Renewable Energy

in the Blackdown Hills Area of Outstanding Natural Beauty

Prepared for the Blackdown Hills AONB Partnership by Land Use Consultants
in association with the Centre for Sustainable Energy

Blackdown Hills AONB

LAND USE CONSULTANTS

43 Chalton Street
London NW1 1JD
Tel: 020 7383 5784
Fax: 020 7383 4798
london@landuse.co.uk

14 Great George Street
Bristol BS1 5RH
Tel: 0117 929 1997
Fax: 0117 929 1998
bristol@landuse.co.uk

37 Otago Street
Glasgow G12 8JJ
Tel: 0141 334 9595
Fax: 0141 334 7789
glasgow@landuse.co.uk

28 Stafford Street
Edinburgh EH3 7BD
Tel: 0131 202 1616
edinburgh@landuse.co.uk

CONTENTS

GLOSSARY OF TERMS

Term	Definition
AD plant	Anaerobic Digestion plant
AONB	Area of Outstanding Natural Beauty
AONB Management Plan	The Blackdown Hills AONB Management Plan 2009 – 2014, Blackdown Hills AONB Partnership http://www.blackdownhillsaonb.org.uk/Management-information-Management-Plan.html
CAD	Centralised Anaerobic Digester
Capacity factor	The percentage of power generation against the theoretical maximum output
CH	Community Heating
CHP	Combined Heat and Power Plant
CO_2	Carbon Dioxide
CO_2eq	Carbon Dioxide equivalent
DCLG	Department of Communities and Local Government
ESCo	Energy Service Company - A common arrangement is for an ESCo to take responsibility for constructing, operating and maintaining a community energy network, so that the end-user avoids the risk of maintaining their own plant and just needs to enter into a contract to purchase energy from the ESCo
FIT	Feed-in Tariff – introduced in April 2010, a scheme that pays for creating green electricity. Applies to both smaller, building-integrated renewables (up to 50kW) and larger stand-alone renewables (up to 5 MW). The latter have a choice of payment under the Renewables Obligation or the FIT, considered on a case by case basis.
GSHP	Ground source heat pump
kW	Kilowatt
KWe	Kilowatt electricity
kWh	Kilowatt hour
LCT	Landscape Character Type
LVIA	Landscape and Visual Impact Assessment
MSW	Municipal solid waste
MW	Megawatt
MWe	Megawatt electricity
National calculation methodologies	The UK national methodology for calculation of the energy performance of buildings incorporating SAP and SBEM (see below)
PV	Photovoltaics
RDPE	Rural Development Programme for England 2007 - 2013
RHI	Renewable Heat Incentive – a potential fixed payment for the renewable heat generated by

Term	Definition
	individual households and businesses (planned to start in April 2011) currently under consultation. It will be similar to the FIT with the tariff level and length of time over which the tariff is paid varying by technology. Open to new projects until 2020
RO	The Renewables Obligation (RO) is the Government's main mechanism for supporting the generation of renewable electricity. It requires licensed electricity suppliers to source a specific and annually increasing percentage of their electricity from renewable sources. The current level is 9.7 percent for 2009/10, rising to 15.4 percent by 2015/16.
SAP	Standard Assessment Procedure for the energy rating of domestic properties
SBEM	Simplified Building Energy Model for the energy rating non-domestic sites
SRC	Short Rotation Coppice

NB The photographs in this report are provided simply to illustrate the different renewable technologies, they have not been specifically selected to represent best practice

1 INTRODUCTION TO THIS STUDY

1.1 This study has been commissioned by the Blackdown Hills Area of Outstanding Natural Beauty (AONB) Partnership. It provides an initial assessment of the *Constraints and Opportunities for Renewable Energy in the Blackdown Hills AONB*. Specifically, for the more common renewable and low carbon technologies it outlines:

- The individual renewable energy technologies, including carbon savings, and for each:
  - Identifies and assesses the cost and feasibility/ease of application.
  - Identifies key landscape and planning considerations specific to the Blackdown Hills.
  - Assesses the appropriateness of each technology for the Blackdown Hills AONB.
  - Presents the information in a practical, easy reference format.

1.2 The range of technologies covered by this study is as follows:

- Biomass
- Anaerobic digestion
- Waste to energy
- Micro hydro
- Photovoltaics (usually building integrated – roof mounted, including solar slates and tiles but also including field-scale deployment)
- Solar hot water
- Solar space heating
- Ground source heat pumps (via boreholes, trenches, aquifers and surface water)
- Air source heat pumps
- Micro district heating (e.g. involving ground source heat pumps or biomass boilers or Combined Heat and Power).
- Stand alone wind energy including small-scale and building mounted wind (typically no more than 3 kW per turbine) both horizontal and vertical axis.

1.3 These are considered in turn in the chapters that follow, with a short chapter dedicated to each technology.

1.4 This informed and independent assessment will be of use to the AONB Partnership, partner organisations, and groups and individuals interested in renewable energy within the AONB.

1.5 This is the equivalent of a scoping study and therefore further work would be required to assess the detailed feasibility of individual technologies within the AONB. The figures used in this report for estimating carbon emissions associated with the various technologies have, where possible, been drawn from the Standard Assessment Procedure (SAP) Revised Emission Factors for the National Calculation Methodologies (2009) as these represent nationally agreed comparators. For hydro, solar photovoltaics, solar hot water and wind energy systems the calculations take account of the embodied energy of the technology[1]. These figures are known to vary according to reference used and have therefore been researched from selected publications as stated in the text. In all cases a 60w light bulb is used as the common measure of carbon emissions. These have relatively high carbon emissions as they are assumed to use carbon-intensive grid electricity generated from traditional sources.

Renewable energy and landscape

1.6 As an Area of Outstanding Natural Beauty, a key concern of these technologies is their potential landscape effects. In most cases the landscape effects of the technologies listed above (i.e. the built aspects of these developments subject to planning controls) are site-specific. In other words, the landscape effects will need to be judged on their merits, based on the specific site selected for the development. In the chapters that follow, generic guidance is provided on potential landscape effects and factors that should be considered in the siting and design of each technology.

1.7 Falling in a different category are wind turbine developments. Because of their height (up to 135 metres in height); potential deployment in groups (as wind farms); and with their introduction of moving parts (their rotary blades) into the landscape, these developments can have landscape-scale effects. In other words, a single development may have the potential to alter the character of the landscape over a significant area. For this reason a separate landscape sensitivity study to wind turbine developments has been included in this study and is described with its results in Appendix 1. This uses as its basis the current landscape character assessment for the Blackdown Hills[2]. Where relevant, key findings from this sensitivity study are brought forward and summarised in the chapters that follow.

1.8 The other technology that has the potential to have landscape-scale effects is that of large-scale photovoltaic developments, potentially covering up to five hectares or more in a single development. As part of this study, these landscape effects have been considered in generic terms only. This is because the likely deployment of photovoltaics at this scale in the UK has only emerged as this small study has progressed, encouraged by the Government's Feed-in Tariff[3]. Furthermore, there are currently no established approaches for considering the landscape-scale effects of this technology in the UK context. The first such sensitivity study is likely to be undertaken for Cornwall Council over this winter (as the County that has received the most planning applications for this type of renewables development). There is a

---

[1] That is the energy used in the manufacture of the technology

[2] Diacano Associates (2008) East Devon and Blackdown Hills Areas of Outstanding Natural Beauty and East Devon District Landscape Character Assessment & Management Guidelines. Prepared for East Devon District Council, East Devon AONB, Blackdown Hills AONB and Natural England.

[3] A scheme that pays people for creating their own "green electricity" http://www.fitariffs.co.uk/?gclid=CPHdkur_46MCFYT-2AodFnix-w

case therefore for supplementing this current renewables study for the Blackdown Hills with a landscape sensitivity study for large-scale photovoltaic developments, learning from the findings of the Cornwall Sensitivity Study. It cannot be assumed that the approach or the findings from the wind turbine sensitivity study can be applied to that of large-scale photovoltaics, although the general landscape guidelines in this sensitivity study provide a useful starting point for considering the likely landscape constraints on large-scale photovoltaic developments.

BACKGROUND

1.9 The Blackdown Hills AONB covers 370 square kilometres of diverse countryside, from exposed plateau tops to deep valleys, straddling the border between Devon and Somerset. The AONB is managed by a Partnership of local authorities, other public bodies, conservation organisations and community groups, who also deliver the objectives of the AONB Management Plan.

1.10 Climate change is now widely accepted as a major issue that requires immediate action at many levels. This and the rising cost of 'energy' are driving a global move for renewable forms of energy. National policy guidance strongly promotes the use of renewable technologies at all levels and, although recognising the sensitivities of the impacts, does not specifically exclude nationally important landscapes from the deployment of these technologies. The Blackdown Hills AONB Partnership agrees that it is right for the AONB landscape to make an appropriate contribution towards renewable energy targets and that the Blackdown Hills landscape has the potential to contribute to the provision of renewable energy. The AONB Management Plan includes the following objective and policy:

- **EQC 2** Emissions of carbon dioxide and other greenhouse gases are decreased to help carbon reduction in the AONB.
- **EQC 2/A** Support and encourage appropriate, small-scale renewable energy schemes to minimise net emissions of carbon dioxide and other greenhouse gases to help achieve carbon reduction without conflicting with the special qualities of the AONB or the conservation of natural beauty.

1.11 Informing and contributing to the implementation of the Management Plan are a landscape character assessment and management guidelines, which cover the Blackdown Hills AONB and adjacent East Devon AONB. These describe the special character of the landscape and provide guidance on measures that will conserve and enhance local character and features[4].

1.12 In recent years the Blackdown Hills AONB Sustainable Development Fund and LEADER+ programme have supported projects to install wood fuel boilers, a bio-diesel demonstration and an anaerobic digestion project. The AONB now has a five-year RDPE programme called Making it Local, run

[4] Diacano Associates (2008) East Devon and Blackdown Hills Areas of Outstanding Natural Beauty and East Devon District Landscape Character Assessment & Management Guidelines. Prepared for East Devon District Council, East Devon AONB, Blackdown Hills AONB and Natural England.

jointly with East Devon AONB, which has objectives to improve the sustainability and resilience of local communities, including the development and use of renewable energy.

1.13 It is therefore important to add local detail to try to influence and direct renewable energy choices in the Blackdown Hills AONB, using evidence to seek sources of renewable energy which are effective at reducing greenhouse gas emissions and those which can support, rather than detract from, landscape character and the special qualities of the AONB. It is anticipated that this piece of work will be an essential tool in providing this evidence.

Summary of the potential suitability of different renewable technologies to the Blackdown Hills AONB

1.14 **Figure 1.1** below provides a 'snapshot' of the potential suitability of the different renewable/low carbon technologies considered through this study. Full descriptions and explanations for this assessment are given in the subsequent chapters. This table is coded by 'traffic lights' with those technologies appropriate to the AONB coded green and those that are considered inappropriate coded red, with those with a strong element of caution coded orange or amber. A reasoned justification for this coding is provided in the final paragraphs of the chapter for each technology. In particular, where technologies are coded green, it is assumed that any guidance on the siting or design of these technologies provided under the heading 'Key Landscape and Planning Considerations' (set out at the end of each technology description) has been adhered to.

Figure 1.1: Potential suitability of different renewable and low carbon technologies within the Blackdown Hills AONB

TYPE	TECHNOLOGY	SUITABILITY
Biomass	Large-scale 10-40MW electricity generation plant	
	Small Combined Heat and Power plant	
	Business / domestic biomass boilers	
	Business / domestic biomass stoves	
Anaerobic digestion	Centralised anaerobic digestion (AD) plant	
	AD serving a group of farms	
	AD serving a single farm	
Waste to energy scheme		
Micro-hydro	Micro-hydro	
	Restoration of traditional mill sites	
Photovoltaics	Building associated PV systems	
	Solar PV farms	v. limited
Solar hot water		
Ground, air and water source heat pumps		
Community heating	Small-scale or micro community heating	
Wind	Large-scale turbines (90m – 135m)	
	Medium-scale turbines (25m – 90m)	v. limited
	Small-scale turbines (12m – 25m height)	
	Micro turbines (<11m)	

2 BIOMASS

DESCRIPTION OF TECHNOLOGY

2.1 Biomass can generally be defined as material of recent biological origin, derived from plant or animal matter. As a fuel rather than a technology, it can be used in a number of different ways to create bioenergy. This section mainly deals with 'dry' biomass that is more commonly combusted either to generate heat or to produce electricity. However, other types of biomass can also be anaerobically digested to generate 'biogas' (see Chapter 3), or used to produce a transport 'biofuel'. Biofuel production is unlikely to be appropriate for development within the AONB as it requires the equivalent of a major industrial plant **and is not considered further in this report**. The combustion of organic materials within the waste stream is covered in Chapter 4 'Waste to Energy'.

2.2 Biomass plants may generate electricity, thermal energy or a combination of the two:

- **Plants designed primarily for the production of electricity**. These are generally the largest schemes, in the range 10–40 MW. Excess heat from the process is not typically utilised. These plants are major multi-million pound developments and due to their large size and requirement for significant quantities of biomass, **they are unlikely to be appropriate for development within the AONB. They are not therefore considered further in this report**.
- **Combined Heat and Power (CHP) plants** where the primary purpose is the generation of electricity but the excess heat is utilised, for instance as industrial process heat or in a district heating scheme. The typical size range for CHP is 5-30 MW thermal energy output but smaller 'packaged' schemes of a few hundred kilowatts have been built in the UK. Most UK CHP systems are sized to have a thermal output of 1.5-2.5 times the electrical output.
- **Plants designed for the production of heat.** These cover a wide range of applications from domestic wood burning stoves and biomass boilers to boilers of a scale suitable for district heating, commercial and community buildings and industrial process heat. Their size can range from a few kilowatts to above 5 MW thermal (heat) energy.

2.3 There are two scales of activity that will be most suitable within the AONB, as described below:

2.4 **Small-scale plants**, such as CHP plants used in community schemes, schools and industrial units whose size will depend on power output. A small heat plant (most suitable within the AONB) for a school might consist of a boiler house some 4 m x 4 m with a fuel bunker of similar proportions. The bunker may be semi-underground (bringing practical benefits for re-filling) with a lockable steel lid. The chimney is likely to be 3 m –10 m high, depending on plant design and surrounding buildings. Sufficient space to manoeuvre a large lorry or tractor and trailer safely is required for fuel delivery. Fuel will usually be either wood pellets or woodchip (see paragraph 2.6 below for more detail on these fuel sources).

2.5 **Household** wood burning stoves are the size of a typical room heater and may be fitted with a back boiler to provide water heating as well as room heat. With a typical annual heating demand of perhaps 1800 kWh they will only require space to store approximately 360 kg of pellets or 2 - 3 skip loads (2 - 3 tonnes) of logs. This could usually be accommodated within a typical garage. Where there is no existing chimney a separate internal or external stainless steel flue can be used. The standard fuel is wood logs. **Household biomass boilers** connected to central heating and hot water systems are generally larger than 15 kW and often use either wood pellets or woodchip. The main space requirement is for the storage of the fuel, typically 7 m^3 of pellets or 21–35 m^3 of woodchip, and access to accommodate bulk deliveries of wood fuel by lorry or tanker. Space is also needed to accommodate the boiler and fuel hopper – which as a rule is about double the space required by an oil boiler.

Figure 2.1: 300kW woodchip boiler at Batsford House, South Gloucestershire [Source: Centre for Sustainable Energy]

2.6 The main types of biomass fuel used in medium and household scale biomass units are sawn logs, woodchip and pellets.

- **Sawn logs:** Sources of sawn logs may include woodland thinnings and wood waste from commercial forestry management and wood products from conservation management. In addition to domestic use, some commercial users prefer log burning installations as bought in logs can be combined with the use of on-site waste materials (off-cuts) and are simpler to maintain.
- **Woodchip:** The best quality woodchip comes from dried roundwood, medium quality from Short Rotation Coppice (SRC), traditional coppice from the coppice management of existing woodland and Miscanthus (although there can be purity issues), and poorer quality chip from

commercial forestry residues. Materials can be mixed to improve calorific value. The market for woodchip is growing rapidly but in many locations it is still at an early stage of development. Other important considerations are the need for: drying/storage facilities, achieving the right mix of materials to attain the right calorific value, and the cost of woodchippers. These are typically beyond the means of most small woodland owners but may be held by woodland / forestry contractors or can be facilitated through a machinery ring of small woodland owners.

