10,000 tonnes per year
	Annual Heat Output = 35,000 MWh/year (thermal)

The capacity of Options 1-3 has been selected to represent the minimum level required for achievement of commercial viability and to provide comparability between these options. This level of land-take is also consistent with the levels considered in East of England studies for their Extended Case scenario. 100,000 tonnes per year of biomass is likely to entail some 200-300 vehicle movements per week.

Whilst we have only completed a general review of current land use and crop production, a more detailed appraisal of land and cropping patterns is unlikely to change the broad conclusions on the success prospects of these various options.

5.2.2 Detailed review of biomass options and success prospects

The following section considers the prospects of success for each of these projects in order to determine what their likely contribution might be in Hertfordshire.

With regard to Options 1-3 (the larger scale facilities), it should be noted that large-scale biomass projects in the UK are relatively few in number. The most notable large-scale projects are, in fact, located in the eastern part of the country at Thetford (chicken litter, 39 MW), Eye (chicken litter, 13 MW), and Ely (straw, 37 MW). It should be noted that these three projects are based on agricultural residues and not energy crops which illustrates the current relative un-competitiveness of energy crops in such applications. One of the reasons for this 'un-competitiveness' is that there is a relatively long lead time before maximum yields of energy crops are produced (3 - 5 years) and initial set-up costs can be high. In order to entice farmers to grow energy crops, longer term growing contracts will be required. Once a consistent and viable energy crop supply has been set up, then the competitiveness of energy crops should be improved. The Ely straw plant could be expanded to accept miscanthus, a crop which agriculture can generally adapt readily to grow, this might help to promote biomass production in the region.

The proximity of such significant biomass projects in the East of England also presents a significant barrier to the deployment of such schemes in Hertfordshire as competition for the biomass resources will be great. Already the Ely, Eye and Thetford projects are taking in feedstocks from a very wide area across and beyond the region. This is, in part, because facilities are most willing to accept feedstocks which attract a gate fee (e.g. meat and bone meal residues). This has occurred at the Scunthorpe poultry litter plant, with the result that poultry litter has been diverted south to facilities in the south-east.

As identified in Section 4, the main constraint to the development of significant biomass renewable energy generation is feedstock. There are several reasons that lead us to believe that the prospects for any of the larger scale biomass energy facilities (i.e. options 1-3) contributing to 2010 and 2020 targets are very low.

- The economic viability of biomass facilities is strongly dependent upon low cost, local biomass supply infrastructures; they cannot tolerate significant transportation costs.

- Competition for biomass crops in the eastern region is relatively high and so importation of crops will also be difficult.
- Hertfordshire currently has no structured biomass production capacity.
- Establishment of a viable biomass infrastructure is complex and requires that several barriers be overcome:
  - Grant aid for energy crops requires the biomass to be grown locally to the point of use. Within 25 miles for large installations and 10 miles for small installations.
  - Change in farming policy – i.e. national support to switching of crop base (payments for energy crops are already available with the introduction of the single payment scheme more support is likely to become available).
  - Crop switching can require some three to five years to achieve 'steady state' (near maximum) reliable production conditions.
  - Crop switching requires that commercial agreements be reached between fuel suppliers and project developers well in advance of projects being secured. i.e. The relatively long lead times require that long contracts be established.

In addition to the above constraints that generally apply to Options 1-3, there are other specific barriers and challenges facing each of the options; these are summarised below:

Table 5.7 Appraisal of biomass options

Option
Biomass for co-firing in large power plant: The use of biomass to co-fire conventional coal-fired power plant has received a great deal of interest, with many of the major coal-fired power plant operators now investigating or actually implementing the use of co-firing in a number of their stations. Power station operators are driven by the attraction of co-firing as a source of ROCs. Unfortunately, there are no large coal-fired electricity generating plants within Hertfordshire. Those that do burn biomass tend to use very low cost wood wastes arising from established industries such as board manufacture, forestry operations. The use of biomass for co-firing in the Rye House CCGT plant would require that the biomass first be gasified. This represents a significant technological challenge and is unlikely to be realistically achievable by 2010.
Biomass for dedicated CHP facility: Whilst the technology is well proven, feedstock availability will be a significant barrier to a dedicated biomass CHP facility in Hertfordshire. Importation of feedstocks is likely to be economically difficult due to competition for low cost biomass in the region. Also, a 100,000 tonne per year facility will still face significant planning hurdles. Whilst there is a small number of successful large scale biomass projects in the UK, the poor economics have resulted in a paucity of new projects proceeding. Indeed the Winkleigh project in Devon is also understood to be experiencing planning difficulties relating to negative local public attitudes towards the project.
Biomass production and production of transportation fuels: There is considerable interest in diversifying the agricultural economy of the East of England region for the production of energy crops such as oil seed rape, sugar beet and wheat for the production of liquid bio-fuels. The Government envisages that these fuels could make up 5% of total fuel use by 2020. In the short term, however, the use of bio-fuels in transport is constrained by the availability of suitable agricultural land, crop yield and the demand for biomass/land for other uses. According to the Hertfordshire Biological Records Centre, the areas of north and east Hertfordshire would be suitable to support these types of crop.
Animal Slurry Wastes in Anaerobic Digestion: Anaerobic digestion of animal slurries for production of electricity via gas engines is a proven technique. Its commercial viability, however, is still questionable; the Holsworthy project in Devon is probably the only significant project in the UK. The Holsworthy project relied on a 50% capital grant (£3.9m). The economics of the project are understood to also be dependent upon being allowed to mix food waste with its cattle and pig slurries and then return the processed manure to farmers' fields. However, tighter restrictions imposed in the aftermath of foot and mouth (which started two months

Option
after construction began) threatened to put this at risk. It is understood that gate fees for the food wastes along with electricity sales are the only sources of revenues; no money exchanges hands between the farmers and plant, the farmer's supply the raw manure and receive processed manure free of charge.. According to the dairy hygiene inspectorate, at the end of 2003 there were only 31 dairy farms in Hertfordshire. Pig and poultry farming has historically been more widespread in the region, but pig farms have decreased by 40% in recent years. Considering the competition which already exists for animal manures in the southeast, it seems unlikely that there would be a sufficient quantity of local feedstock to fuel a viable anaerobic digestion facility. **Sewage sludge (90% dry solids) Energy from Waste**: Anglian Water is understood to be aggressively exploring opportunities for thermal treatment of sewage sludge in the Eastern region with the objective of recovering energy. Their prime driver is the reducing land bank available for disposal to land. They have considered and commenced development of several energy recovery projects in the region. The prospects of such a project proceeding are considered reasonable, although planning may still be a problem primarily due to public reaction to 'waste incineration'. Thames Water also has an anaerobic digestion plant at their Stanstead Abbots facility. The plant has an operating capacity of 1.5 MW. **MSW Energy from Waste**: Increasing pressures on local authorities to reduce the quantities of biodegradable municipal waste going to landfill are leading to the development of schemes relying on increased processing of waste, including thermal treatment with energy recovery. It has been noted that the East of England Sustainable Development Round Table studies do not consider EFW as a legitimate renewable energy technology. Electrical energy recovered from waste does, however, contribute to the UK's compliance with the EU Renewable Energy Directive.. The Hertfordshire Waste Strategy confirms the key policy decision not to consider the use of mass-burn waste incineration (beyond existing contractual commitments) as a means of disposing of Hertfordshire's municipal waste. It identifies emerging thermal treatment technologies such as anaerobic digestion and pyrolysis/gasification as potential solutions. Entec has undertaken several energy recovery studies for local authorities and considers it unlikely that such technologies will emerge as economically viable or as a widely applied, financeable solution to waste disposal over the next five years. A survey of Hertfordshire's organic streams would be useful to identify any additional opportunities, especially which offered the potential to produce renewable energy and reduce waste to landfill. It is understood that such a survey is being completed as part of the Renewables East Biomass Foundation Study. Despite the position of the region's Waste Strategy, several of the consultees of this study expressed an interest in the recovery of energy from waste, especially where waste has to be incinerated anyway.
Small scale biomass-heat facilities: For domestic and commercial scale heat only projects, biomass technology is well understood and the installation process is relatively straightforward, being carried out by general building services contractors and plumbers etc. Feedstock is usually pellet form for domestic applications and pellets or wood-chip for larger scale units; an established nation-wide supply infrastructure is developing. Biomass is financially competitive against oil. Public buildings are also suitable for conversion to biomass heating. HCC and the local authorities could consider heating their portfolio of buildings using biomass (such projects, e.g. schools have previously attracted grant funding). These type of projects would help to establish fuel supply networks and infrastructure in the county. Transport logistics can be minimised and community benefits enhanced by establishing local fuel cooperatives.

On the basis of the above basic assessment, the potential contribution to renewable energy targets from biomass sources is summarised as follows:

Table 5.8 Potential contribution from biomass options

Option	Estimated Avoided CO_2 Emissions (tonnes/year)
1. Biomass for co-firing in large power plant	168,000
2. Biomass for dedicated CHP facility	94,000

Option	Estimated Avoided CO_2 Emissions (tonnes/year)
3. Biomass production and production of transportation fuels	Bio-Diesel : 39,000
	Bio-Ethanol : 107,000
4. Animal Slurry Wastes in Anaerobic Digestion	6,000
5. Sewage sludge (90% dry solids) EFW	13,000
6. MSW EFW	45,000
7. Small scale biomass-heat facilities	9,000

These estimates are based on conversion factors and formulae provided in the DEFRA document, ""Environmental Reporting – Guidelines for Company Reporting on Greenhouse Gas Emissions".

It should be noted that the estimated avoided CO2 emissions for bio-fuels (Option 3) are higher than would be achieved in practice as they exclude any CO2 emissions associated with the production of the fuel.

The County Waste Strategy confirms that Hertfordshire's landfill capacity is diminishing rapidly; the majority of Hertfordshire's landfilled waste is transported to Bedfordshire. The Strategy also confirms that there is little evidence of historical sites as many have been restored to green fields for farming and agricultural purposes, or as open spaces.

OFGEM records reveal that there is a landfill-gas/energy recovery facility at the Westmill Road site of EDL Operations at Ware (4MW capacity). Detailed evaluation of resources at other former Hertfordshire landfill sites is beyond the scope of this study, but there would appear to be little prospect of any further renewable energy generation potential from landfill gas within the County.

5.3 Hydro

Hertfordshire does not have a significant hydro electric potential. It is a relatively flat county with no mountain or even significant hill ranges, has no major rivers crossing it and has relatively low rainfall.

The majority of the surface run-off from Hertfordshire feeds into the Lea (or Lee) and its tributaries which covers most of the catchments in central and eastern Hertfordshire. The Lea leaves the county to the south near Cheshunt before joining the Thames in London. The catchments to the west feed various tributaries of the river Colne and the Grand Union Canal. The Colne leaves the county to the southwest before joining the Thames near Staines.

All of the small-scale hydro potential within Hertfordshire is located at small, low-head, relatively modest flow sites. The best potential probably lays with the refurbishment of former mill sites or on canal infrastructure.

The 'Small Scale Hydroelectric Generation Potential in the UK' study carried out by Salford University in 1989 (often referred to as the Salford study) identified 12 sites within Hertfordshire for consideration. All 12 were concluded to be uneconomical under the terms of the study and were therefore not considered in detail. The 12 sites are listed in Table 5.9.