- **Pellets:** Pellets are a refined, solid fuel biomass with low moisture content and are easy to transport and store. Although energy-demanding in their production, pellets are easier to use in fully automated heating systems. They are manufactured from a range of products including Short Rotation Coppice (SRC), Miscanthus, straw, sawdust, woodchip, shavings, bark and wood residues. Pellets from the spent meal of processed oilseed are much cheaper to produce but have a lower calorific value. There is already at least one wood pellet manufacturer operating in the Blackdown Hills. Compared to woodchip pellets usually have a higher calorific value, more consistent moisture content, higher bulk density and produce less ash.

CARBON SAVINGS

2.7 Biomass is considered to be a sustainable fuel, with low carbon emissions as the carbon dioxide (CO_2) released when energy is generated from biomass is balanced by that absorbed during its growth. The ultimate carbon balance can only be assessed once the fossil fuels used in the biomass growing process, processing and transport have been taken into account. However, overall CO_2 emissions per unit of energy generated are much lower for biomass when compared with fossil fuels.

2.8 Emissions factors arising from the use of biomass have been published for use in the National Calculation Methodologies: Standard Assessment Procedure (SAP) for the energy rating of domestic properties[5] and the Simplified Building Energy Model (SBEM) for non-domestic sites[6]. They are expressed in terms of CO_2 equivalent (CO_2eq) as they take into consideration the three main greenhouse gases; carbon dioxide (CO_2), nitrogen dioxide (N_2O) and methane (CH_4).

2.9 As an indication of potential CO_2 equivalent savings: If a household has an old oil-fired boiler (efficiency 80%) and consumes 20,000kWh per year and this is changed to a wood chip boiler (efficiency 85%), the CO_2eq savings would be 5,398 kg CO_2eq per annum (see **Figure 2.2** and **Box 2.1**). This saving is equivalent to the amount of CO_2 produced by leaving 17 x 60 watt light bulbs switched on continually for a year. This is a significant amount for an individual property. Clearly the actual carbon savings for an individual

[5] SAP is the Government's Standard Assessment Procedure for Energy Rating of Dwellings. SAP 2005 is adopted by government as part of the UK national methodology for calculation of the energy performance of buildings. It is used to demonstrate compliance with building regulations for dwellings

[6] Source: www.bre.co.uk/filelibrary/SAP/2009/STP09-CO201_Revised_emission_factors.pdf

household will depend on the biomass fuel used and the type of fossil fuel that is displaced.

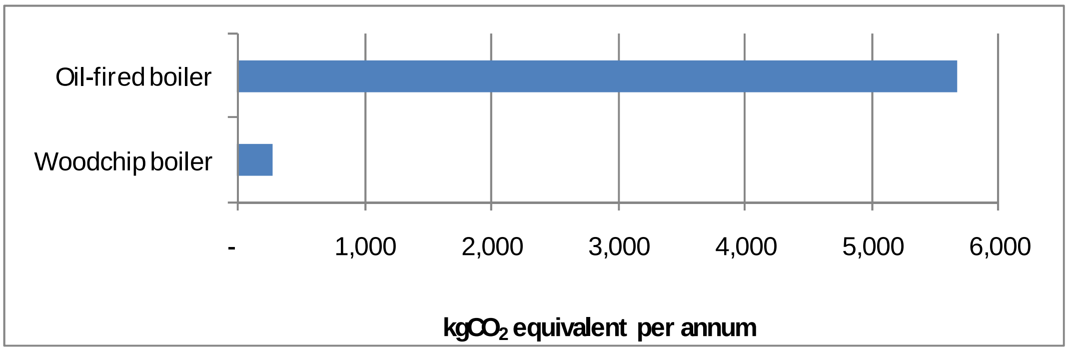


Figure 2.2: Comparison of annual CO_2eq emissions from oil-fired boiler and woodchip boiler

Box 2.1 Calculation of carbon savings

Carbon savings for an individual development will depend on the biomass fuel used and the type of fossil fuel that is displaced. The figures obtained for biomass fuels are as follows:

Combustion for heat:

- Logs – 0.018 kgCO2eq/kWh
- Chips – 0.015 kgCO2eq/kWh
- Pellets – 0.037 kgCO_2eq/kWh

Combustion for Community Heating (CH) and Combined Heat and Power (CHP) to generate heat or heat and power has been assigned a single figure due to the complexity and mix of fuels used:

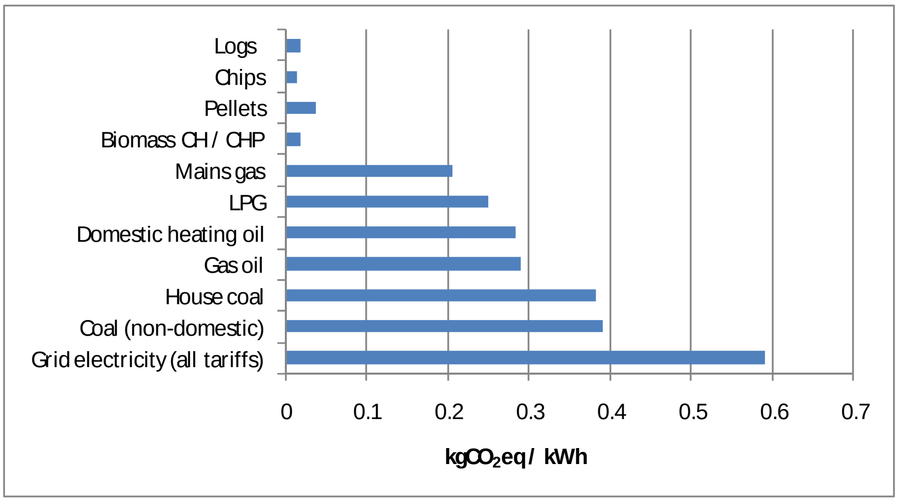
- Biomass – 0.019 kg CO_2eq/kWh

Emissions calculated for fossil fuels and grid electricity, from the same source[5] are:

- Mains gas – 0.206 kg CO_2eq/kWh
- LPG – 0.251 kg CO_2eq/kWh
- Domestic heating oil – 0.284 kg CO_2eq/kWh
- Gas oil – 0.290 kg CO_2eq/kWh
- House coal – 0.382 kg CO_2eq/kWh
- Coal (non-domestic) – 0.391 kg CO_2eq/kWh
- Grid electricity (all tariffs) – 0.591 kgCO_2eq/kWh

Box 2.1 (cont'd)

The figure below compares the CO_2 equivalent content of each of these fuels per kWh:



Calculations for example

If a household has an old oil-fired boiler (efficiency 80%) and consumes 20,000kWh per year which is changed to a wood chip boiler (efficiency 85%). The CO_2eq savings per annum would be:

- Present delivered heat = 20,000kWh x 0.8 = 16,000kWh
- Requirement for biomass = 16,000kWh / 0.85 = 18,825 kWh
- Oil CO_2eq emissions = 20,000 x 0.284 = 5,680 kg CO_2eq
- Wood chip CO_2eq emissions = 18,825 x 0.015 = 282 kg CO_2eq
- Total savings = 5,680 – 282 = 5,398 kg CO_2eq per annum.

COST AND EASE OF APPLICATION

2.10 A 100 kW **wood chip boiler** for a farmhouse and offices would typically cost £30,000. Costs do however vary according to the technology used, the amount of pipework, any thermal storage required etc. Unlike most other renewable technologies there is also a cost associated with buying the fuel.

2.11 A stand alone room heater (**wood burning stove**) costs from £1,000 - £3,000 (or £3,500 - £4,000 for those with an oven for cooking). To this needs to be added the cost of installation of £1,000 - £2,000 to cover the cost of lining the chimney or building a new flue. A log, pellet or woodchip boiler for a typical house costs from £5,000 - £10,000.

2.12 Both stand alone room heaters and boilers offer a convenient form of heating for isolated properties that would traditionally use oil. Wood burning stoves are easy to install and can offer a useful adjunct to traditional forms of heating (oil/gas), greatly reducing the amount of fuel used. They have three particular values: in a central position providing 24-hour background heating; as the primary heating in the main living area; as the primary source of heating in offices of home workers where the alternative is central heating when the rest of the house is empty.

2.13 Due to the small number of installed systems, costs for **CHP plants** are difficult to quantify. Also the heat distribution network will form a significant proportion of the total cost, and the size and nature of these networks can vary immensely.

2.14 Fuel costs generally depend on the distance from the supplier and typically are of the following order (based on current costs in the Blackdown Hills):

- Sawn logs: £130 - £140 / tonne delivered at 25% moisture content[7].
- Good quality woodchip: £75 - £100/tonne.
- Wood pellets £195 (loose blown) – £260 (bagged)/tonne.

2.15 While woodchip is bulkier than pellets it is much more cost effective for larger users such as big estates, hospitals, hotels, secondary schools, factories, offices, care homes and glasshouses. As a general rule running costs are most competitive in areas that do not have a gas supply. But this equation is changing as the costs of traditional fuels rise.

2.16 The possible introduction of the Renewable Heat Incentive (RHI) scheme in April 2011 would make the installation of biomass systems more attractive in purely economic terms. Biomass boilers, from basic hand-loaded fires that incorporate water heating, to complex and fully automated industrial boilers, would be eligible for a payment of a calculated 'deemed' or metered heat output over a 15 year lifetime[8].

- Up to 45kW: 9p/kWh (deemed)
- 45 to 500kW: 6.5p/kWh (deemed)
- 500kW and above: 1.6 to 2.5p/kWh (metered)

2.17 The deemed amount will be based on the '*reasonable heat requirement* (or heat load) that the installation is intended to serve' as determined by SAP and SBEM (see paragraph 2.8).

FURTHER USEFUL REFERENCES

- Communities and Local Government. (2004). *Planning for Renewable Energy: Companion Guide to PPS22.* (Technical Annex – Section 1).
- Land Use Consultants. (2007). *Bioenergy: Environmental Impact and Best Practice.* Wildlife and Countryside Link.
- Energy Savings Trust. (2007). *Biomass – Small Scale Fact Sheet 8.*

[7] This is based on 2010 costs in the Blackdown Hills. Costs vary significantly across the country. Moisture content is rarely stated, dependent on the length the wood has been seasoned or if it has been kiln-dried. Logs are usually sold by the load and not the tonne.

[8] Renewable Heat Incentive Consultation on the proposed RHI financial support scheme www.decc.gov.uk/publications/basket.aspx?FilePath=Consultations%5cRHI%5c1_20100204094844_e_%40%40_ConsultationonRenewableHeatIncentive.pdf&filetype=4

- Forestry Commission. (2002). *Establishment and Management of Short Rotation Coppice.*
- Forestry Commission. (2006). *The Environmental Impacts of Woodfuel.*
- Environmental Protection UK. (2009) *Biomass and Air Quality Information for Developers*.
- British Biogen. (1996). *Short Rotation Coppice for Energy Production. Good Practice Guidelines.*
- British Biogen. (1999). *Wood Fuel from Forestry and Arboriculture: the development of a sustainable energy production industry - Good Practice Guidelines.*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

2.18 The use of biomass within the Blackdown Hills AONB needs to be considered at two levels:

- Provision of biomass fuel
- The landscape implications of the plant themselves.

2.19 **Biomass fuel:** This study has **not** looked at the growing of biomass crops or their landscape implications within the AONB. Nevertheless, increased demand for woodchip and sawn logs within the AONB raises the possibility of creating a market for coppice timber, hedge trimmings and forestry arisings. This would encourage the appropriate management of the many small woods within the AONB, especially those that have fallen out of management over the last 50 years. It may also develop a return from the appropriate management of the hedgerow network which is such a distinctive feature of the Blackdown Hills AONB.

2.20 **Plants:** As noted above (paragraph 2.2), large-scale plants associated with the production of electricity would be of a scale out of keeping with the AONB. They have therefore not been considered further.

2.21 On the other hand, small-scale CHP plants and domestic biomass boilers and stoves can be accommodated within the existing settlement structure and have the very real potential to provide a clear stimulus to the reintroduction of traditional coppice management – essential for maintaining the biodiversity of many of the ancient woodlands of the AONB. Growth in the demand for sawn logs and woodchip could also stimulate the conversion of ancient woodland sites planted with conifers back to traditional coppice woodland.

2.22 The AONB's rich oak, ash and wet woodlands are identified by the AONB Management Plan as key habitats valued within the protected landscape. 13% of the AONB is under woodland cover, with ancient woodland occupying around 2% of the total land area (over 1,600 hectares). Relevant objectives and policies, which a reinstatement of coppice management could help achieve, include:

- **Objective BG 1:** Key wildlife sites…are appropriately managed to conserve and enhance their special features.

- **Policy BG 1/B:** Support initiatives… to achieve management of key habitats and conservation of priority species within the AONB.
- **Policy FLM 2/A:** Support and promote initiatives that encourage sensitive environmental management of woodlands…
- **Policy FLM 2/B:** Promote initiatives that encourage sensitive environmental management of woodlands to deliver economic benefits and promote business opportunities…particularly encouraging the use of sustainable woodland products locally.

2.23 The main considerations in the design and siting of these CHP plants and of wood burning stoves are:

Small-scale CHP plants

- The sympathetic design of any fuel storage and boiler housing that does not detract from the local vernacular.
- Siting of the 3 – 10m high chimney so that it does not obstruct any key views or detract from the setting of listed buildings or Conservation Areas.

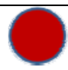
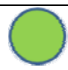
Household boilers / woodburning stoves

- Design of the flue to be unobtrusive in views of the building (particularly in the case of a listed building or a building in a Conservation Area), making use of suitable materials and colour treatments.
- Any storage or boiler housing to be unobtrusive, reflecting local vernacular where relevant.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

2.24 The development of small-scale biomass plants for community and business premises and the use of biomass boilers and woodburning stoves by households within the AONB are encouraged as part of the response to mitigate climate change. The use of local woodfuel sources brings significant reductions in CO_2 emissions and provides a much needed stimulus to the local woodfuel supply chain. It will also stimulate local wood-based businesses helping diversify and strengthen the local land-based economy. They therefore offer a win:win:win opportunity especially as the biomass boilers and their associated facilities are small in scale and can be accommodated within the traditional settlement structure of the Blackdown Hills. Nevertheless, for all these benefits to be realised such schemes will need to use local wood sources rather than those associated with other agricultural by-products or imported woodfuels. This requires the development of strong local supply chains for woodfuels.

2.25 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Large-scale 10-40MW biomass electricity generation plant	
Small Combined Heat and Power (CHP) plant	
Business / domestic biomass stoves and boilers	

3 ANAEROBIC DIGESTION

DESCRIPTION OF TECHNOLOGY

3.1 Anaerobic Digestion (AD) is the process of breaking down plant or animal matter by microbial action in the absence of air, to produce a gas with high methane content. This methane can be captured and burned to produce heat, electricity or a combination of the two. As a greenhouse gas, methane is around 21 times more potent than carbon dioxide over a period of 100 years.

3.2 The main types of organic material feedstock used in AD are:

- **Sewage sludge**: Sewage sludge is the semi-solid residue remaining from the treatment of sewage and waste water. AD of sewage sludge currently takes place at many sewage treatment works in the UK, although only some of these schemes recover the energy from the sewage gas. Since sewage treatment is generally centralised in the UK, the digesters tend to be large-scale.
- **Farm slurry**: Intensive livestock rearing produces large quantities of slurry (liquid manure) and AD is beginning to be used widely in UK agriculture, generally in the form of small on-farm digesters from which biogas is captured and burned to heat farm buildings, although larger centralised anaerobic digesters (CADs) also exist which use feedstocks imported from a number of sources.
- **Municipal solid waste (MSW)**: Municipal solid waste is waste collected by or on behalf of a local authority and predominantly consists of household waste, but may also contain commercial or industrial waste. MSW contains a significant proportion of organic materials, including food, garden cuttings and paper, and the EU Landfill Directive requires that organic materials are progressively diverted from landfill. Some elements of MSW can undergo energy extraction via AD so having the potential to contribute to both waste management and renewable energy.
- Experiments have also taken place to assess the use of **conservation arisings**, such as reeds, in small-scale anaerobic digestion and the mixing of such sources with more conventional organic materials.

3.3 In addition to biogas which can be used for energy generation, AD also produces a nitrogen-rich liquor which can be used as a fertiliser, and solids which can potentially be composted to produce soil conditioner, provided that toxic materials are removed from MSW (if used) prior to digestion.