Table 5.9 Hydro potential

Ref	Location	River	OS Reference	Comments
01	East Hyde, Harpendon	Lee or Lea	TL 132 172	Disused Mill, review of aerial photographs shows much of the water infrastructure is still in place. Available flow likely to be ~0.5 m3/s, with head <4m, hence available power < 20kW.
02	Mill, St Albans	Ver	TL 136 077	Disused Mill, review of aerial photographs shows much of the water infrastructure is still in place. Available flow likely to be ~0.35 m3/s, with head <4m, hence available power < 15kW.
03	Bourne End, Hemel Hempsted	Bulborne	TL 033 064	Canal Infrastructure, review of aerial photographs shows water infrastructure still in place, as this is a controlled water way it is difficult to estimate flow but likely to be <0.5 m3/s head is noted to be <2m. Hence available power < 7 kW.
04	Mount Pleasant, Rickmansworth	Colne	TQ 041 910	Canal Infrastructure, review of aerial photographs shows water infrastructure still in place, as this is a controlled water way it is difficult to estimate flow but likely to be <2 m3/s head is noted to be <2m. Hence available power < 30 kW.
05	Brocket Hall, Hatfield	Lee or Lea	TQ 215 125	Weir, review of aerial photograph shows no signs of water infrastructure other than weir which may have been used for landscaping within Brocket Park rather than energy storage. Available flow likely to be ~0.8 m3/s, with head likely to be <3m, hence available power < 20 kW.
06	Lemsford Mill, Hatfield	Lee or Lea	TL 219 123	Disused Mill, review of aerial photographs shows some of the water infrastructure is still in place. Available flow likely to be ~0.8 m3/s, with head <4m, hence available power < 25 kW.
07	Mill Green, Hatfield	Lee or Lea	TL 240 098	Restored and operational Mil. Available flow likely to be ~0.8 m3/s, with head <2m, hence available power < 12 kW.
08	Cecil Saw Mill, Hatfield	Lee or Lea	TL 250 098	Mill, review of aerial photographs shows water infrastructure is still in place (possibly still operational). Available flow likely to be ~0.8 m3/s, with head <4m, hence available power < 25 kW.
09	Weir, Hertford	Lee or Lea	TL 321 115	Weir, (possibly former mill site) review of aerial photograph shows some signs of previous water infrastructure. Available flow likely to be ~1.0 m3/s, with head likely to be <4m, hence available power < 30 kW.
10	Dobbs Weir, Hoddesdon	Lee or Lea	TL 383 083	Canal Infrastructure, review of aerial photographs shows water infrastructure still in place, as this is a controlled water way it is difficult to estimate flow but likely to be <3.5 m3/s head is noted to be <2m. Hence available power < 50 kW.
11	Fieldes Weir, Hoddesdon	Lee or Lea	TL 391 092	Canal Infrastructure, review of aerial photographs shows water infrastructure still in place, as this is a controlled water way it is difficult to estimate flow but likely to be <3.5 m3/s head is noted to be <2m. Hence available power < 50 kW.
12	Kings Weir, Cheshunt	Lee or Lea	TL 376 052	Canal Infrastructure, review of aerial photographs shows water infrastructure still in place, as this is a controlled water way it is difficult to estimate flow but

Ref	Location	River	OS Reference	Comments
				likely to be <3.5 m3/s head is noted to be <2m. Hence available power < 50 kW.

The estimates of maximum available flow has been made from the nearest Environment Agency gauging stations which may be some distance from the actual site, and,

The estimates of head are based on the highest head likely to be encountered on this type of site, with the exception of the sites noted to be <2m, as this was a criteria for discarding some sites in the Salford study. The maximum power figure should therefore be taken as an 'order of magnitude' estimate only.

The above sites are likely to be the best sites in terms of energy capture. It should be noted that sites with less than 2m of head tend to be relatively very expensive. The most cost-effective sites are likely to be refurbished mills especially if they can be incorporated within a larger development where the energy can be used on site.

Micro run-of-river projects of the sort possible in Hertfordshire tend to cost between £2,500 and £5,000 per kW installed and generally have between 50% and 90% load factors. These schemes only tend to become financially viable where substantial capital grants are available or where there are other commercial reasons for completing the project.

The total maximum potential capacity of the above sites amounts to some 330kW installed capacity. In addition to the sites noted above a map review of the county identified a significant number of other former mill sites, weirs and canal locks all of which will have some, all be it very small, potential. It is estimated that there may be a further 100 sites or so with a capacity of between 10 and 20kW. Hence if every site with any potential was to be developed the total resource is unlikely to be significantly more than 2MW.

Table 5.10 Summary of hydro potential

Scenario	Capacity	Production Output	Estimated Avoided CO_2 Emissions (tonnes/year)
Low Case	0.10 MW	0.61 GWh/year	260
Best Case	2.00 MW	12.3 GWh/year	5,270

5.4 Embedded energy technologies

This section considers the potential for application of renewable energy technologies that can be integrated or 'embedded' into the built environment. Typically these include solar photovoltaic electricity generation, solar thermal/passive solar designs and ground source heat pumps. Although not truly embedded within the fabric of a property, the potential for community heating and roof-top wind turbines are also considered within this section of the report.

The majority of this section is focused on the domestic sector as the anticipated level of new build, in particular, is considered to represent a significant opportunity that can be strongly positively influenced by the local councils. Consideration is given to the commercial/industrial, highways and domestic sectors.

5.4.1 Embedded Generation Technologies

Solar PV

The integration of solar energy into buildings is dependent primarily on the form and orientation of the roof structure and the situation regarding the buildings' surroundings. The potential renewable energy that could theoretically be generated from this technology is therefore proportional to the total roof area of all the buildings in the county that have a suitable form and orientation.

Solar Thermal Water Heating

In many respects, the installation of solar thermal technology is subject to similar market conditions as for solar PV. However, solar thermal technology is considered more 'low-tech' and hence has fewer barriers to implementation and is also much lower in capital cost. Consequently it has achieved a higher market penetration.

The simple pay-back period for solar water heating, whilst considerably lower than that for solar PV is still nearly 10 years. The introduction of the Clear Skies grant scheme has the effect of reducing this to between five and seven years and there is some evidence that a number of major housebuilders are considering solar water heating either as part of an additional 'green-pack' or as a means of obtaining an 'Excellent' rating under the BRE EcoHomes scheme.

Passive Solar

Passive solar design for new buildings aims to reduce heating and lighting loads by careful design. The effectiveness of a passive solar house or business premises is largely influenced by the lifestyle or habits of the occupants/ users and requires their behaviour in terms of heating controls and use of artificial lighting to be compatible with the house. For the majority of occupants this is not a high priority. Under ideal conditions, passive solar design is thought to reduce the energy consumption of a house by about 10%, although this is difficult to quantify. Such savings can often be achieved more reliably through increased levels of fabric insulation and a high efficiency heating system. The aim of this study is to focus on the opportunities for the deployment of renewable energy and not energy efficiency or alteration of habits and lifestyles. Nevertheless the contribution that improvements in energy efficiency and lifestyle education can make should not be underestimated.

Ground Source Heat Pumps

The use of Ground Source Heat Pumps (GSHP) can provide a very energy efficient means of heating and cooling a building. They typically consume about a quarter of the energy that would be consumed by an equivalent boiler. However, they also typically (although not exclusively) use electricity and hence the benefit in terms of CO_2 emissions is much less significant. They are also considerably more expensive to install.