Figure 3.1: 340 kW AD plant Lowbrook Farm, Dorset [Source: http://www.nefocus.com/do/ecco/view_item?listid=1&listcatid=123&listitemid=2624]

3.4 An anaerobic digestion plant typically comprises a digester tank, buildings to house ancillary equipment such as a generator, a biogas storage tank, a flare stack (3-10 m in height) and associated pipework. Plants can vary in scale from:

- A small scheme treating the waste from an individual farm (e.g. 150 kWe).
- A medium-sized centralised facility dealing with wastes from several farms (potentially supplemented by crops such as maize grown specifically to feed the digester).
- A sizeable industrial centralised anaerobic digester (CAD) plant handling large quantities of MSW (e.g. 2.1 MWe). This category of AD plant is unlikely to be appropriate to the AONB due to the lack of a suitable waste stream.

CARBON SAVINGS

3.5 The ultimate carbon balance can only be assessed once the feedstock used in the AD system, processing and transport have been taken into account. AD brings two savings; firstly it prevents the direct release of methane from the natural breakdown of organic material feedstocks. Secondly it displaces fossil fuel use, thus reducing CO_2eq emissions. An emission factor, again expressed in terms of CO_2 equivalent, has been calculated for the National Calculation Methodologies (see paragraph 2.8) for biogas as 0.024 kgCO_2eq/kWh.

3.6 As an indication of potential CO_2 equivalent savings: If a site has an annual consumption of 200,000 kWh (equivalent to 10 households) and changes from oil-fired boilers to biogas, this would provide annual CO_2eq savings of 52,400 kg CO_2eq. (see **Figure 3.2** and **Box 3.1**), This saving is the same as the amount of CO_2 produced by leaving 167 x 60 watt light bulbs (or 16.7 x 60 watt light bulbs per household) switched on continually for a year. Clearly the actual carbon savings will depend on the biomass used in the digester and on the type of fossil fuel that is displaced.

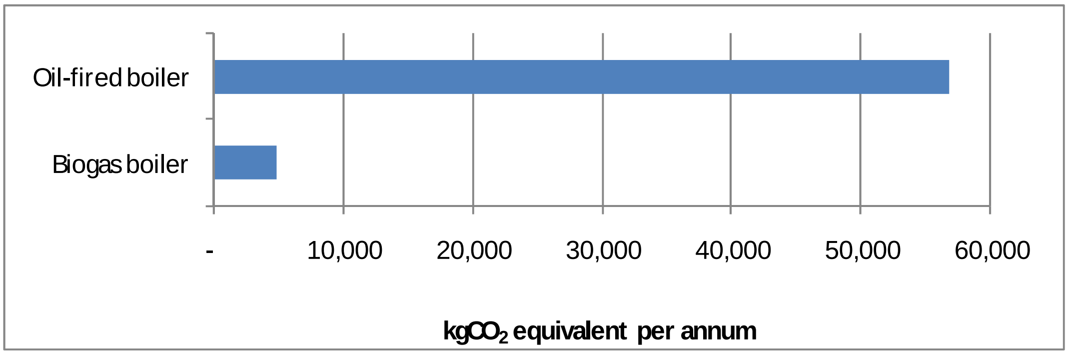


Figure 3.2: Comparison of annual CO_2eq emissions of an oil fired gas boiler and a biogas boiler

Box 3.1 Calculation of carbon savings Carbon savings for an individual development will depend upon the type of fossil fuel that is displaced. For example, if a site has an annual consumption of 200,000 kWh changing from oil-fired boilers to biogas would provide CO_2eq savings of: • Present CO_2eq emissions = 200,000kWh x 0.284 = 56,800 kg CO_2eq • Biogas CO_2eq emissions = 200,000kWh x 0.024 = 4,800 kg CO_2eq • Total savings = 56,800 – 4,800 = 52,400 kg CO_2eq. per annum

COST AND EASE OF APPLICATION

3.6 The cost of an AD system depends on its size and whether it is a single on-farm system or a CAD system. A small digester of 10 kWe capacity, using residues from 100 head of cattle, is likely to cost £60,000-£70,000. Running costs (staff, insurance, transport, licence fees, operation and maintenance) will be between £7,000 and £10,000 per year.

3.7 Projects can be more cost effective if considered as part of waste management plans (either farms, food processors or local authorities). It is also possible to get revenue from sales of electricity, fertiliser and heat.

3.8 Under the proposed Renewable Heat Incentive (RHI) on-site combustion of biogas will be eligible for a payment for a calculated 'deemed' heat output over a 10 year lifetime. Proposed tariffs are:

- All systems up to 200kW: 5.5p/kWh

3.9 RHI payment can also be received for injecting the biogas (termed biomethane) produced into the mains gas system. This will be a metered payment of 4p/kWh for all scales of development.

3.10 Further payments could be received for proposals that generate electricity under the Feed-in Tariff (FIT)[9]. Proposed tariffs are:

- All systems up to 500kW: 11.5p/kWh (20 year duration)

[9] www.fitariffs.co.uk

- 500kW and above: 9.0p/kWh (20 year duration)

FURTHER USEFUL REFERENCES

- Communities and Local Government. (2004). *Planning for Renewable Energy: Companion Guide to PPS22.* (Technical Annex – Section 1).
- DCLG. (2004). *Planning for Waste Management Facilities: A Research Study.*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

3.11 Most anaerobic digestion (AD) plants will be located close to the waste source, and so smaller scale facilities treating locally produced waste are often sited on farms and other agricultural locations. On-farm digesters therefore have the potential to be accommodated within the existing complex of farm buildings. Conversely, centralised anaerobic digestion facilities (**CAD plants**) that handle large quantities of agricultural wastes, sewage sludge or municipal waste are likely to be located within or adjacent to existing commercial/industrial areas or wastewater treatment works. CADs are unlikely to be appropriate within the AONB because wastes will generally need to be imported from outside the area, placing pressure on the roads of the AONB. The remainder of this section therefore focuses on farm-based anaerobic digestion – both those serving an individual farm and a group of farms. Such digesters offer a form of farm diversification, directly linked to added value – in this case adding value to farm wastes. They represent a form of production that benefits the wider environment, removing farm slurries that are a source of diffuse pollution, with the remaining solid digestate providing a good and stable manure, while also offering a source of renewable energy.

3.12 So long as these digesters are integrated into the existing farm complex, are part buried, and natural screening is provided where appropriate, small digesters can be incorporated into the wider landscape and should not conflict with AONB objectives. Maximum use should be made of site contours without major earthworks and care should be taken to minimise the prominence of any storage areas.

3.13 Larger digesters serving a group of farms may also have a role to play, bringing local collaboration and potentially providing a local energy source for local community facilities. These will need to be considered on their merits in terms of the scale of the development; potential traffic generation; and the need or otherwise for the growth of crops such as maize, specifically to provide a feedstock for the digester.

3.14 The AONB Management Plan recognises that the *'good quality and condition of the air, water and soil are key to the outstanding environment of the Blackdown Hills'*. The promotion of anaerobic digestion as an energy source could help deliver the following:

- **Objective EQC 1:** Key natural resources, such as air, water and soils, are protected and conserved through research, understanding and sustainable management.

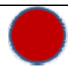
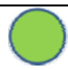
- **Policy EQC 1/A:** Encourage, support and promote initiatives that safeguard earth, air and water resources.
- **Policy EQC 1/C:** Work with partners to reduce sediment and nutrient run-off through catchment-scale projects.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

3.15 Anaerobic digesters utilising farm wastes bring considerable benefits. They convert methane, a significant greenhouse gas, and a major by product of animal slurries, into energy. They therefore make a major contribution to reducing greenhouse gas emissions, both by reducing the quantities of methane produced and by providing a carbon neutral energy source that substitutes for energy produced from fossil fuels. They also potentially provide a form of farm diversification if the energy and potentially the digestate are sold off the farm.

3.16 So long as these digesters are integrated into the existing farm complex, are part buried, and natural screening is provided where appropriate, small digesters can be integrated into the wider landscape. Larger digesters shared between a number of farms will need to be considered on their own merits with regards to impacts on the landscape and the built environment.

3.17 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Centralised anaerobic digestion (AD) plant	
AD serving a group of farms	
AD serving a single farm	

4 WASTE TO ENERGY

DESCRIPTION OF TECHNOLOGY

4.1 Energy can be generated from waste by either a biological or thermal process. The principal biological process is described in paragraph 3.1. This section deals with thermal processes which use a high temperature to release the chemical energy in the waste. Not all thermal processes used to extract energy from waste can be considered renewable energy. For example, the combustion of municipal solid waste in conventional waste incinerators is not deemed to be renewable under the requirements of the Renewables Obligation[10]. To meet the requirements of the Renewables Obligation, generating plants have to meet one or more of the following criteria[11]:

- The waste has been converted to a liquid or gas using either gasification pyrolysis or anaerobic digestion.
- It is an accredited CHP generating station (accredited under the Combined Heat and Power Quality Assurance (CHPQA) programme.)
- The only waste(s) used are liquid fossil fuels (e.g. Recovered Fuel Oil) and/or solid recovered fuel[12].

4.2 In all of the above, it is only the biomass fraction of the waste which is deemed to be renewable and eligible under the Renewables Obligation.

4.3 Only those installations eligible under the Renewables Obligation are considered further in this report. The three main types of thermal plant eligible are:

- **Pyrolysis**: Pyrolysis is the process of heating fuel at high temperatures in conditions of limited or no oxygen to produce a mixture of gaseous and liquid fuels and a solid inert residue (mainly carbon).

Figure 4.1: Avonmouth pyrolysis plant [Source: Compact Power]

[10] The Renewables Obligation (RO) is the Government's main mechanism for supporting the generation of renewable electricity. It requires licensed electricity suppliers to source a specific and annually increasing percentage of their electricity from renewable sources. The current level is 9.7 percent for 2009/10, rising to 15.4 percent by 2015/16.

[11] Ofgem (2009) Renewables Obligation: Fuel measurement and sampling guidance. http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Documents1/FMS%20final.pdf

[12] Solid recovered fuel is a fuel produced by shredding and dehydrating municipal solid waste (MSW) in a converter or steam pressure plant.

- **Gasification**: This is the process of heating wastes in the presence of air or steam, which converts the carbon to a burnable gas called syngas, leaving a solid residue.
- **Combined Heat and Power (CHP)**: The most efficient waste to energy schemes generate both electricity and heat, through Combined Heat and Power (CHP) plants. This may be via combustion, pyrolysis or gasification. CHP is particularly beneficial as most of the energy in the waste can be put to good use and the improvement in energy efficiency leads to a corresponding reduction in emissions. It is desirable for CHP plants to be part of community heating schemes in order to minimise the costs of the heat distribution system.

4.4 Waste to energy plants vary in size from small installations (serving factories for example) to large-scale MSW plants. New projects therefore might either be accommodated within existing or converted buildings, or may require large new sites.

4.5 A typical waste-fuelled combined heat and power process will involve some or all of the following:

- waste reception and storage;
- waste processing, material sorting and recovery;
- feeding waste into the combustion, pyrolysis or gasification chamber;
- the combustion, pyrolysis or gasification reactor and turbines;
- handling, storage and disposal of ash; and
- handling, storage and disposal of liquid effluents such as boiler water and surface water.

4.6 The typical physical characteristics of an enclosed thermal treatment plant are:

- Site: 1-5ha.
- Buildings: Steel clad industrial shed 60m -120m x 60m x 25m with a stack or chimney 30-70m in height, although this is dependent on the technology type used.
- Vehicular movements: 20-50 vehicles a day.

CARBON SAVINGS

4.7 The ultimate carbon balance can only be assessed once the fuel source used in the waste to energy system, processing and transport have been taken into account. An emission factor, again expressed in terms of CO_2 equivalent, has been calculated for the National Calculation Methodologies (see paragraph 2.8) for waste used to generate heat or heat and power as: waste to energy – 0.047 $kgCO_2eq/kWh$.

4.8 As an indication of potential CO_2 equivalent savings: If a site has an annual electrical consumption of 20,000 kWh (equivalent to 5 households), and changes from the grid to electricity generated by a waste to energy power plant, the CO_2eq savings per annum would be in the order of: 10,880 kg

CO_2eq. (see **Figure 4.2** and **Box 4.1**). This is the same amount of CO_2 as that produced by leaving 35 x 60 watt light bulbs switched on continually for a year (or 7 x 60 watt light bulbs per household).

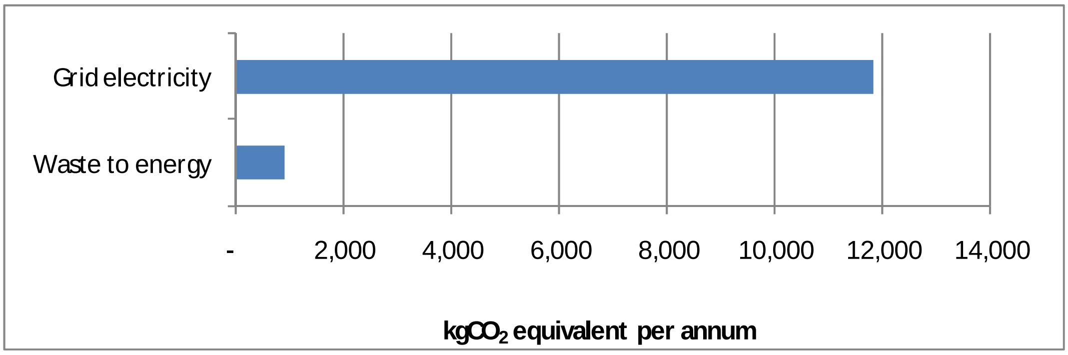


Figure 4.2: Comparison of annual CO_2eq emissions from grid electricity and electricity from waste to energy

Box 4.1 Calculation of carbon savings

Carbon savings for an individual development will depend upon the type of energy and fossil fuel that is displaced. For example, if a household has an annual electrical consumption of 20,000 kWh, changing from grid to electricity generated by a waste to energy power plant the CO_2eq savings would be in the order of:

- Present CO_2eq emissions = 20,000kWh x 0.591 = 11,820 kg CO_2eq
- Waste to energy CO_2eq emissions = 20,000kWh x 0.047 = 940 kg CO_2eq
- Total savings = 11,820 – 940 = 10,880 kg CO_2eq

FURTHER USEFUL REFERENCES

- DCLG. (2004). *Planning for Waste Management Facilities: A Research Study.*
- Ofgem. (2009). *Renewables Obligation: Fuel measurement and sampling guidance.*

COST AND EASE OF APPLICATION

4.9 The costs of waste to energy schemes are highly variable depending on their size and type of thermal treatment process used. These are very major capital schemes.

4.10 Under the proposed Renewable Heat Incentive (RHI), heat generated by medium or large waste to energy CHP systems will be eligible to receive payments. Due to perceived difficulties in metering the input fuels, the RHI proportion will be calculated in the following way:

- *"RHI proportion determined on basis of agreeing with Ofgem sufficient evidence for 50% fossil fuel content; additional supporting evidence required for claiming less than 50% fossil fuel content"*[13].

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

4.11 As major industrial plants requiring large-scale industrial buildings, a chimney up to 70m high, a suitable waste stream, and frequent traffic movements, these developments are unlikely to be suitable within the Blackdown Hills AONB.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

4.12 This type of development is unlikely to be suitable within the AONB.

Large-scale waste to energy plants	

[13] Renewable Heat Incentive Consultation on the proposed RHI financial support scheme

5 MICRO-HYDRO

DESCRIPTION OF TECHNOLOGY

5.1 Hydro power is the use of water flowing from a higher to a lower level to drive a turbine connected to an electrical generator, with the energy generated proportional to the volume of water and vertical drop or head.

5.2 Small-scale hydro power plants in the UK generally refer to sites generating up to a few hundred kilowatts where electricity is fed directly to the National Grid. Plants at the smaller end of this scale (typically below 100 kW) are often referred to as micro-hydro and may include schemes providing power to a single home.

5.3 For all hydro power schemes, the Environment Agency will need to be contacted to issue an abstraction licence. In addition, an Impoundment Licence and Flood Defence Consent may also be required from the Environment Agency.

5.4 The main physical elements of a hydro scheme are as follows:

- A **source of water** that will provide a reasonably constant supply. Sufficient depth of water is required at the point at which water is taken from the watercourse, and this is achieved by building a weir across the watercourse (of sufficient height to fill the penstock). This is called the 'intake'.
- A **pipeline**, often known as a penstock, to connect the intake to the turbine. A short open 'headrace' channel may be required between the intake and the pipeline, but long headrace channels are rare due to environmental and economic constraints.
- The '**turbine house' -** a cover / small shed housing the turbine (converting hydro power into rotary mechanical power), generator (converting the mechanical power into electricity) and ancillary equipment.
- A '**tailrace'** returning the water to the watercourse.
- A **connection to the electricity network**, or to the user's premises.

Figure 5.1: River Dart, Ashburton Devon, 50kW [Source: http://www.westernrenew.co.uk/casestudies/River%20Dart.pdf]

5.5 The majority of suitable locations are likely to be for 'run of river' schemes, where a proportion of a river's flow is taken from behind a low weir and returned to the same watercourse downstream after passing through the turbine. Appropriate locations for 'storage' schemes, where the whole river is dammed and flow released through turbines when power is required, are unlikely to exist in the AONB.

5.6 'Low head run of river' schemes are typically sites in lowland areas, often installed on historic mill sites using the existing channel system and weir or dam. They divert water from behind a weir along a 'leat' (channel) to a turbine intake which is screened to exclude debris and fish. After passing through the turbine, water is discharged along the 'tailrace' (channel) back into the river. The 'depleted reach' of river between leat entrance and tailrace exit will have reduced water flow whilst the turbine is running.

5.7 'High head run of river' schemes are typically found on steeper ground and the diverted water is typically carried to the turbine via an enclosed penstock (pipeline). The length of depleted reach tends to be shorter as the water needs to travel a shorter horizontal distance to build up the same head. The volume of water diverted from the river to generate a given amount of power is also lower.

CARBON SAVINGS

5.8 As there are no direct carbon emissions from micro-hydro electricity generation, the CO_2eq emissions per kWh will be dependent on the embodied energy of the equipment and the installation works carried out.

5.9 Full life-cycle estimations have been made, with a recent meta-study conducted by the University of Sydney[14], as part of a larger investigation. This estimated that emissions from hydro generation were in the region of 0.015 kgCO_2eq/kWh. This will result in CO_2eq savings of about 0.576 kgCO_2eq/kWh of grid electricity displaced by micro-hydro generated electricity.

5.10 As an indication of potential CO_2 equivalent savings: An average household with electricity consumption of 4,000kWh per annum, switching from grid electricity to electricity generated by micro-hydro, would make carbon savings of some 2,304 kgCO_2eq per annum (see **Figure 5.2** and **Box 5.1**). This is the same as the amount of CO_2 produced by leaving 7 x 60 watt light bulbs switched on continually for a year.

[14] Life-Cycle Energy and Greenhouse Gas Emissions of Nuclear Power in Australia
www.isa.org.usyd.edu.au/publications/documents/ISA_Nuclear_Report.pdf

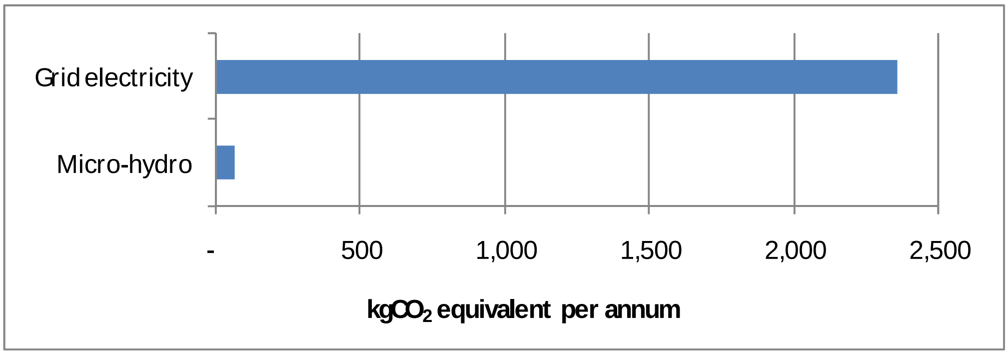


Figure 5.1: Comparison of annual CO_2 eq. emissions from grid electricity and micro-hydro

Box 5.1 Calculation of carbon savings

An average household with electricity consumption of 4,000kWh per annum, switching from grid electricity to electricity generated by micro-hydro, would make the following carbon savings:

- Current emissions with grid electricity: 4,000 kWh x 0.591 = 2,364 $kgCO_2eq$
- Emissions using micro-hydro: 4,000 kWh x 0.015 = 60 $kgCO_2eq$
- Resulting savings: 2,364 - 60 = 2,304 $kgCO_2eq$

COST AND EASE OF APPLICATION

5.11 The costs of small hydro schemes are very site specific. For low head systems (not including the civil works - so assuming there is an existing pond or weir), low cost turbine /generator units have now been developed for a wide range of heads and flows. These are manufactured in the UK and available at prices of less than £2,000 per kW.

5.12 Hydro-electricity has good correlation with demand (more energy is generated in winter when heating and lighting loads are highest); maintenance and running costs are low; and systems have a life of over 25 years.

5.13 Payments could be received for proposals that generate electricity under the Feed-in Tariff. Tariffs are:

- Up to 15kW: 19.9p/kWh (20 year duration)
- 15 to 100kW: 17.8p/kWh (20 year duration)

FURTHER USEFUL REFERENCES

- Communities and Local Government. (2004). *Planning for Renewable Energy: Companion Guide to PPS22. (Technical Annex – Section 4).*
- Scottish Natural Heritage. (2001). *Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes.*

- Environment Agency. (2009). *Good Practice Guidelines Annex to the Environment Agency Hydropower Handbook*.
- Environment Agency. (2010). *Opportunity and Environmental Sensitivity Mapping for Hydropower in England and Wales.*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

5.14 The Blackdown Hills may have considerable potential for micro-hydro schemes with its rivers, many small tributary streams and steep slopes. Further investigation is required to identify the feasibility of potential sites, although current Environment Agency assessments may have identified some potential locations.

5.15 These schemes can be integrated into the landscape with careful siting and design and by making use of landform and existing vegetation to help screen the new small turbine housing, penstock and tailrace. Hydro schemes sited in rivers lined with trees may be concealed more easily. Equal consideration should be given to the sensitive restoration of old water mill sites and other existing structures (i.e. weirs, mill ponds, millraces or leats, hammer ponds, sluice gates and tailrace outlets) relating to past water-powered industries. In areas of more open landscape, high standards of design will help to minimise visual impacts, including the use of local materials for weirs and built structures along with vegetation screening. Burying pipelines and minimising hard surfacing and 'formal' planting can help to integrate the scheme into the rural landscape.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

5.16 Micro-hydro represents a cost and carbon efficient form of energy generation and the chance to sell to the grid when generation exceeds local use. It is likely to be a highly suitable technology for the Blackdown Hills with its many rivers and streams and steep slopes. Such small-scale schemes can be assimilated into the landscape with careful siting and local planting that reflects the landscape character of the area – the primary constraint will be ensuring that these schemes do not exacerbate low flow conditions within the water courses or adversely affect natural river geomorphology. There is also significant potential to restore traditional mills and other water features associated with the past generation of power. Adaptation of these mills for micro-hydro generation can be achieved without any alteration of the river – utilising the existing leat and mill race, and with the turbine located beneath or adjacent to the mill, utilising the mill race. Where the mill is listed the advice of the local authority building conservation officer should be sought. In all cases the Environment Agency will be required to issue an Abstraction Licence.

5.17 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Micro hydropower plants	

6 PHOTOVOLTAICS

DESCRIPTION OF TECHNOLOGY

6.1 Solar energy generation involves the use of the sun's energy to provide hot water or electricity. Solar Photovoltaic (PV) systems use solar cells to generate electricity directly from sunlight. The electricity produced can either be stored in batteries or fed into the grid via the mains supply. PV is particularly suited to buildings that use electricity during the day such as offices, schools, and shops.

6.2 Solar photovoltaic (PV) cells can either be roof mounted (**Figure 6.1**) or free-standing in modular form, or integrated into the roof or facades of buildings through the use of solar shingles, solar tiles / slates (**Figure 6.2**), solar glass laminates and other solar building design solutions. PV cells may also be attached directly to the appliances they power, such as lights or parking meters. The most common form of device comprises a number of semiconductor cells which are interconnected to form a solar panel or module. There is considerable variation in appearance, but all solar panels are dark in colour, and have low reflective properties.

Figure 6.1: Retrofit solar PV panels [Source: Blackdown Hills AONB Partnership]

Figure 6.2: Integrated solar PV(on the left) Pinkery Centre, Exmoor National Park [Source: Exmoor National Park Authority]

6.3 PV cells perform best in the UK when inclined at an angle of 20°-40°, facing due south and clear of the shade of trees and buildings. Some flexibility may be necessary when installed on existing buildings but performance will be degraded when designed outside of these criteria. Solar panels are typically 0.5 to 1 m^2 having a peak output of 70 to 160 watts. A number of modules are usually connected together in an array to produce the required output, the area of which can vary from a few square metres to several hundred square metres. A typical array on a domestic dwelling would have an area of 9-18 m^2, and would produce 1-2 kW peak output. Grid-connected solar PV systems work in conjunction with an inverter to feed electricity into the mains. Off-grid systems, however, require battery storage the size of which will vary according to the load.

6.4 In addition to PV modules associated with built development, there is increasing interest (stimulated by the Feed-in Tariff) from renewable energy developers in establishing **solar PV farms.** Although, none are known to have been built in England to-date, they are commonplace in mainland European counties such as Spain. A solar PV farm would typically involve the erection of several rows of PV units on fixed mounted racks or modules set up to track the sun. The size of solar farm installations currently being considered by developers in England is around 1-3MW. A 1MW development would typically require a site of approximately 2-3 hectares but sites of up to 5 hectares are being considered on the South West peninsula. The output of a typical panel used would be approximately 200 watts, so a 1MW solar farm would require 500 racks containing 10 panels in each rack. A 1MW development would also require a substation of approximately 3m x 2m and 2.5m in height and a suitable access road for construction. Racks may require regular cleaning (using tractor-mounted equipment) to maximise energy production.

CARBON SAVINGS

6.5 As there are no direct carbon emissions from PV generated electricity, the emissions are derived from the manufacture of the PV panels and the balance of system equipment. Many academic studies have looked in to the life-cycle emissions of PV, with a recent study by Fthenkakis *et al.*[15] that found current estimates of the greenhouse gas emissions for typical solar PV systems range from 0.029 to 0.035 $kgCO_2eq/kWh$. The Sydney University meta-study referred to in paragraph 5.9 found a median figure of 0.106 $kgCO_2eq/kWh$. Taking an average of these two figures gives a figure of 0.069 $kgCO_2eq/kWh$.

6.6 As an indication of potential CO_2 equivalent savings: An average household with electricity consumption of 4,000kWh per annum and a typical solar PV system producing 1,500kWh per annum, would make CO_2 savings of 783 $kgCO_2eq$ per annum by switching from grid electricity (see **Figure 6.3** and **Box 6.1**). This is equivalent to the amount of CO_2 produced by leaving 2.5 x 60 watt light bulbs switched on continually for a year.

[15] Fthenakis, V.M., Kim, H.C., Alsema, M., (2008). Emissions from photovoltaic life-cycles. Environmental Science and Technology 42, 2168–2174.

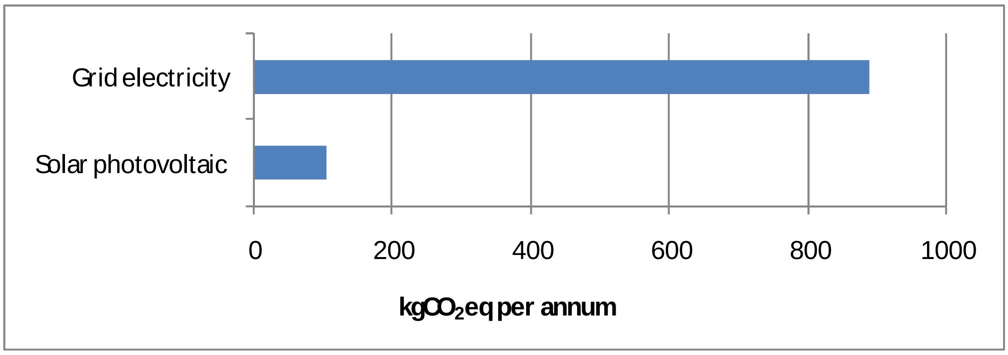


Figure 6.3: Comparison of annual CO_2 eq. emissions from grid electricity and solar PV

Box 6.1 Calculation of carbon savings

A typical household consuming 4,000kWh per annum and with a solar PV system producing 1,500kWh per year would make the following CO_2 savings by offsetting grid electricity:

- Current emissions with grid electricity: 1,500 kWh x 0.591 = 887 $kgCO_2eq$
- Emissions using PV: 1,500 kWh x 0.069 = 104 $kgCO_2eq$
- Resulting savings: 887-104 = 783 $kgCO_2eq$ per annum

COST AND EASE OF APPLICATION

6.7 Prices for PV systems vary, depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted (if building mounted). The size of the system is dictated by the amount of electricity required.

6.8 For the average domestic system, costs can be around £4,000- £9,000 per kWp installed. Solar tiles cost more than conventional panels, and panels that are integrated into a roof are more expensive than those that are roof mounted.

6.9 Maintenance requirements are low, with visual checks by the user and cleaning to remove accumulated dirt – a solar panel needs to be clean to operate at its rated capacity. The life of PV systems can be long as there are no moving parts and the components are usually high quality materials. Expected life is typically between 30-40 years.

6.10 The amount of electricity generated is dictated by the availability of light with higher levels generated in the summer when household demands may be at their lowest. Under grid connected options, excess electricity can be sold to the grid.

6.11 PV installations will benefit from payments under the Feed-in Tariff. Payments will be made for every kWh generated, and for all those exported to the grid. The grid exports will be deemed to be 50% of the generation figure and are paid at the rate of 3p/kWh. The amount paid per kWh generated varies in relation to the size and type of installation as set out below:

- Up to 4kWp (new build): 36.1p/kWh (25 year duration)
- Up to 4kWp (retrofit): 41.3p/kWh (25 year duration)
- 4 to 10kWp: 36.1p/kWh (25 year duration)
- 10 to 100kWp: 31.4p/kWh (25 year duration)
- 100kW to 5MWp: 29.3p/kWh (25 year duration)
- Standalone systems: 29.3p/kWh (25 year duration)

FURTHER USEFUL REFERENCES

- Communities and Local Government. (2004). *Planning for Renewable Energy: Companion Guide to PPS22.* [See Technical Annex Section 6.]
- Solar Trade Association (STA): www.solartradeassociation.org.uk
- Energy Savings Trust. *Photovoltaic (PV) Solar Electricity - Factsheet 4*
- Various local authorities around the UK have drafted guidance on solar panels including the New Forest National Park, Hull, and Hertsmere.

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

6.12 **Building associated PV systems:** PV offers flexible roofing systems for the production of electricity. The visual impact of a solar unit will be determined by its location which in turn will be determined by the orientation required to maximize solar energy gain. Maximum solar gain will be obtained by locating solar units on south facing roofs (solar units can still be productive if oriented eastwards or westwards, but will achieve maximum productivity if oriented due south). The scale of solar units in relation to the roof area will vary with the technology: PV roof shingles, for example, which have a similar appearance to traditional roof coverings (**Figure 6.2**), are more likely to cover a larger percentage of the roof than retrofit PV panels (**Figure 6.1**).

6.13 Roof-mounted solar units on buildings can sometimes have a 'modernising' effect on the character and appearance, particularly when they are located on the principal elevation of a property. Solar panels are available in different colours to suit varying architectural designs, ranging from contemporary designs to those attempting to match more traditional tiles or slates. Consideration should therefore be given to matching solar panels with other roof materials. Where possible, solar panels should be flush with the roof and mounted at the same angle as the roof to minimise contrast.

6.14 Equally, for retrofit PV it may be best, visually, if they are located on a rear roof pitch or adjacent outbuilding or incorporated as a garden feature, especially in the case of older buildings reflecting local vernacular styles. In new developments they should be integral to the overall design. Particular care will be required in the case of Listed Buildings and Conservation Areas where the advice of the local authority building conservation officer should be sought. Throughout, the aim should be to:

- Maintain and enhance the rich heritage of historic buildings and settlements of the AONB, reflecting their local character;
- Ensure that new development, restoration and conversions reinforce and enhance the character of settlements and their setting;
- Ensure that high quality modern design fits neatly and complements building traditions of the past.