GSHP technology is particularly advantageous for buildings that are either off the gas network or where both heating and cooling may be required. Due to the installation procedures, which involve either drilling boreholes or moving large areas of earth, GSHPs are also best suited to new buildings. This limits the likely potential application of this technology. For the existing domestic sector, the market penetration is likely to remain very low. The main application is likely to be relatively small commercial buildings and public sector buildings such as schools.

The specification of a GSHP for any new or refurbished building would need to be considered in the context of the overall building design and the inclusion of other energy efficiency measures. The contribution that a GSHP can make in reducing energy consumption at an individual property is significant, however the potential for uptake across Hertfordshire is likely to be low. Consequently, the estimation of renewable energy generation from GSHPs for existing properties has not been considered in the context of Hertfordshire's renewable energy targets.

5.4.2 Residential

The Technical Potential

To gauge the potential impact of renewable energy technology in the residential sector, the proportion of fossil-derived energy displaced and associated carbon dioxide (CO_2) savings from a typical mid-sized dwelling have been assessed. These are expressed as a percentage of the total household energy consumption for heating and electricity and CO_2 emissions associated with a standard gas-fired condensing boiler in a property built to the insulation standards required by Part L of the current Building Regulations, see Table 5.11.

Table 5.11 Typical Saving from Renewable Energy

Technology	Fossil-Derived Energy Displaced	CO_2 Reduction	Equivalent MWh/year	Equivalent CO_2 tonnes/yr
Photovoltaic Cells	2%	3%	0.2	0.1
Solar Water Heating	7%	5%	1.1	0.2
Ground Source Heat Pumps	50%	27%	8.1	1.1
Wood Pellet Boiler	75%	57%	12	2.3
Micro-CHP	-1%	7%	-0.1	0.3
Increased insulation	9%	7%	1.5	0.3

Note that with micro-CHP, the initial trials suggest that the total energy consumption may be higher than with a conventional boiler but there are reductions in CO_2 emissions due to the reduction in the consumption of electricity from the grid. Similarly, a biomass boiler will typically use more energy than the equivalent gas-fired boiler as it is less efficient but, as the fuel is all carbon neutral, there are substantial net reductions in CO_2 emissions.

Table 5.11 also includes the impact from increasing thermal insulation. Whilst this is not a renewable energy technology it is one of the easiest ways of reducing the CO_2 emissions from dwellings and is included to help put the impact of the other technologies into context.

Not all of the above techniques and technologies can be applied on a single installation. Heat could be provided by either a ground source heat pump, a wood pellet boiler or a micro-CHP. Solar water heating can generally be applied irrespective of the method of water heating adopted, providing there is a hot water cylinder. Either solar photo-voltaic or a micro-CHP could be applied for production of electricity.

On the basis of this simple assessment it is evident that switching to a wood pellet boiler or ground source heat pump would provide significant CO_2 reductions albeit at some significant expense. For a more modest cost, application of thermal insulation beyond building regulations in combination with, for example, solar water heating has the potential to achieve about a 15% contribution to a household's energy needs.

Residential New Build

For the purposes of this assessment we have made the following assumptions about the amount of new build that could be subject to planning policy orientated towards increased use of renewable energy sources:

Total dwellings proposed	= 79,600 dwellings 2001-2021
Dwellings built 2001-2004	= 9,376 dwellings
Dwellings with Outstanding Planning Permission (OPP) as at April 2004	= 9,938 dwellings
Dwellings assumed to be built prior to Inspector's Binding LDF Report[1] (less OPP to avoid double-counting)	= (12,648 - 9,938) dwellings = 2,710 dwellings
Dwellings assumed to be permitted from 2004 to 2008 prior to when a new RE policy is assumed to be agreed for the development plan[2]	= 15,920 dwellings
Max. no. of dwellings that might be subject of new LDF policy on RE by 2021 based on EoE draft Plan	= 79,600 - 9,376 - 9,938 – 2,718 - 15,920 dwellings
	= 41,656 dwellings

[1] It has been assumed that the binding Inspector's Reports on most of the LDFs will have been published by 2008. It has also been assumed that the number of dwellings that will be built from 2004 to 2008 will be 4 years x 3,162 dwellings (which represents the mid-point between the annual average of 2,344 dwellings built over the last 4 years and the Draft EoE Plan annual target of 3,980 dwellings.

[2] A certain number of additional dwellings will be permitted between 2004 and when a new RE policy is in the development plan (assumed as 2008) which will not be the subject of such a requirement. The Draft EoE annual target of 3,980 dwellings has been used for the purposes of calculation. N.B. LPAs are likely to be able to require RE in new development before 2008 under regional Policy ENV8 once the Panel's Report has been published.

This would represent an average annual build rate of about 3,500 dwellings over the period 2009-2021.

The integration of renewable energy in buildings is usually more cost-effective when installed during construction rather than retrospectively. More significantly, there is the opportunity to promote renewable energy through planning guidance or specific development conditions. This approach is being pioneered by the Greater London Authority, which is now imposing a condition on new developments over a certain size requiring at least 10% of the total energy use to be supplied from local renewable sources.

If a similar approach is taken in Hertfordshire for all new housing developments, the annual renewable energy generation would increase by about 5.5 GWh every year. By the year 2021, some 66 GWh per year of fossil-derived energy would have been displaced.

The implications on the rate of deployment of such technologies is summarised in the following tables for a 10% displacement scenario as well as a low scenario of 5% and an extended case, equivalent to displacement of 20% of fossil-derived energy consumption.

Table 5.12 Potential Renewable Technology Deployment

Technology	Low Scenario (5% Displacement)	High Scenario (10% Displacement)	Extended Case (20% Displacement)
Photovoltaic Cells	1%	2%	5%
Solar Water Heating	5%	10%	30%
Ground Source Heat Pumps	3%	5%	10%
Wood Pellet Boiler	3%	6%	11%
MicroCHP	2%	4%	6%
Increased insulation	10%	25%	50%

These figures are estimates based on a qualitative assessment of current market penetration and the current cost benefit (in terms of energy reduction/CO2 saving) potential of these technologies and are intended for illustrative purposes only. They do, however, provide an indication of the relatively high rate of deployment required in order to achieve a reasonable degree of fossil-derived energy displacement.

The corresponding generation of renewable energy and reduction in CO_2 emissions (compared with a standard gas-fired heating system) are summarised in Table 5.13. These relate to the energy and emissions associated with about 3,500 dwellings and hence represent potential year on year savings.