6.15 The AONB Management Plan also includes the following objectives and policies of relevance to the installation of building associated PV systems:

- **Objective PD 2:** Traditional, local materials and energy- and water-efficient technologies are used widely in all development.
- **Policy PD 2/A:** Encourage new developments or conversions to use traditional and local materials, to be as carbon-neutral and water efficient as reasonably practicable, and to incorporate appropriate renewable energy sources.

6.16 **Solar PV farms:** None have currently been developed in England (although a considerable number are under investigation) and so landscape implications are not yet fully understood. However, such developments are likely to have wider landscape impacts because of their:

- Scale – covering at least 2 - 3 hectares with some 500 PV panels arranged in racks.
- Their purposeful orientation to catch the sun – meaning that they are most likely to be found on south-facing slopes, greatly increasing their visibility across a wide area. The nearest equivalent existing development type would be a large-scale glass house development.
- Potential need for an access road and control building.
- Concrete foundations to each rack.
- Need for underground cabling linking the racks, a sub-station and connection from the sub-station to the grid.
- Potential security fencing.

6.17 As argued in paragraph 1.8 there is a case for carrying out a landscape sensitivity study for these potential developments based on the model being developed for Cornwall. Like large-scale glasshouse developments, such energy developments have the potential to change the character of the local landscape with the potential to be visible over considerable distances if located on exposed hill sides with little natural screening.

6.18 The key considerations in judging the landscape implications of large-scale photovoltaics are likely to be:

- The overall scale of the development, with smaller developments of less than two hectares more likely to be in keeping with the small-scale landscape of the Blackdown Hills;
- Both the nature and visibility of ancillary developments including security fencing;

- Not disturbing underground archaeology (especially during construction) or semi-natural habitats, and not sited within the setting of important historic features and archaeological sites;
- Their location relative to topography with plateau top locations (away from the plateau edge) not overviewed by higher ground likely to be better locations, avoiding sloping ground, where these developments may be seen over a considerable distance;
- Not visible in long views, including those from outside the AONB;
- Not viewed from public vantage points, including public rights of way and other paths;
- Well screened by a combination of local topography and vegetation including the hedgerow network and woodland.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

6.19 **Building-associated PV systems:** These offer a long lasting approach to domestic and business electricity generation and the opportunity to sell to the grid at times when generation exceeds demand. It also offers a solution with minimal landscape effects so long as care is taken to minimise the visibility of the PV panels and/or they are integral to the building design (in the case of new build and extensions, as illustrated by Figure 6.2). Specific advice should be sought from the local authority building conservation officer in the case of Listed Buildings and Conservation Areas.

6.20 **Solar PV farms:** These will need to be very carefully sited taking account of the factors listed in paragraph 6.18, if they are to be accommodated within the Blackdown Hills AONB without having adverse landscape impacts that could significantly alter the character of the landscape. Any such planning application for this type of development would need to be supported by a detailed Landscape and Visual Impact Assessment (LVIA) to demonstrate its impact on the landscape, in particular the visibility from surrounding public vantage points. Only developments that are entirely hidden from such vantage points and are small in scale, are likely to be suitable for consideration.

6.21 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

PV cells integrated onto a building	
Solar PV Farms	*VERY LIMITED*

7 SOLAR HOT WATER

DESCRIPTION OF TECHNOLOGY

7.1 Solar hot water systems use solar collectors, usually placed on the roof of a building, to preheat water for use in sinks, showers and other hot water applications. They do not provide enough energy for space heating. The technology may also be referred to as solar thermal or solar water heating. While the UK climate is not sufficiently hot and sunny to meet all domestic hot water requirements year round, a well designed solar thermal system should meet 50-70% of demand during May to September.

7.2 Solar thermal energy represents the most easily installed and potentially cheapest renewable energy application for domestic buildings. For non-domestic buildings, it is only appropriate if they have a high hot water demand, such as swimming pools, hotels and some industrial buildings. Solar thermal collectors work in conjunction with a hot water tank located within the building, which stores hot water and has an independent heating source such as a boiler or immersion heater to supplement the solar thermal system.

7.3 Similarly to solar PV, for best performance in the UK, the solar collectors (either flat plate or more efficient evacuated tube[16]) need to be inclined at an angle of 30°- 40°, facing due south and clear of the shade of trees and buildings. Some flexibility may be necessary when installed on existing buildings but performance will be degraded when designed outside of these criteria. The collectors do not usually stand more than 12 cm proud of the existing roofline, are generally dark coloured, and on a domestic building, are typically 3-5 m^2 in area. Increasingly, collectors are becoming available that can be incorporated into a new or existing roof in much the same way as roof windows. Although most are commonly roof mounted, a free-standing ground structure is also possible and is frequently used for swimming pools.

Figure 7.1: Solar thermal panels [Source: Blackdown Hills AONB Partnership]

[16] Flat plate systems consist of an absorber plate with a transparent cover to collect the sun's heat; evacuated tube systems consist of a row of glass tubes, each containing an absorber plate feeding into a manifold.

CARBON SAVINGS

7.4 As with micro-hydro and PV the majority of carbon emissions are related to the manufacture and installation of the system. There is a small electrical demand from the system pump that can be provided by either grid or PV generated electricity. Full life cycle analyses have been conducted on solar thermal systems with a recent study by the University of Bath[17], this has determined the CO_2eq emissions to be in the region of 0.017 kgCO_2eq/kWh.

7.5 The total carbon savings will be dependent upon the fossil fuel displaced, with estimates given below for a 2.8m² system generating 815kWh per year.

- Grid electricity: 0.591 x 815 = 482 kgCO_2eq
- New oil-fired boiler with an efficiency of 90%:
  0.284 x (815 ÷ 0.9) = 257 kgCO_2eq
- Solar thermal: 0.017 x 815 = 14 kgCO_2eq. per annum

7.6 In this example of a typical household use of solar hot water panels, an annual saving of 243 and 468 kgCO_2eq would be achieved by displacing oil and electricity respectively (see **Figure 7.2**). The CO_2 equivalent saved in this example is equal to the amount that would be produced by leaving 1(displacing oil) or 2 (displacing grid electricity) 60 watt light bulbs switched on continually for a year.

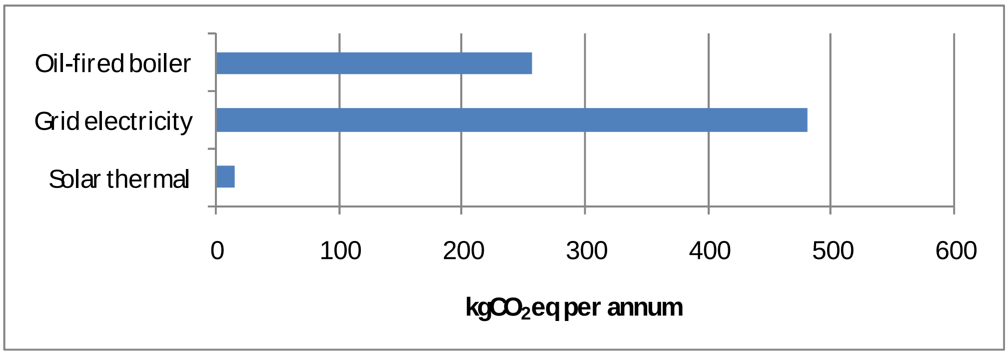


Figure 7.2: Annual CO_2eq from a 2.8m² solar thermal system, compared with grid electricity and oil-fired alternatives

COST AND EASE OF APPLICATION

7.7 The typical installation cost for a domestic system is £2,000-£8,000. Solar hot water systems generally come with a 10-year warranty and require very little maintenance. A yearly check by the householder and a more detailed check by a professional installer every 3-5 years is sufficient. Larger systems cost slightly less per unit of energy output. A well maintained system would be expected to last 20-30 years.

7.8 Under the proposed Renewable Heat Incentive (RHI) solar thermal systems will be eligible for a payment on a calculated 'deemed' heat output over a 20 year lifetime. Proposed tariffs are:

- Up to 20kW: 18p/kWh

[17] Study available here: www.solartwinprojects.com/downloads/MG2008-SG-005.pdf

- 20 to 100kW: 17p/kWh

FURTHER USEFUL REFERENCES

- Communities and Local Government. (2004). *Planning for Renewable Energy: Companion Guide to PPS22. [See Technical Annex Section 7.]*
- Source: Severn Wye Energy Agency. *Solar Hot Water Factsheet.*
- Solar Trade Association (STA): www.solartradeassociation.org.uk
- Energy Savings Trust. *Solar Water Heating - Factsheet 3*
- Various local authorities around the UK have drafted guidance on solar panels including the New Forest National Park, Hull, and Hertsmere.

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

7.9 Solar hot water systems offer a low impact solution to the heating of water within individual properties, meeting between 50% - 70% of hot water needs between May and September. To minimise intrusion, ideally, they should be located on a rear or side roof pitch or other roof elevations where visibility is limited. In new development they should be integral to the overall design. Particular care will be required in relation to Listed Buildings and Conservation Areas where the advice of the local authority building conservation officer should be sought. As for PV, throughout the aim should be to:

- Maintain and enhance the rich heritage of historic buildings and settlements of the AONB, reflecting their local character;
- Ensure that new development, restoration and conversions reinforce and enhance the character of settlements and their setting;
- Ensure that high quality modern design fits neatly and complements building traditions of the past.

7.10 As for Solar PV, the AONB Management Plan includes the following objectives and policies of relevance to the installation of solar hot water systems:

- **Objective PD 2:** Traditional, local materials and energy- and water-efficient technologies are used widely in all development.
- **Policy PD 2/A:** Encourage new developments or conversions to use traditional and local materials, to be as carbon-neutral and water efficient as reasonably practicable, and to incorporate appropriate renewable energy sources.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

7.11 Solar hot water heating offers a low carbon and cost effective solution for water heating (other than central heating) during the spring and summer months. It also offers a solution with low landscape impact so long as care is taken to minimise the visibility of the heating collector and/or it is integral to the building design (in the case of new build and extensions). Specific advice should be sought from the local authority building conservation officer in the case of Listed Buildings and Conservation Areas.

7.12 In summary, the appropriateness of this technology within the AONB is as follows:

Solar hot water heating panels	

8 GROUND, AIR, AND WATER SOURCE HEAT PUMPS

DESCRIPTION OF TECHNOLOGY

8.1 **Ground source heat pump (GSHP)** technology makes use of the heat energy stored in the ground surrounding (or even underneath) buildings. Essentially, heat is taken out of the ground and passed through a heat exchanger to release it into the building. Diverse applications include space heating, water heating, heat recovery, space cooling and dehumidification in both the residential and commercial building sectors. As they operate most effectively when raising water to a temperature no more than about 40°C. Ground source heat pumps (**and all other heat pumps**) are best used with underfloor heating systems or low temperature radiators (with a larger surface area), and are not usually considered suitable for retrofitting into existing high temperature radiator systems previously supplied by conventional boilers. Underfloor low temperature systems are particularly appropriate for large rooms, such as school classrooms and halls. The heat pump itself is a similar size to a large fridge and is situated inside the building.

8.2 **Water source heat pumps** extract heat from large bodies of water or rivers (with a reasonably high flow volume in order to minimise any resulting changes in water temperature). As with ground source heat pumps, despite the relatively low temperatures of the water source, heat can be extracted from it in a heat exchanger to feed a low-temperature central heating system. An abstraction licence from the Environment Agency is normally required.

8.3 **Air source heat pumps** use the ambient air as a heat source for heating a building. These heat pumps tend to be much easier and cheaper to install than ground source heat pumps (as they lack any need for external heat collector loops), but are also usually less efficient. In certain cases, they can be considered for retrofitting to previous gas and oil systems.

8.4 A typical **ground source heat pump** system has three major components: a heat pump, a ground collector loop (typically coils known as slinkies when laid in trenches in the ground or vertical pipes within boreholes) and an interior heating or cooling distribution system.

Figure 8.1: Ground source heat pump unit (left) and 'slinky' ground loop (right) [Source: www.gshp.org.uk]

8.5 The physical components of a **water source heat pump** are similar but with the heat exchanger located in a water body rather than the ground.

8.6 **Air source heat pumps** can either be mounted directly on an external wall (sometimes under a window) where they look like (and are in effect) air-conditioning units running in reverse, or they can feed a centralised ducted warm air central heating system.

Figure 8.2: Air source heat pump unit [Source: www.airsource-heatpump.co.uk**]**

CARBON SAVINGS

8.7 As the heat pumps defined above operate from grid electricity, carbon savings for all heat pump installations will depend upon the annual coefficient of performance (CoP) of the system. The CoP is the ratio of energy that the heat pump outputs, relative to the amount of energy that it consumes in operation. So, for example, if a heat pump outputs 3 kWh of heat for each 1kWh that it consumes, its CoP is 3.0. The CoP will depend upon the type of heat pump and the delivery system installed. Estimated CoPs have been calculated for the Standard Assessment Procedure (SAP) (see paragraph 2.8), and are as follows (illustrated in **Figure 8.3** below):

- Ground source heat pump - underfloor heating: CoP 3.2
- Ground source heat pump - radiators: CoP 2.25
- Water source heat pump - underfloor heating: CoP 3.0
- Water source heat pump - radiators: CoP 2.1
- Air source heat pump (air to water) - underfloor heating: CoP 2.5
- Air source heat pump (air to water) - radiators: CoP 1.75
- Air source heat pump (air to air): CoP 2.5

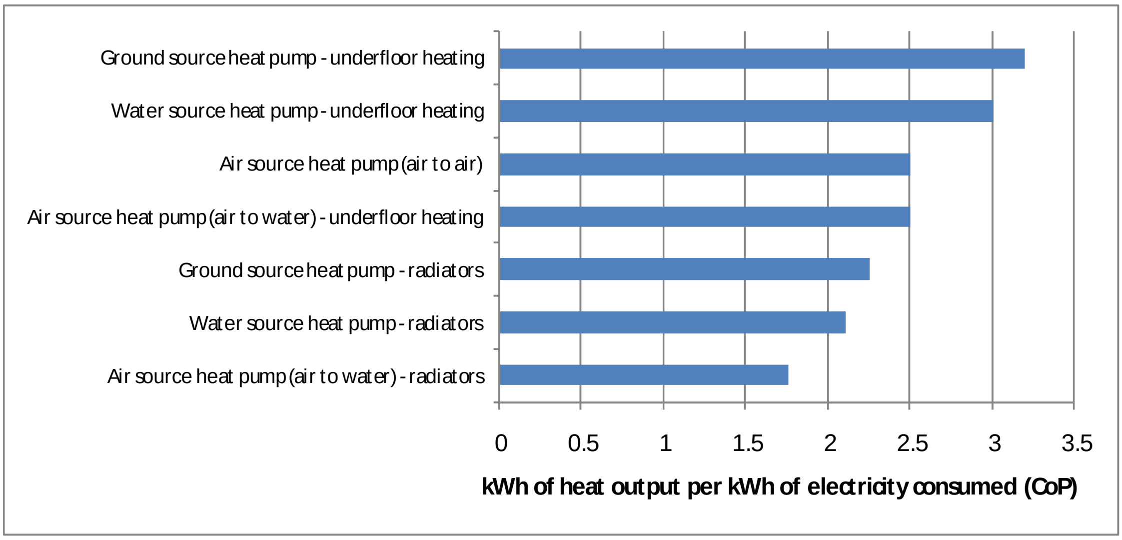


Figure 8.3: Coefficient of performance for a range of heat pump types

8.8 Within an individual dwelling, carbon savings would depend on the fossil fuel displaced and the type of heat pump installed. For example, if a ground source heat pump with underfloor heating is installed in a residential refurbishment with annual heating demand of 20,000kWh instead of an oil fired boiler, the annual saving would be 1,986 kg CO_2eq. per year (see **Figure 8.4**). This is equal to the amount of CO_2 that would be produced by leaving 6 x 60 watt light bulbs switched on continually for a year. The calculations for this example are:

- Domestic heating oil: 0.284 x 20,000 = 5,680 kgCO_2eq
- Ground source heat pump - underfloor heating: CoP 3.2: 0.591 x (20,000/3.2) = 3,694 kgCO_2eq
- Total savings = 5,680 – 3,694 = 1,986 kg CO_2eq. per year.