Table 5.13 Average Fossil Energy Displacement and CO_2 Reductions Introduced Each Year

	Energy (MWh)			CO_2 (tonne)		
	Low (5%)	High (10%)	Extended (20%)	Low (5%)	High (10%)	Extended (20%)
Photovoltaic Cells	8	17	42	4	7	18
Solar Water Heating	187	375	1,125	36	71	214
Ground Source Heat Pumps	839	1,398	2,796	113	188	375
Wood Pellet Boiler	1,250	2,499	4,582	237	475	871
MicroCHP	- 10	- 20	- 30	20	39	59
Increased insulation	512	1,281	2,562	103	259	517
Totals	2,787	5,550	11,077	512	1,039	2,054

The estimated total amount of fossil energy displaced and associated CO_2 reductions in the year 2021 are summarised in Table 5.14.

Table 5.14 Estimated Fossil Energy Displacement and CO_2 Reductions Occurring in Year 2021

	Energy (MWh)			CO_2 (tonne)		
	Low (5%)	High (10%)	Extended (20%)	Low (5%)	High (10%)	Extended (20%)
Photovoltaic Cells	100	200	500	43	86	215
Solar Water Heating	2,249	4,499	13,497	427	855	2,564
Ground Source Heat Pumps	10,067	16,778	33,556	1,352	2,253	4,506
Wood Pellet Boiler	14,996	29,992	54,986	2,849	5,699	10,447
MicroCHP	-120	- 240	- 360	236	472	708
Increased insulation	6,148	15,371	30,742	1,242	3,105	6,210
Totals	33,441	66,601	132,921	6,149	12,469	24,650

The potential benefit of the technologies summarised in the above tables is, of course, subject to the assumptions regarding the deployment rates. Even the deployment rates assumed for the low (5% reduction) scenario are significantly above rates currently being achieved. The principal barrier to deployment is primarily cost. Renewable technology within the domestic sector still requires market transformation, i.e. greater quantities to help reduce unit prices.

Introduction of appropriate planning policy has the potential to improve deployment rates but will introduce increased cost burdens for developers and ultimately the owners of such properties. The issue of planning policy is considered in more detail in the sister report produced under this study, "Hertfordshire Renewable Energy Study - Planning Considerations".

5.4.3 Community Energy Associated with New Build

The proposed housing construction plans for the County include potential large scale developments, particularly in East Hertfordshire. This raises the possibility of developing community heating schemes.

Community heating involves the central generation of both heat and electricity and the provision of hot water to individual dwellings, rather than each dwelling having its own boiler. Such schemes tend to use gas-fired technology but can provide substantial reductions in CO_2 emissions due to the use of combined heat and power and offsetting electricity consumption from the grid supply.

For a community heating scheme, the central energy centre will typically include one or more CHP units and supplementary and stand-by boilers. One or more of the boilers could be fuelled with biomass thereby further reducing the CO_2 emissions associated with the development. However, the initial assessment is based on gas-fired plant only and assumes that CHP will operate at least 9 months of the year. (It may not be cost-effective to operate the CHP in the summer months when the heat demand is much lower.)

On this basis and for a development of 1,000 dwellings, the annual reduction in primary energy consumption would be nearly 3,500 MWh, with a corresponding saving in CO_2 emissions of about 740 tonnes.

There are, however, are significant risks and practical and commercial considerations that need to be addressed with a community heating system.

Community heating requires an energy services company to finance and operate the energy centre. A number of companies have established track records and can provide much of the finance but require in return that the end-users enter into long-term contracts for their energy supply. Providing developers have agreed to install the community heating across the whole site, the provision of hot water is usually accepted by the occupiers once they have become familiar with the concept. For the supply of electricity, being tied to a long-term contract is not compatible with the OFGEM licence conditions, which were designed to promote competition. Where costs are competitive, such as with the Utilicom scheme in Southampton, this does not necessarily present a problem and OFGEM are currently reviewing their position. However, at present the situation remains uncertain.

As with any large investment, the energy services company also needs to generate income as soon as possible and so although there are economies of scale, the timescale for large developments is also crucial. The cost of community heating to the individual housing developer is relatively low as a heat exchanger replaces the boiler with only a marginal net cost. In previous feasibility studies however, the cost of the pipe infrastructure has become a major issue. Responsibility for infrastructure needs be carefully defined as developments would typically involve more than one house builder. There is therefore a role for the local authorities to either take a share in the energy services company and/or introduce planning or development conditions that commit stakeholders to the development of the community heating approach. Community heating consequently requires political will and commitment to help mitigate some of the financial risks associated with its development.

Existing Residential Property

The success of renewable energy deployment in the private domestic sector depends very much on persuading property owners to invest their own money on such devices. In general, with the exception of enthusiasts and people with dedicated environmental views, owners need to be convinced that they will benefit financially from installing measures.

Depending on the application in question, most property owners are targeted to improve energy efficiency and install renewable energy devices by some form of promotion. Local schemes are generally created through a bidding process for funding from a central source and have a fixed period of operation. Although national schemes may have a centralised fund for grants, these may be promoted by more localised projects designed to assist people in applying for grant assistance.

For the purposes of this study we have considered only the potential impacts arising from application of solar PV, solar water heating and rooftop wind turbines as the deployment of other embedded generation technology such as ground source heat pump is likely to be very low in existing dwellings.

Solar PV

The assessment of the potential from solar energy is determined by estimates of the take-up of the technology both under current market conditions and in conjunction with future market transformation.

Under current market conditions, the proportion of householders that install PV technology is very low indeed, even with the introduction of the Clear Skies grant scheme. This is primarily due to the cost that has to be met by the individual; hence there may be greater benefit in targeting house-builders. A business as usual take-up of 1 in 20,000 dwellings is assumed and this could possibly double in the extended case. Table 5.12 illustrates the likely impact of such assumptions. The estimates provided are based on the assumption that each installation would, on average, include a total area of photovoltaic panel of $2m^2$.

Table 5.15 Scenarios for domestic solar PV energy generation

Scenario	Maximum Annual Deployment Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Solar PV				
Existing householders – promotion of current grant schemes	4,900	1 in 20,000	6	3
Existing householders – extended promotion and additional financial support	9,900	2 in 20,000	25	11

Solar thermal/passive solar

A major promotion of solar water heating has been taking place in Kirklees and Calderdale in Yorkshire with financial support being provided by both the Metropolitan Council and the

Energy Saving Trust. The estimates for the target penetration of solar thermal technology are therefore based on the initial results from this scheme. For the purposes of this study, the average installation is assumed to comprise a total area of solar panel of $3m^2$.

Table 5.16 illustrates the potential impact that might be achieved by solar thermal/passive solar.

Table 5.16 Scenarios for domestic solar thermal energy offset

Scenario	Maximum Annual Deployment Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Solar Thermal Heating				
Existing householders – promotion of current grant schemes	68,600	1 in 10,000	86	16
Existing householders – extended promotion and additional financial support	137,300	4 in 10,000	340	65

Roof-top wind turbines

The application of very small-scale wind turbines to individual buildings is being piloted in a number of areas across the UK. These range in size from a 200W domestic turbine to larger machines for commercial buildings, which typically have an output of about 2kW. Within the domestic sector, the application of small-scale wind turbines will depend on the size and location of the property but at present there is very little information on where these are likely to be installed.

For the purposes of this study, it is assumed that the target market penetration on existing properties could be similar to the solar water heating programme being implemented by Kirklees Metropolitan Council on the basis that the primary interest is in renewable energy rather than solar water heating per se. The maximum potential for this technology is based on a 16% penetration of suitable properties. These are summarised in Table 5.17.

Table 5.17 Scenarios for domestic roof-top wind turbines

Scenario	Maximum Annual Deployment Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Existing householders – promotion of current grant schemes	3,350	1 in 10,000	4	2
Existing householders – extended promotion and additional financial support	6,700	4 in 10,000	17	7

5.4.4 Commercial and Institutional

A number of technological solutions exist to increase renewable energy production within commercial and institutional sector. If a company is planning to move into a new building, it presents the ideal opportunity to consider energy efficiency in the design. Passive solar features should feature heavily in the design of such buildings. Employing CHP could also be considered, which may be beneficial. Not only might a company benefit from energy savings with a well-designed modern building, extra prestige could also be marketed from an efficient and innovative new building design.

The success of improving renewable energy deployment within industry and commerce depends very much on persuading a business to implement policies that will cover such areas. It has to be demonstrated that a company will benefit financially from installing these measures within their business. However more and more companies are realising that they can enhance their public reputation by considering how their activities can affect the environment and implementing mitigating measures. Safety, Health & Environmental reporting is becoming a standard part of many companies' annual reporting process, making it important that a business is showing that it is decreasing any negative environmental impact that it may have.

For small and medium sized enterprises (SMEs) that have less than 250 employees, both the Energy Savings Trust (EST) and Action Energy (AE) are carrying out energy efficiency promotion. Energy efficiency advice is available through the national network of Energy Efficiency Advice Centres, a small business line run by Action Energy and also via the Internet. The AE small business line offers a service whereby a company can have a free energy review conducted on site. Financial support is also being made by a number of programmes, including the Energy Services Scheme (EST), Light Switch (EST), Energy Loans (AE) and Enhance Capital Allowance (AE).

Large companies are dealt with primarily through AE but increasingly the Carbon Trust is targeting initiatives at this sector. Free energy reviews are available along with eligibility for the Enhanced Capital Allowance scheme. SHE reporting is becoming increasingly wide spread in larger companies, along with in certain cases, a drive to become accredited to an environmental standard such as ISO 14001.

The occurrence of solar PV installations in the commercial sector is similarly very low. Under current market conditions, PV technology tends to be used by organisations wishing to make a strong environmental statement, rather than in response to any economic drivers. The scenarios for the implementation of PV technology in this sector is very subjective and hence Table 5.18 simply illustrates the potential energy generation for up to 1% market penetration.

Table 5.18 Scenarios for commercial solar PV energy generation

Scenario	Maximum Annual Deployment Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Promotion of the current grant scheme to businesses	1,020	0.1% of available roof space	13	6
Additional grant aid to businesses	2,040	1% of available roof space	120	52

5.4.5 Highways

Lighting equipment along public roads, trunk roads and motorways use a significant quantity of electricity. The Highways Agency recently commissioned a feasibility study to consider the potential for Highways to provide renewable energy (*Highways as Renewable Energy Sources,* D R Carder, 2005). The study concluded that although installation of renewable energy technologies usually requires significant initial investment, highways do provide potential for small scale generation, from solar, wind and micro-hydro (where water courses are associated with roadways).

A detailed assessment of the potential for Hertfordshire would require more detailed analysis of available renewable resources than was possible within this study. Nevertheless, the county should look to encourage the Highways Agency to uptake renewable energy technologies wherever appropriate and consider the use of such technologies on roads under local authority management (i.e.non motorways and trunk roads).

5.5 Planning Experience

In order to assess the level of activity in Hertfordshire each local authority within the County was contacted to establish how many planning applications for renewable energy technologies have been received, and how each of these received.

Table 5.19 provides a summary of the responses received. These responses have been collated from direct communications with the relevant planning officer (or member of the planning team).

Table 5.19 Review of planning applications by local authority

Local Authority	Planning experience of renewable technologies
Broxbourne	Approximately 1 or 2 applications for solar panels per year. These are generally approved.
Dacorum	Occasional applications for photovoltaic panels, generally accepted.
	One enquiry received for a wind turbine at a school, but no application received yet.
	Currently preparing a masterplan for the district heating scheme of a new neighbourhood being created.
East Hertfordshire	A small number of applications for solar panels and 1 ecohouse. These are generally accepted although an application for a solar panel on a listed building was recently refused.
Hertsemere	Approximately 1 or 2 applications for solar panels per year. These are generally approved.
North Hertfordshire	One application for the temporary siting of an anemometer. The applicant never formally confirmed the purpose of the anemometer to us, but it was believed to be to assess the suitability of the site for a wind farm of up to six turbines. Representations were received from various aviation bodies, none of whom sought refusal, and the Parish Council, which was strongly opposed to the application. The application was rejected by Members, contrary to the officer's recommendation. The reason for refusal was:
	"The proposed anemometer tower would, by reason of its siting, design and overall height, adversely affect the character and appearance of the Landscape Conservation Area and countryside area within which it would be located contrary to the provisions of

Local Authority	Planning experience of renewable technologies
	Policies 12 and 13 of the North Hertfordshire District Local Plan No 2 with Alterations and Policy 43 of the Hertfordshire Structure Plan Review 1991-2011".
St Albans	Approximately 1 or 2 applications for solar panels per year. These are generally approved, although the latest application was refused because it was within a conservation area. No applications for wind or biomass.
Stevenage	No applications within the last 3 years
Three Rivers	RES HQ at Beaufort Court is within Three Rivers
Watford	No applications received.
Welwyn Hatfield	Six applications for domestic solar panels in the last few years. Two have been refused because of design and siting within a conservation area. One application was approved by Councillors against officers recommendations. There are also two cases where solar panels were erected without planning permission, one of these is currently being taken through the legal process. Guidance is currently being produced to promote use of renewable energy.
Hertfordshire County Council	Permission has been granted for a new school on the Hatfield Aerodrome site. This includes proposals for a wind turbine and solar panels.