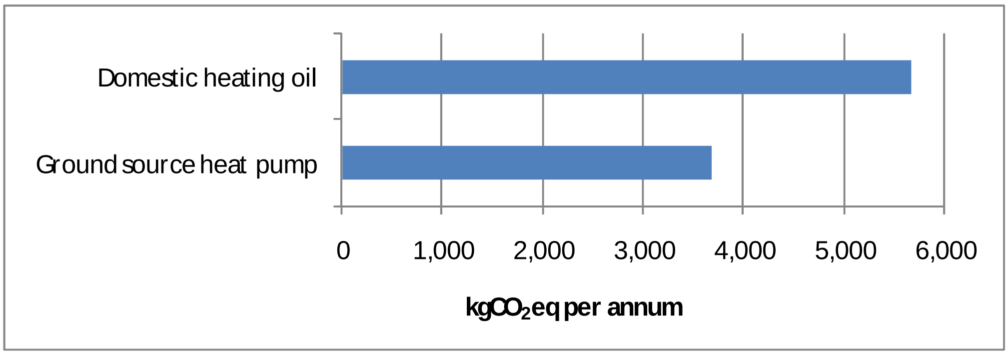


Figure 8.4: Comparison of annual CO_2eq emissions from domestic heating oil and ground source heat pump

COST AND EASE OF APPLICATION

8.9 A typical 8 kW system costs £6,000-£10,000 plus the price of connection to the distribution system. This can vary with property and location. Combining the installation with other building works can reduce costs. As a general rule the running costs are more favourable in areas that do not have a gas supply.

8.10 Ground source heat pumps are very easy to operate and require little or no user intervention. They have very low maintenance costs and can be expected to provide reliable heating for in excess of 20 years.

8.11 Under the proposed Renewable Heat Incentive (RHI) heat pump systems will be eligible for a payment on a calculated 'deemed' or metered heat output over a 20 year lifetime. Proposed tariffs are:

Ground source heat pump: (20 year duration)

- Up to 45kW: 18p/kWh (deemed)
- 45 to 350kW: 5.5p/kWh (deemed)
- 350kW and above: 1.5p/kWh (metered)

Air source heat pump: (20 year duration)

- Up to 45kW: 7.5p/kWh (deemed)
- 45 to 350kW: 2p/kWh (deemed)

8.12 Whether to include water source heat pumps with ground source heat pumps or air source heat pumps was left open in the RHI consultation.

FURTHER USEFUL REFERENCES

- The UK Heat Pump Network: *www.heatpumpnet.org.uk*
- The Heat Pump Association: *www.feta.co.uk*
- Ground Source Heat Pump Association: *www.gshp.org.uk*
- The IEA Heat Pump Centre - includes case studies for groundsource heat pump installations:*www.heatpumpcentre.org*
- Energy Savings Trust: *'Domestic Ground Source Heat Pumps'* (GPG 339)
- Severn Wye Energy Agency. (2009). *Factsheet on Air Source Heat Pumps.*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

8.13 Once installed heat pumps will have minimal impact on the landscape as they are all but invisible – the main visible structure is the 'air conditioning unit' associated with air source heat pumps – other heat pumps have no externally visible elements once installed.

8.14 Ground source heat pumps involve the laying of coils of pipe in either a horizontal trench or a vertical borehole. Once installed, the pipework can easily be covered with soft or hard surfaces and so the system will not be visible from outside the building. However, there are two issues that need to be taken into account:

- The below ground pipes associated with ground source heat pumps involve significant ground disturbance during construction. Sensitive installation should avoid disturbing ground which would be difficult to restore, such as semi-natural habitats, tree roots and archaeological remains. The local authority may require an archaeological survey before construction and advice will need to be sought from the local authority building conservation officer.

- Some systems involve the laying of pipes beneath heat absorbent surface materials, such as tarmacadam. Care will be needed to ensure that such surface materials are not out of character with the local area and do not introduce large areas of formal hard surfacing into a previously informal rural setting.

8.15 Air source heat pumps require an external heat pump that captures heat from the ambient outside air. These units resemble air conditioning units in terms of their size and appearance and therefore should be sited on the least visible elevations.

8.16 The AONB Management Plan includes the following policies that would need to be considered when installing ground- or air-source heat pumps:

- **Objective BG 1:** Key wildlife sites, and sites of geological and geomorphological importance are appropriately managed to conserve and enhance their special features.
- **Objective PD 2:** Traditional, local materials and energy- and water-efficient technologies are used widely in all development.
- **Policy PD 2/A:** Encourage new developments or conversions to use traditional and local materials, to be as carbon-neutral and water efficient as reasonably practicable, and to incorporate appropriate renewable energy sources.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

8.17 Once installed ground and water source heat pumps will have no visual impact (unless they have involved tree removal in the laying of trenches or the introduction of new hard surfacing). Nevertheless, care is needed to ensure that during construction (of trenches) they do not adversely affect archaeological sites, tree roots or semi-natural habitats of value. In the case of ground source heat pumps it will also be important to avoid the introduction of formal hard surfacing, such as tarmac, over the heat collector pipes where this will have the effect of 'urbanising' a previously rural setting.

8.18 Air source heat pumps have minimal visual impact if mounted on a rear or side elevation of the building and will have minimal impact during construction. All heat pumps offer considerable reductions in carbon emissions when compared with even the most efficient forms of traditional heating systems. In the case of Listed Buildings and Conservation Areas advice should be sought from the local authority building conservation officer.

8.19 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Ground, water and air source heat pumps	

9 COMMUNITY HEATING SCHEMES

DESCRIPTION OF TECHNOLOGY

9.1 Community heating schemes (also known as district heating schemes) deliver heat to multiple buildings from a central heat source through a network of pipes to deliver space heating and hot water. In this way heat can usually be generated and delivered more efficiently than with multiple individual systems. There is generally believed to be significant potential for such schemes in the UK, although relatively few systems are currently in place.

9.2 The energy centre can generate heat alone, or can be designed as a Combined Heat and Power (CHP) plant to generate both electricity and heat. In some cases, the heat output can also be used to drive an adsorption chilling process which can then provide cooling to end-users served by the network.

9.3 The pipe network can be installed at the same time as other services (water, drainage, etc.) to minimise costs in new developments. This type of system is also suitable for existing buildings, although a programme of works would be required for retrofitting. The scale of these schemes can range from small-scale systems e.g. a biomass boiler supplying a group of ten dwellings, to large-scale schemes supplying town centres or communities, although the former application is most likely to be appropriate in the context of the Blackdown Hills AONB.

9.4 These schemes can be flexible in terms of their energy source. While hot water is normally the energy carrier, the heat itself can be derived from a wide range of fuel, plant and conversion process types, including traditional gas boilers, biomass boilers, gas or biomass CHP systems, and waste heat from existing processes such as power generation and waste incineration (although the latter are unlikely to be relevant within the AONB). As these heat networks are designed to last for many years, this flexibility can also future-proof the system to technological advances.

9.5 The technology typically comprises an energy centre, a network of insulated pipes and a series of heat exchangers with heat meters in buildings being supplied with heat.

CARBON SAVINGS

9.6 Emission factors for use in the National Calculation Methodologies have been calculated for micro district heating, for both heat (community heating) or heat and power (CHP) for a range of fuels (**Figure 9.1**), they are as follows:

- Mains gas – 0.206 kgCO_2eq/kWh
- Coal – 0.391 kgCO_2eq/kWh
- LPG – 0.251 kgCO_2eq/kWh
- Heating oil – 0.291 kgCO_2eq/kWh
- Biomass – 0.019 kgCO_2eq/kWh

- Biogas – 0.024 $kgCO_2eq/kWh$
- Waste – 0.047 $kgCO_2eq/kWh$
- Waste heat from power stations– 0.058 $kgCO_2eq/kWh$
- Geothermal heat sources – 0.041 $kgCO_2eq/kWh$

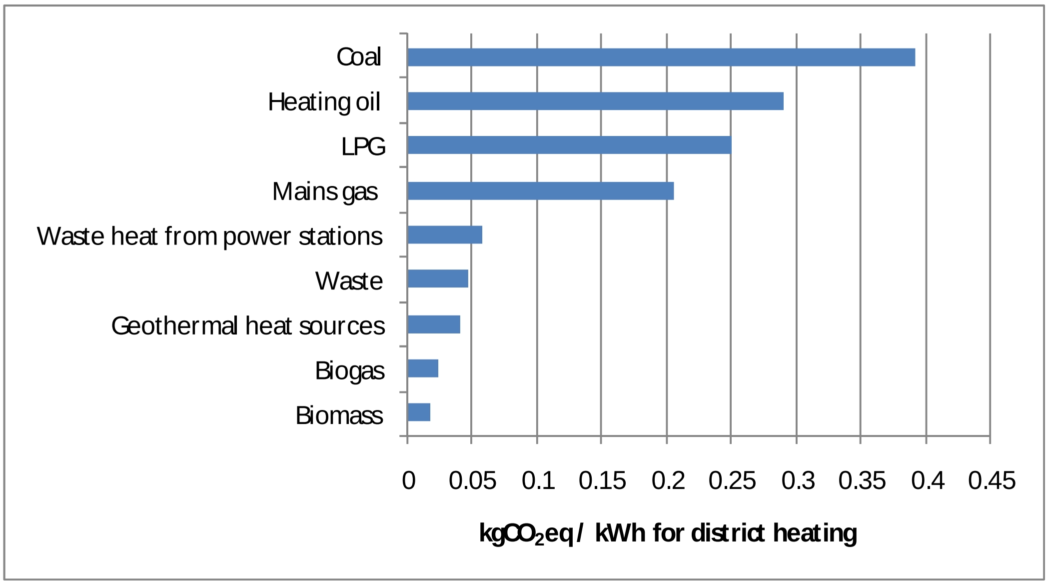


Figure 9.1: CO_2eq emissions per kWh for a range of community heating fuels

9.7 The carbon savings of an installation would depend upon the fuel chosen and type of fossil fuel replaced. For example, if a community heating system, fuelled by biomass, is installed in a residential area refurbishment, with an annual heating demand of 300,000kWh (equivalent to 15 dwellings) instead of individual oil-fired boilers, the saving would be 79,500 kg CO_2eq. per annum. This is equivalent to the amount of CO_2 that would be produced by leaving 255 x 60 watt light bulbs switched on continually for a year (or 17 x 60 watt light bulbs per household). The calculations for this example are as follows:

- Domestic heating oil: 0.284 x 300,000 = 85,200 $kgCO_2eq$
- Community / district heating – biomass = 0.019 x 300,000kWh = 5,700 $kgCO_2eq$
- Total savings = 85,200 – 5,700 = 79,500 kg CO2eq per annum. (This is illustrated in **Figure 9.2** overleaf).

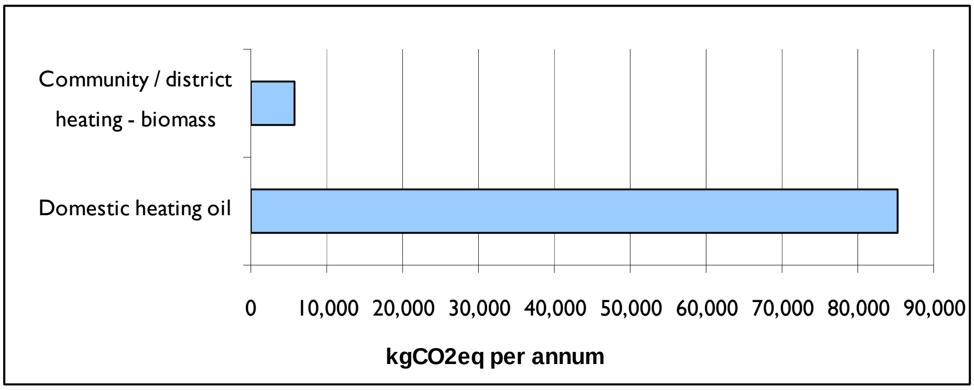


Figure 9.2: Comparison of annual CO_2eq emissions from domestic heating oil and community district heating

COST AND EASE OF APPLICATION

9.8 One of the main constraints to community heating systems is the need to identify a sufficient heat demand density (i.e. grouping of dwellings of businesses). High heat densities mean shorter pipe runs and lower costs. Viability is very much site-specific but in the context of the AONB opportunities may include new affordable housing proposals, groupings of leisure providers, or groupings of businesses, such as those forming part of farm diversification. In the Pembrokeshire Coast National Park, the Authority offices and those of adjacent organisations are heated by a central biomass boiler. The co-location of existing and new development within community heating schemes can also help to diversify the heat load (i.e. promote a more constant demand for heat) and help to optimise plant design.

9.9 Within the UK, the size and complexity of community heating schemes tend to act as a significant constraint along with the cost and associated risk. The technology itself is less of a constraint as demonstrated by the many successful installations outside the UK.

9.10 Community heating schemes can be operated under a range of business models, with most generally referred to as Energy Service Companies (ESCos). A common arrangement is for an ESCo to take responsibility for constructing, operating and maintaining a network, so that the end-user avoids the risk of maintaining their own plant and just needs to enter into a contract to purchase energy from the ESCo. Alternatively for small schemes the energy can be supplied by the landowner to lessees.

FURTHER USEFUL REFERENCES

- CABE - *http://www.cabe.org.uk/sustainable-cities/advice/local-energy-and-combined-heat-and-power*
- Combined Heat and Power Association - *http://www.chpa.co.uk/*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

9.11 Opportunities for community heating systems within the AONB are likely to be limited by the small scale of development that will usually be appropriate but there may be a case for smaller schemes such as a biomass boiler supplying a group of ten dwellings.

9.12 These schemes involve the laying of the pipe network in horizontal trenches. Once installed, the pipework is virtually all underground and can be covered with soft or hard surfaces, and so the system will not normally be visible from above ground once constructed. However, the laying of pipes involves ground disturbance and sensitive installation should avoid disturbing ground which would be difficult to restore (as in the case of Ground Source Heat Pumps).

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

9.13 In principle, small-scale community heating schemes would be appropriate within the AONB but its suitability will depend on the nature of the heat source used and the overall scale and nature of the development, where the considerations will be significantly broader than the use of a community heating system alone.

9.14 In summary, the appropriateness of this technology within the AONB is as follows:

Small-scale or micro district heating	

10 WIND ENERGY

DESCRIPTION OF TECHNOLOGY – GENERAL PRINCIPLES

Figure 10.1: Carno Wind Farm, Powys [Source: © Npower Renewables]

10.1 On-shore wind power is an established and proven technology with thousands of installations currently deployed across many countries. The UK has the largest wind energy resource in Europe. The *UK Renewable Energy Strategy* (2009) sets out a lead scenario in which wind generation, both onshore and offshore, will provide over two-thirds of our renewable electricity supply by 2020. This is the context of the EU target that 20% of all energy (electricity, heat and transport) will be from renewable sources by 2020.

10.2 Wind turbines operate between a range of wind speeds defined by the 'cut-in', 'rated' and 'cut-out' wind speeds, which are specific to the turbine model. Below a certain wind speed, (the **cut-in** speed) there is insufficient energy in the wind for the turbine to generate electricity. As wind speed increases, the turbine will then start generating, with its power output increasing up to its maximum 'nameplate' power rating at the **rated** wind speed. As wind speeds continue to increase, the turbine will remain at its maximum output up to the **cut-out** wind speed, at which point the turbine must stop and 'park' the rotor in order to avoid potential damage from the excessive forces in the wind. Therefore, the amount of energy that turbines generate will depend primarily on wind speed but will be limited by the maximum output (kW) of the individual turbine. As the turbine will not operate below the cut-in wind speed or above the cut-out wind speed, the blades will be periodically stationary. For a typical upland site in the UK, a turbine is likely to be operational for around 70-85% of the time.[18]

10.3 There are two main types of turbine – horizontal axis and vertical axis. The vast majority of machines are currently designed using a horizontal axis three-blade rotor system mounted on a steel mast. The rotor converts a portion

[18] See http://www.bwea.com/energy/rely.html

of the power in wind into rotational motion, which is then converted into electricity by a generator located in the nacelle[19]. Vertical axis turbines use a range of designs in which the rotor shaft spins on a vertical axis. Although vertical axis turbines have not performed well in the commercial market historically, they can be better suited to locations which experience turbulent wind conditions such as urban areas as they do not need to be aligned with the prevailing wind direction.

10.4 Turbines are rated according to their maximum electrical output in kilowatts (kW) or megawatts (MW). There are no universally accepted categories to describe the scale of individual wind turbines but **Table 10.1** shows typical scales of turbine and potential outputs in terms of the number of homes supplied.

Table 10.1: Typical scales of wind turbines (used in the following descriptions)

Scale[20]	Typical Turbine Rating	Typical Turbine Height (to blade tip)	Potential No. of Homes Supplied[21]
Micro (less than 2.5 kW)	2.5 kW	11m	0.7
Small (2.5 – 50 kW)	20 kW	< 25m	6
Medium (50 kW – 750 kW)	500 kW	25m – 90m	205
Large (above 750 kW)	2.5 MW	90m - 135m	1,536

CARBON SAVINGS

10.5 As with micro-hydro and PV the majority of carbon emissions are related to the manufacture and installation of the system, with usually no direct carbon emissions during operation. A significant number of full life cycle analyses have been conducted on wind turbines of various sizes with a recent meta-study by the University of Sydney determining the average CO_2eq emissions for the different size of turbines to be in the region of:

- Micro turbines (less than 2.5 kW): 0.042 kgCO_2eq/kWh
- (Building mounted micro turbines are significantly worse[22])
- Small turbines (2.5 to 50 kW): 0.029 kgCO_2eq/kWh
- Medium turbines (50 kW to 750 kW): 0.018 kgCO_2eq/kWh
- Large turbines (above 750 kW): 0.027 kgCO_2eq/kWh

[19] The nacelle is the generator and gearbox housing which, on a horizontal axis turbine forms, the rear part of the horizontal axis around which the blades rotate.
[20] The scales given are not definitive and are used for illustration purposes only.
[21] The potential number of homes supplied is assessed from the estimated annual energy outputs from the turbine ratings shown, using capacity factors of 0.3 (large scale), 0.2 (medium scale) and 0.15 (small scale and micro) and an annual average household electricity consumption of 4,278kWh. Energy output from micro-scale turbines is highly dependent on the local wind conditions but is significantly greater in rural or more exposed areas. The given figure of 0.7 assumes a suitably windy site (see: *Small-scale wind energy: Policy insights and practical guidance,* Carbon Trust CTC738, 2008)
[22] Warwick wind trials: www.warwickwindtrials.org.uk

10.6 Overall, the differences in the lifecycle emissions of each turbine scale are minimal, with micro turbines having the highest comparative level of carbon emissions.

10.7 As all turbines displace grid electricity, carbon savings can be calculated for an individual installation. In the following paragraphs, carbon savings are illustrated for each of the scales of wind turbine identified in **Table 10.1**.

FURTHER USEFUL REFERENCES - GENERAL

- Sustainable Development Commission. (2005). *A guide to the key issues surrounding onshore wind power development in the UK.*
- Communities and Local Government. (2004). *Planning for Renewable Energy: Companion Guide to PPS22. [See Technical Annex Section 8.]*
- Severn Wye Energy Agency - *Wind Power Basics Fact Sheet.*
- Scottish Natural Heritage. (2001). *Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes.*
- RSPB, WWF, English Nature and BWEA. (2001). *Wind Farm Development and Nature Conservation. Available from* http://www.bwea.com/pdf/wfd.pdf

LARGE WIND TURBINES (90m – 135m height to blade tip)

DESCRIPTION OF TECHNOLOGY – SIZE SPECIFIC

10.8 Large wind turbines can be deployed singly, in small clusters (2-5 turbines), or in larger groups as wind farms (typically 5 or more turbines). The turbine itself consists of the tower, hub, blades, nacelle (which contains the generator and gearboxes) and a transformer which can be housed either inside the nacelle or at the base of the tower. The turbines can have a life of up to 25 years but will require daily/weekly maintenance checks. The infrastructure required for large-scale wind turbine developments includes:

- Road access to the site and on-site tracks able to accommodate heavy goods vehicles carrying long, heavy and wide loads (for the turbine blades and construction cranes).
- A temporary construction compound and lay down area for major components.
- A concrete foundation pad for each turbine.
- An area of hardstanding next to each turbine to act as a base for cranes during turbine erection, which is generally removed after construction.
- Underground cables connecting the turbines (buried in trenches).
- One or more anemometer masts to monitor wind direction and speed.
- A control building (to ensure the turbines are operating correctly) and a substation (which are often located in the same building).

- Connection from the sub-station to the electricity distribution network (i.e. the grid).

CARBON SAVINGS

10.9 A 2.5 MW large turbine producing around 6,500,000 kWh per annum serving some 1,650 households, would generate some 3,666,000 kgCO_2eq in carbon savings per year through the replacement of grid electricity generated from conventional fuel sources. This is equal to the amount of CO_2 that would be produced by leaving 11,797 x 60 watt light bulbs switched on continually for a year (or 7 x 60 watt light bulbs per household). This example, is based on the following calculations and is illustrated in **Figure 10.2**:

- Grid electricity: 0.591 x 6,500,000 kWh = 3,841,500 kgCO_2eq
- Large turbine: 0.027 x 6,500,000 kWh= 175,500 kgCO_2eq
- This would generate savings of 3,841,500 – 468,000 = 3,666,000 kgCO_2eq per year

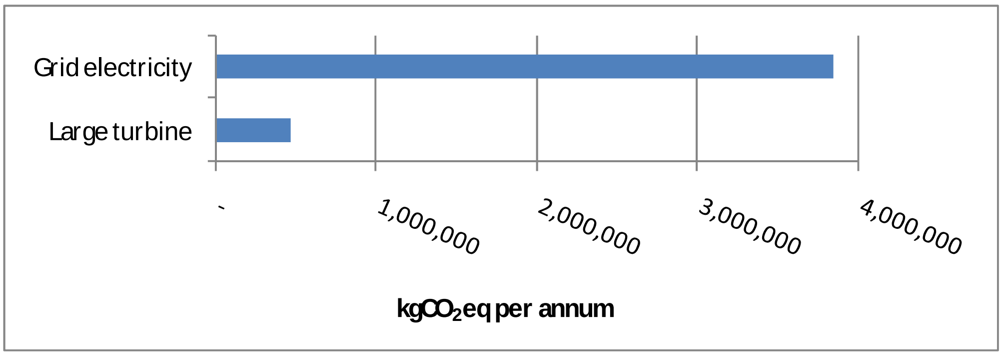


Figure 10.2: Comparison of CO_2eq emissions from grid electricity compared with lifecycle emissions from a large-scale wind turbine

COST AND EASE OF APPLICATION

10.10 In the UK, the use of large-scale wind turbines is currently a commercially viable proposition. A single large-scale wind power turbine can cost in the region of £800,000 – £1.5 million depending on its size, excluding infrastructure costs. Despite the high capital costs, on a site with good wind speeds, large-scale wind turbines are one of the most economically viable forms of renewable energy, with support given to wind through the Renewable Obligation Certificates (ROCs) and the Feed-in Tariff (FIT)[23] . These guarantee a long-term fixed income for wind energy generated at all scales.

[23] The Energy Act 2008 provides broad enabling powers for the introduction of feed-in tariffs (FITs) for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity - 50 kilowatts (KW) in the case of fossil fuelled CHP. FITs will guarantee a price for a fixed period for electricity generated using small-scale low carbon technologies. The Department of Energy and Climate Change believe that the increased certainty that this will provide will encourage individual households, communities, businesses, schools, hospitals, universities and a host of other organisations to consider installing small-scale low carbon electricity generation technologies.

10.11 Under the Feed-in Tariff payments will be made for every kWh generated, and for all that exported to the grid. The grid exports will be deemed to be 50% of the generation figure and are paid at the rate of 3p/kWh. The amount paid per kWh generated varies in relation to the size of installation. For large turbines the relevant rates will be:

- 500kW to 1.5MW: 9.4p/kWh (20 year duration)
- 1.5MW to 5MW: 4.5p/kWh (20 year duration)

FURTHER USEFUL REFERENCES

- Scottish Natural Heritage (November 2009). *Cumulative Effect of Wind farms: DRAFT Version 3 for Consultation.*
- Scottish Natural Heritage (Draft 2008). *Designing Wind Farms in the Landscape.*
- Scottish Natural Heritage's *Survey Methods for Assessing the Impacts of Onshore Wind farms on Bird Communities* (2005).
- Langston R. H. W and Pullan J. D. (2003). *Wind farms and Birds: An analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues.* BirdLife International on behalf of the Berne Convention. Available from http://www.coe.int/t/dg4/cultureheritage/conventions/bern/T-PVS/sc23_inf12_en.pdf.
- BWEA (1991). *A Case of Shadow Flicker/Flashing: Assessment and Solution.*
- Scottish Government/Nayak et al. (2008). *Guide to Calculating Carbon Savings from Wind Farms on Scottish Peatlands - A New Approach.*
- Headland Archaeology (2006). *Environmental Impact Assessment of Wind Farms: Cultural Heritage and the Problem of 'Setting'.*
- BBC and Ofcom (2004). *The Impact of Large Buildings and Structures (Including Wind farms) on Terrestrial Television Reception.*
- BBC online assessment tool: http://windfarms.kw.bbc.co.uk/cgi-bin/rd/windfarms/windfarm.cgi .
- CAP 764 - CAA *Policy and Guidelines on Wind Turbines*, CAA: http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=2358 .
- DTI (2002). *Wind Energy and Aviation Interests - Interim Guidelines*
- Spaven Consulting. (2001). *Wind Turbines and Radar: Operational Experience and Mitigation Measures.*
- Centre for Sustainable Energy (2009). *Delivering community benefits from wind energy development: a toolkit. Report to the Renewables Advisory Board.*
- Centre for Sustainable Energy and Garrad Hassan (2005). *Community benefits from wind power. A study of UK practice and comparison with leading European Countries.* Report to the Renewables Advisory Board and the DTI. www.cse.org.uk/pdf/pub1049.pdf .

- Centre for Sustainable Energy and Garrad Hassan (2005). *Community benefits from wind power. Policy Maker's summary.* www.cse.org.uk/pdf/pub1051.pdf .
- MORI Scotland (2002). *Tourist Attitudes towards Wind farms.*
- DTI (2006). *Renewable Energy Awareness and Attitudes Survey.*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

10.12 Large-scale wind turbines are substantial vertical structures which can often be highly visible in the landscape. Wind energy developments are unique, in relation to other tall structures, in that they introduce a source of movement into the landscape. The most visually prominent aspect of a wind turbine development are the wind turbines themselves, but ancillary developments may also be visually significant including the access roads, electrical substation, pylons and potential control building.

10.13 The AONB's prominent ridgelines, open plateaux, strong landform feature of the north-facing escarpment, low levels of modern development, small-scale landscape pattern and high inter-visibility with adjacent landscapes (including centres of population at Wellington, Taunton, Chard, Axminster and Honiton) make this landscape very sensitive to the siting of large-scale wind turbines.

10.14 The wind turbine landscape sensitivity study (**Appendix 1**), concludes that all areas of the protected landscape would be highly sensitive to the development of the larger scales of turbine (those 90 to 135 metres in height). Turbines of this scale would often be strongly visible from a long distance, and out of scale with the small landscape pattern of the AONB – much of which is of medieval origin. As an indication of the potential visibility and uncharacteristic size of large-scale turbines in this landscape, the Wellington Monument, a highly visible landmark on the edge of the north west escarpment of the Blackdown Hills, seen from the M5, Wellington and Taunton, is 53 metres in height. Yet the monument would be dwarfed by a large-scale turbine, which would be over double its height.

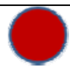
10.15 The AONB Management Plan includes the following objectives that underline the sensitivity of the AONB landscape to this scale of development:

- **Objective PD 1:** All new development in the AONB is of the highest quality, is in keeping with the landscape and conserves its wildlife, historic character and other special qualities.
- **Objective PD 3:** The tranquillity of the Blackdown Hills AONB is conserved by restricting or reducing noise and light pollution and major developments in and adjacent to the AONB.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

10.16 Large-scale wind turbines offer an economically viable form of commercial wind energy and over time can make a significant contribution to CO_2 reduction. However, in this nationally protected landscape characterised by a strong landform with dramatic wooded ridgelines, a small-scale landscape pattern of medieval origins, sparse settlement pattern, undeveloped skylines and high levels of inter-visibility with adjacent landscapes, it is extremely unlikely that any location could be found where large-scale turbines would not have a significant adverse affect on the AONB's special qualities and statutory purposes of designation. For these reasons this scale of turbine is considered inappropriate in this protected landscape.

10.17 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Large-scale turbines (90m-135m in height to turbine blade tip)	

MEDIUM WIND TURBINES (25m – 90m height to blade tip)

DESCRIPTION OF TECHNOLOGY – SIZE SPECIFIC

10.18 Medium-scale wind turbines are most likely to be deployed singly (i.e. as part of a community project, or linked to a school, farm, or small industrial unit). The turbine itself consists of the tower (which may be a pole, lattice or solid tubular tower), hub, blades, nacelle (housing the generator and gear box and forming the rear of the axis around which the blades turn) and a transformer which is typically located at the base of the tower. Connection from the sub-station to the electricity distribution network (i.e. the grid) will usually be required.

10.19 The infrastructure required for medium-scale wind turbine developments includes:

- Road access to the site. On-site tracks may or may not be required depending on the size of the turbines.
- A concrete foundation pad for each turbine.
- A temporary crane hardstanding area(s) adjacent to the turbine foundations.
- Anemometer mast for monitoring wind speed.
- Underground cables connecting the turbine (buried in trenches) to the electrical sub-station.
- A small electrical sub-station/control building.
- Connection from the sub-station to the electricity distribution network (i.e. the grid) if the turbine is on grid.

CARBON SAVINGS

10.20 A 500kW medium-scale turbine producing around 800,000kWh per annum, serving some 200 households would generate some 458,400 kgCO_2eq. in carbon savings per year through the replacement of grid electricity generated from conventional fuel sources. This is equal to the amount of CO_2 that would be produced by leaving 1,476 x 60 watt light bulbs switched on continually for a year (or 7 x 60 watt light bulbs per household). This example, is based on the following calculations and is illustrated in **Figure 10.3**:

- Grid electricity: 0.591 x 800,000 kWh= 472,800 kgCO_2eq
- Medium turbine: 0.018 x 800,000 kWh= 14,400 kgCO_2eq
- This would generate savings of 472,800 – 14,400 = 458,400 kgCO_2eq. per year

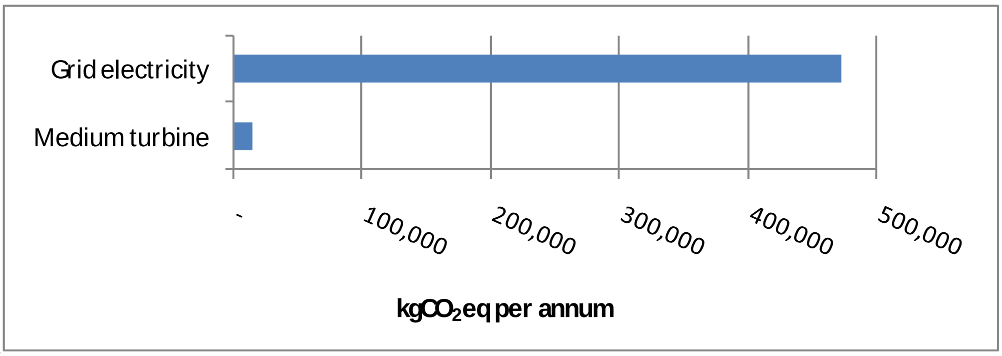


Figure 10.3: Comparison of CO_2eq emissions from grid electricity compared with lifecycle emissions from a medium-scale wind turbine

COST AND EASE OF APPLICATION

10.21 The typical installed cost of a medium-scale turbine will be influenced by generating capacity. A 50 kW turbine would cost in the region of £130,000, although costs could be reduced by using a lattice tower rather than a tubular tower. By comparison, a 200 kW turbine would cost approximately £250,000. Medium sized turbines can be purchased new or, subject to availability, second-hand from Europe, where many are being replaced by larger turbines on the same site. A 200 kW turbine, for example, might cost around £150,000 if obtained second hand from Holland.