With a couple of exceptions the review largely demonstrates that planning constraints are not preventing the uptake of small scale (domestic) renewable energy technologies in Hertfordshire. Exceptions notably occur where applications are within Building Conservation Areas. This review would suggest that the uptake of small-scale renewables is not generally limited by planning. In that case, uptake is most likely limited by lack of awareness, lack of interest and the relatively high costs.

The only evidence of any interest in a large commercial renewable energy venture is the application for a meteorological mast in North Hertfordshire. The negative response to the temporary application for an anemometer does not provide much encouragement for a positive response to a planning application for an actual windfarm.

6. Conclusions and Recommendations

The assessment of renewable energy options undertaken in this study indicates that there is the technical potential within Hertfordshire to achieve the levels of renewable energy production proposed in the East of England Sustainable Development Round Table study, by a number of various means.

Large Scale Renewable Energy Production

The following table summarises the extent to which renewable energy deployment might be achieved with large scale technologies. Clearly, achievement of these potential levels will be highly contingent upon not only local planning policy but also a range of external factors, such as developer uptake, aviation objections (commercial wind projects), and the consumer uptake.

For the more competitive renewable technologies, such as onshore wind, planning policy will remain the critical issue for attracting commercial developers. Strong regional and local level planning policies and increased public awareness can play a major part in attracting developers and influencing the deployment of renewable technologies in Hertfordshire.

Technology	Potential capacity (MW electrical)	Potential electrical output (GW_eh/year)	Potential total energy output (GWh/year)	CO_2 reduction (tonnes CO_2/year)
WIND	Existing: 0.225	Existing: 0.25	Existing: 0.25	110
Large Wind Turbines	Possible: 10	Possible: 25	Possible: 25	10,800
	Extended: 65	Extended: 163	Extended: 163	70,100
BIOMASS				
Co-firing in large power plant	31	175	175	168,000
Dedicated CHP facility	17	125	285	94,000
Bio-diesel				39,000
Bio-Ethanol				107,000
Animal Slurries and Anaerobic Digestion	2	14	14	6,000
Sewage sludge (90% dry solids) EFW	4	30	30	13,000
MSW EFW	14	104	104	45,000
Small scale biomass-heat facilities	N/A	N/A	35	9,000
WATER : Hydro	Low : 0.1	Low : 0.6	Low : 0.6	260
	High : 2.0	High : 12.3	High : 12.3	5,300

It should be noted that the estimated avoided CO_2 emissions for bio-fuels (Option 3) are higher than would be achieved in practice as they exclude any CO_2 emissions associated with the production of the fuel.

Embedded Renewable Energy Production (New Dwellings)

The new dwelling build plans for Hertfordshire present a significant opportunity for local councils to positively influence the uptake of embedded renewable energy technologies and/or displacement of fossil-derived energy and associated reductions of CO_2 emissions. The following table summarises the potential benefits that might be realised annually by 2021 on completion of the current new dwelling build programme. The table shows the benefits arising if various levels (5%, 10%, 20%) of household energy consumption are required to be provided by renewable sources or improved insulation.

	Fossil Energy Displaced (GWh)			**CO_2 Reductions (tonne)**		
	Low (5%)	**High (10%)**	**Extended (20%)**	**Low (5%)**	**High (10%)**	**Extended (20%)**
Photovoltaic Cells	0.1	0.2	0.5	43	86	215
Solar Water Heating	2.2	4.5	13.5	427	855	2,564
Ground Source Heat Pumps	10.1	16.8	33.6	1,352	2,253	4,506
Wood Pellet Boiler	15.0	30.0	55.0	2,849	5,699	10,447
MicroCHP	- 0.1	- 0.2	- 0.4	236	472	708
Increased insulation	6.1	15.4	30.7	1,242	3,105	6,210
Totals	33.4	66.6	132.9	6,149	12,469	24,650

Whilst the assessment suggests significant benefits might be realised, significant barriers would require to be overcome to ensure such deployment levels can be achieved in practice. Even the deployment rates assumed for the low (5% reduction) scenario are significantly above rates currently being achieved. The principal barrier to deployment is primarily cost. Renewable technology within the domestic sector still requires market transformation, i.e. greater quantities to help reduce unit prices.

Introduction of appropriate planning policy has the potential to improve deployment rates but will introduce increased cost burdens for developers and ultimately the owners of such properties.

Community Heating (New Dwellings)

The proposed housing construction plans for the County include potential large scale developments, particularly in East Hertfordshire. This raises the possibility of developing community heating schemes. For a community heating scheme for a development of 1,000 dwellings, the annual saving in CO_2 emissions is estimated to be of the order of about 740 tonnes.

There are, however, are significant risks and practical and commercial considerations that need to be addressed with a community heating system.

Embedded Renewable Energy Production (Existing Dwellings)

The success of renewable energy deployment across existing dwellings depends very much on persuading property owners to invest their own money on such devices. In general, with the exception of enthusiasts and people with dedicated environmental views, owners need to be convinced that they will benefit financially from installing measures. The following table indicates the level of renewable energy generation that might be introduced year on year for various penetration rates.

Scenario	Maximum Annual Deployment Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Solar PV				
Existing householders – promotion of current grant schemes	4,900	1 in 20,000	6	3
Existing householders – extended promotion and additional financial support	9,900	2 in 20,000	25	11
Solar Thermal Heating				
Existing householders – promotion of current grant schemes	68,600	1 in 10,000	86	16
Existing householders – extended promotion and additional financial support	137,300	4 in 10,000	340	65
Rooftop Wind Turbine				
Existing householders – promotion of current grant schemes	3,350	1 in 10,000	4	2
Existing householders – extended promotion and additional financial support	6,700	4 in 10,000	17	7

Commercial

A number of technological solutions exist to increase renewable energy production within commercial and institutional sector including passive solar features (to reduce energy demand), application of CHP on larger building/complexes and solar PV. For illustration purposes the following table identifies potential energy generation for up to 1% market penetration.

Scenario	Maximum Annual Deployme nt Potential (MWh)	Target annual penetration	Target annual energy generation increase (MWh)	Annual CO_2 reduction improvement (tonnes CO_2/year)
Promotion of the current grant scheme to businesses	1,020	0.1% of available roof space	13	6
Additional grant aid to businesses	2,040	1% of available roof space	120	52

Highways

A recent study for the Highways Agency concluded that highways do provide potential for small scale generation, from solar, wind and micro-hydro (where water courses are associated with roadways). A detailed assessment of the potential for Hertfordshire would require more detailed analysis of available renewable resources than was possible within this study. Nevertheless, the county should look to encourage the Highways Agency to uptake renewable energy technologies wherever appropriate and consider the use of such technologies on roads under local authority management (i.e.non motorways and trunk roads).

Summary

In summary, large scale renewable energy production technologies could make a significant impact upon Hertfordshire's proposed targets but they will represent major developments that will attract significant public interest during the planning process.

The new dwelling build plans for Hertfordshire present a significant opportunity for local councils to positively influence the uptake of embedded renewable energy technologies and/or displacement of fossil-derived energy and associated reductions of CO_2 emissions. Almost 50% of Hertfordshire's renewable proposed renewable energy target could be achieved if 10% of the average household energy demand for new build dwellings were to be displaced by demand reduction (eg improved insulation) or incorporation of embedded renewable technologies.

Conclusion

This report does not attempt to recommend renewable energy targets for the County. Target-setting is a process that will be informed, in part, by this study, but also by the opinions of Local Authority members, officers and the general public. The report does, however, indicate that the potential exists to achieve the levels of renewable energy production proposed in the East of England Sustainable Development Round Table study.

7. References

Boyle G, “Renewable Energy A Power for a Sustainable Future”, 2nd Ed, Oxford Press

DEFRA, “Environmental Reporting – Guidelines for Company Reporting on Greenhouse Gas Emissions”.

DEFRA/DTI, “First annual report on implementation of the Energy White Paper”, April 2004.

Ecofys UK Ltd, “A Renewable Energy Operational Plan For The East Of England, Part 2: Strategic Framework”, September 2003

Enviros, “Report for DTI - The Costs Of Supplying Renewable Energy”, February 2005

Tony Hams Associates, ESD, Global to Local Ltd, “Renewable Energy & Land Use Planning Study. A Report To The East Of England Sustainable Development Round Table : Making Renewable Energy A Reality - Setting A Challenging Target For The Eastern Region”.

Tony Hams Associates, ESD, Global to Local Ltd, “Advisory Note On Planning And Sustainable Energy In The East Of England”, April 2004.

Hertfordshire County Council, “Hertfordshire Waste Strategy, A Joint Municipal Waste Management Strategy for Hertfordshire 2002 – 2024”

House Of Commons Science And Technology Committee, “Towards A Noncarbon Fuel Economy: Research, Development And Demonstration Fourth Report Of Session 2002–03”

NEA, IEA, OECD, “Projected Costs of Generating Electricity 2005 Update”, 2005

Oxera, “Interim Report for DTI – What is the Potential for Commercial Viable Renewable Generation Technologies”, January 2005

PB Power, “The Cost of Generating Electricity, A study carried out for The Royal Academy of Engineering”, March 2004.

Performance and Innovation Unit, “The Energy Review”, February 2002.

Secretary of State for Trade and Industry (DTI), “Our energy future - creating a low carbon economy”, February 2003

The Stationery Office Limited, “The Renewables Obligation Order 2002”, March 2002.

TRL “Feasibility Study: Highways as Renewable Energy Sources” (D R Carder), January 2005.

Appendix A
Summary of Consultee Responses

Consultee	Issues Identified
Hertfordshire CC	Importance of energy hierarchy. Renewable energy prospects to 2020 and beyond. Hertfordshire county energy consumption. Review of County’s planning application history (renewable technologies). Landscape enhancement. Stone-curlew breeding in N Hertfordshire. Impact of potential developments on Metley Hill Radio Communications Agency. Impact of potential wind farm developments on Stansted Airport. Environmental impact of short rotation coppice. Energy recovery from municipal waste. Impacts of genetically modified crops used for bio-fuels. Future energy issues. Highway-based small-scale renewable technologies.
St Albans DC	Identification of exemplar renewable energy schemes.
Stevenage BC	Impact sof potential schemes upon the County. Energy recovery from municipal waste.
Welwyn & Hatfield DC	Need to encourage up-take of community level renewable energy generation. Importance of energy hierarchy.
Dacorum BC	Handbook for Planning Officers. Draft Regional Spatial Strategy energy consumption figures.
N Herts DC	East of England renewable energy target for Hertfordshire. Significance of East of England Plan Policy ENV8. Importance of energy hierarchy. Visual impact of wind-farms. Need for environmental impact assessment for specific renewable energy schemes. Scale of wind farm developments. Prospects for renewable energy developments.

Consultee	Issues Identified
Renewables East	Royal Academy of Engineering generating costs data. PPS 22: Criteria-based policies. Differentiation of Building Control and Planning Control responsibilities in respect of energy efficiency measures. Visual (and cumulative) impact of wind-farms. Bio-fuel delivery infrastructure. Duties on bio-fuels. Feedstock supply consistency – bio-diesel. Significance of East of England Policy ENV8. Barrier to deployment (small scale technologies) – local skill base. Competitiveness of energy crops. Local competition for biomass. Other organic wastes streams. Biomass heating for public authority buildings. Need for SPD.
St Albans Friend of the Earth	East of England renewable energy target for Hertfordshire. Need for urgent action.
N Herts Friends of the Earth	Explanation of terminology. Hertfordshire county energy consumption. Time-scale to develop major renewable energy schemes.
Homer Associates	Importance of energy hierarchy. Prospects for anaerobic digestion of animal slurries. Further work requirements.

Appendix B
Wind Farm Constraints Map (Air Traffic)