10.22 The Feed-in Tariff[24] now guarantees a long-term fixed income for wind energy, increasing the economic viability of turbines of this scale. Under the Feed-in Tariff payments will be made for every kWh generated, and for all that exported to the grid. The grid exports will be deemed to be 50% of the generation figure and are paid at the rate of 3p/kWh. The amount paid per

[24] The Energy Act 2008 provides broad enabling powers for the introduction of feed-in tariffs (FITs) for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity - 50 kilowatts (KW) in the case of fossil fuelled CHP. FITs will guarantee a price for a fixed period for electricity generated using small-scale low carbon technologies. The Department of Energy and Climate Change believe that the increased certainty that this will provide will encourage individual households, communities, businesses, schools, hospitals, universities and a host of other organisations to consider installing small-scale low carbon electricity generation technologies.

kWh generated varies in relation to the size of installation. For medium-scale turbines the relevant rates will be:

- 15 to 100kW: 24.1p/kWh (20 year duration)
- 100 to 500kW:18.8p/kWh (20 year duration)
- 500 to 1.5MW: 9.4p/kWh (20 year duration)

FURTHER USEFUL REFERENCES

- Energy Savings Trust (2004). *Installing small wind-powered electricity generating systems (CE72).*
- Most of the references set out under large-scale wind turbines will also be relevant.

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

10.23 As for large-scale wind turbine developments the most visually prominent aspect of medium-scale turbines will be the wind turbine itself, particularly as it introduces a source of movement into the landscape. At this scale of development the impact of ancillary developments will generally be less than for the larger, commercial turbines.

10.24 Reflecting the findings of the wind turbine landscape sensitivity study (**Appendix 1**) it is concluded that this scale of turbine would not generally be appropriate in the AONB. The exception are locations linked to areas of existing commercial or industrial development (e.g. the AONB's airfields) on the plateau top within the Open Inland Planned Plateau Landscape Character Type (LCT). In these areas there would be limited potential for the development of small numbers of single medium-scale turbines. Turbines would not be suitable for prominent hill-top, ridge or escarpment locations, and developers would need to capitalise on the screening effects of woodland cover and the rolling topography of the Blackdown Hills to minimise visual impacts. Specifically, turbine developments of this scale on the plateau top will need to:

- Avoid locations on prominent ridgelines and the north-facing escarpment – locations which would be highly visible from locations both within and outside the AONB.
- Ensure turbine locations do not detract from the famous local landmark of the Wellington Monument and the setting of other cultural features such as prominent Iron Age hillforts and the views to and from them.
- Ensure that turbine locations do not detract from the setting of historic and designed landscapes, or the setting of Conservation Areas and Listed Buildings.
- Utilise the screening effects of the area's woodlands to incorporate development into its landscape setting.
- Avoid areas of fragile vegetation (particularly heathland, mire and ancient woodland) which are difficult to restore.
- Protect long, uninterrupted views across the open plateau.

- Keep development away from the most tranquil parts of the landscape.
- Consider landform when developing proposals of more than one turbine - ensuring layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints.
- Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or use of existing buildings.

10.25 The AONB Management Plan includes the following objectives that underline the sensitivity of the AONB landscape to this scale of development:

- **Objective PD 1:** All new development in the AONB is of the highest quality, is in keeping with the landscape and conserves its wildlife, historic character and other special qualities.
- **Objective PD 3:** The tranquillity of the Blackdown Hills AONB is conserved by restricting or reducing noise and light pollution and major developments in and adjacent to the AONB

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

10.26 Medium-scale wind turbines do offer significant carbon savings and an economically viable source of renewable energy. They do however have the potential to detract from the characteristically strong landform, small-scale landscape patterns and high levels of tranquillity associated with the protected landscape, particularly at the larger end of this turbine height range.

10.27 Reflecting the wind turbine landscape sensitivity study, the main area where there is some potential for the development of turbines in this height range is within the Open Inland Planned Plateau Landscape Character Type (LCT). The large landscape-scale and simple landform of the plateau, uniform character of regular pastoral fields, the presence of industrial and commercial development within airfields, and the occurrence of vertical structures such as radar masts and the television mast above Stockland, indicate that there may be some scope for the development of medium height turbines within ***parts*** of this LCT so long as adverse affects on the following are avoided:

- the prominent and distinctive landform of the northern escarpment and wooded ridges;
- long views across the open plateau;
- strong Parliamentary field patterns;
- undeveloped skylines and the local landmark feature of the Wellington Monument;
- sparse settlement pattern and overall lack of modern development;
- uninterrupted views to the Blackdown Hills from settlements outside the AONB to the north.

10.28 All proposals should be treated on their individual merits and should reflect the guidance set out in paragraph 10.24 above. They should be supported by a Landscape and Visual Impact Assessment (LVIA) that carefully assesses the landscape visibility of the proposed development and the potential impacts of associated grid connection.

10.29 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Medium-scale turbines (25m – 90m in height to turbine blade tip)	*VERY LIMITED*

SMALL WIND TURBINES (up to 25m height to blade tip)

DESCRIPTION OF TECHNOLOGY – SIZE SPECIFIC

10.30 The turbine itself consists of the tower (which may be a pole, lattice or solid tubular tower), hub, blades, nacelle (housing the generator and gear box and forming the rear of the axis around which the blades turn) and a transformer which is typically located at the base of the tower. Connection from the sub-station to the electricity distribution network (i.e. the grid) will usually be required. Alternatively, smaller turbines may take the form of an 'off-grid' application in which case they will be linked to an inverter and battery unit.

10.31 The infrastructure required for small-scale wind turbine developments includes:

- Vehicular access to the site during construction.
- A concrete foundation pad for each turbine.
- Underground cables connecting the turbine (buried in trenches) to the electrical sub-station.
- A small electrical sub-station/control building.
- Connection from the sub-station to the electricity distribution network (i.e. the grid) if the turbine is on grid.

Figure 10.4: A small-scale 6kw wind turbine [Source: Blackdown Hills AONB Partnership]

CARBON SAVINGS

10.32 A 20kW small turbine producing some 26,000kWh per annum, serving some 6.5 dwellings, would generate some 14,612 kgCO_2eq in carbon savings per year through the replacement of grid electricity generated from conventional fuel sources. This is equal to the amount of CO_2 that would be produced by leaving 47 x 60 watt light bulbs switched on continually for a year (or some 7 x 60 watt light bulbs per household). This example, is based on the following calculations and is illustrated in **Figure 10.5**:

- Grid electricity: 0.591 x 26,000 = 15,366 kgCO_2eq
- Small turbine: 0.029 x 26,000 = 754 kgCO_2eq
- This would generate savings of 15,366 – 754 = 14,612 kgCO_2eq. per year

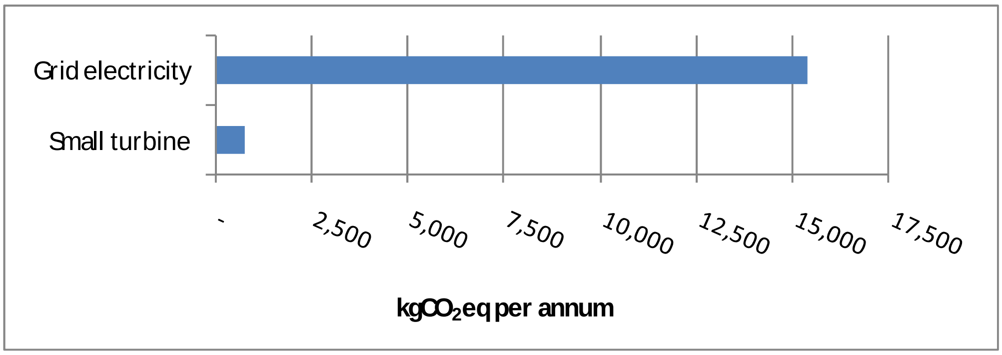


Figure 10.5: Comparison of CO_2eq emissions from grid electricity compared with lifecycle emissions from a small-scale wind turbine

COST AND EASE OF APPLICATION

10.33 The typical installed cost of a 15 kW turbine is £45,000.

10.34 The Feed-in Tariff[25] now guarantees a long-term fixed income for wind energy, increasing the economic viability of turbines of this scale. Under the Feed-in Tariff payments will be made for every kWh generated, and for all that exported to the grid. The grid exports will be deemed to be 50% of the generation figure and are paid at the rate of 3p/kWh. The amount paid per kWh generated varies in relation to the size of installation. For small-scale turbines the relevant rates will be:

- Up to 1.5kW: 34.5p/kWh (20 year duration)
- 1.5 to 15kW: 26.7p/kWh (20 year duration)
- 15 to 100kW: 24.1p/kWh (20 year duration)

FURTHER USEFUL REFERENCES

- Energy Savings Trust (2004). *Installing small wind-powered electricity generating systems (CE72).*
- Most of the references set out under large-scale wind turbines will also be relevant.

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

10.35 As for other scales of turbine development the most visually prominent aspect is the wind turbine itself, particularly as it introduces a source of movement into the landscape. At this scale of development the impact of ancillary developments will generally be minimal.

10.36 Reflecting the findings of the wind turbine landscape sensitivity study (**Appendix 1**) there is some potential for the development of small-scale turbines on the plateau top (singly and in small groups) linked to areas of existing commercial or industrial development (e.g. the AONB's airfields) within the Open Inland Planned Plateau Landscape Character Type (LCT). Areas of existing development and settlement, including farmsteads across the AONB could also provide suitable locations for single small-scale wind turbines so long as they are sensitively sited. Small-scale turbines are more likely to be filtered from view by the AONB's sloping topography and woodland cover when compared to larger scales of turbine. In siting these small-scale turbines care will be needed to:

- Avoid locations on prominent ridgelines and the north-facing escarpment – locations which would be highly visible from locations both within and outside the AONB.
- Ensure turbine locations do not detract from the famous local landmark of the Wellington Monument and the setting of other cultural features such as prominent Iron Age hillforts and the views to and from them.

[25] The Energy Act 2008 provides broad enabling powers for the introduction of feed-in tariffs (FITs) for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity - 50 kilowatts (KW) in the case of fossil fuelled CHP. FITs will guarantee a price for a fixed period for electricity generated using small-scale low carbon technologies. The Department of Energy and Climate Change believe that the increased certainty that this will provide will encourage individual households, communities, businesses, schools, hospitals, universities and a host of other organisations to consider installing small-scale low carbon electricity generation technologies.

- Ensure that turbine locations do not detract from the setting of historic and designed landscapes, or the setting of Conservation Areas and Listed Buildings.
- Respect the historic settlement pattern, including associated views to church spires (forming distinctive vertical elements within the open valley landscapes).
- Respect the presence of human-scale elements, including orchards and riverside trees, that contribute to local distinctiveness (in the river valleys of the AONB).
- Utilise the screening effects of the area's woodlands to incorporate development into its landscape setting.
- Avoid areas of fragile vegetation (particularly heathland, mire and ancient woodland) which are difficult to restore.
- Protect long, uninterrupted views across the open plateau.
- Keep development away from the most tranquil parts of the landscape.
- Consider landform when developing proposals of more than one turbine - ensuring layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints.
- Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or use of existing buildings.

10.37 Care will also be needed to ensure that the cumulative impacts of small turbine developments do not, in combination, impact on the above concerns.

10.38 The AONB Management Plan includes the following objective that underline the sensitivity of the AONB landscape to this scale of development:

- **Objective PD 1:** All new development in the AONB is of the highest quality, is in keeping with the landscape and conserves its wildlife, historic character and other special qualities.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

10.39 Small-scale wind turbines do offer carbon savings and an economically viable source of renewable energy. There is potential for their use, if very carefully sited, on the plateau top in locations associated with areas of existing developments (the airfields) and in association with existing settlements and farmsteads across the AONB. It will be very important, however, to select sites that are not visually prominent; that use the natural screening of landform, woodlands and hedgerows to limit long views of the turbine(s) from the wider landscape; are clearly linked to existing development; and are of a height that reflects the scale of their surroundings. Care will need to be taken to ensure that the cumulative development of individual turbines does not infringe the guidelines set out under paragraph 10.36 even if an individual turbine would not.

10.40 All proposals should be treated on their individual merits and should reflect the guidance set out in paragraph 10.36 above. They should be supported by a Landscape and Visual Impact Assessment (LVIA) that assesses the landscape visibility of the proposed development.

10.41 In summary, the appropriateness of this technology within the Blackdown Hills AONB is as follows:

Small-scale turbines (12m-25m in height to turbine blade tip)	

MICRO WIND TURBINES

DESCRIPTION OF TECHNOLOGY – SIZE SPECIFIC

10.42 Micro wind turbines range from individual battery charging systems (e.g. for electric fences and remote weather stations) to those that provide power for homes, schools or community halls. A small system of 600 watts could be used for charging batteries for caravans and boats. Smaller systems of less than 100 watts are used for charging batteries of 12V or 24W. The optimum size for the average household would be 1.5 - 3 kW. The main household and business use would be to provide low voltage household lighting.

10.43 For use associated with premises there are two types of micro turbines available: mast-mounted and roof-mounted turbines. Micro wind turbines can be connected to the local electrical distribution network or operated with battery storage systems. Micro turbines can have a life of up to 20 years but will require service checks every few years to ensure they continue to work efficiently.

10.44 Most micro wind turbines will need to be located close to the premises they are serving, both to fall within that land ownership and to avoid excessive cabling.

Figure 10.6: A micro-wind turbine [Source: Blackdown Hills AONB Partnership]

CARBON SAVINGS

10.45 A micro-scale turbine of 2kW producing around 2,500kWh / year would generate some 1,373 $kgCO_2eq$. in carbon savings per year, through the replacement of grid electricity generated from conventional fuel sources. This is equal to the amount of CO_2 that would be produced by leaving 4 x 60 watt light bulbs switched on continually for a year. However, these savings are often not achieved (especially building-mounted models) as they are often located in sub-optimal locations meaning that their electricity generation is very much reduced. The above example, is based on the following calculations and is illustrated in **Figure 10.7**:

- Grid electricity: 0.591 x 2,500 kWh = 1,478 $kgCO_2eq$
- Micro turbine: 0.042 x 2,500 kWh = 105 $kgCO_2eq$
- This would generate savings of 1,478 – 105 = 1,373 $kgCO_2eq$. per year

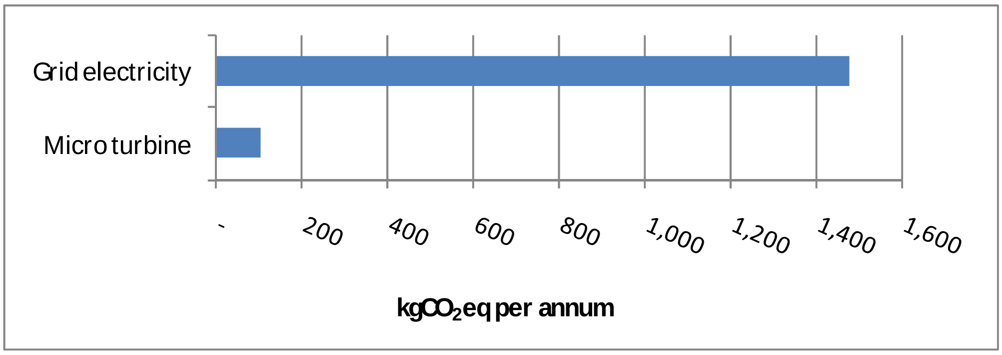


Figure 10.7: Comparison of CO_2eq emissions from grid electricity compared with lifecycle emissions from a micro wind turbine

COST AND EASE OF APPLICATION

10.46 Systems up to 1 kW cost around £1,500 whereas larger systems in the region of 2.5 kW could cost £10,000 installed. These costs are inclusive of the turbine, mast, inverters, battery storage (if required) and installation. However it is important to remember that costs always vary depending on location and the size and type of system. At present there is much debate about whether micro-wind turbines are efficient as current models do not appear to be delivering the power outputs necessary to justify their use.

10.47 The Feed-in Tariff[26] now guarantees a long-term fixed income for wind energy generated at all scales. Under the Feed-in Tariff payments will be made for every kWh generated, and for all that exported to the grid. The grid exports will be deemed to be 50% of the generation figure and are paid at the rate of 3p/kWh. The amount paid per kWh generated varies in relation to the size of installation. For micro-scale turbines the relevant rates will be:

[26] The Energy Act 2008 provides broad enabling powers for the introduction of feed-in tariffs (FITs) for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity - 50 kilowatts (KW) in the case of fossil fuelled CHP. FITs will guarantee a price for a fixed period for electricity generated using small-scale low carbon technologies. The Department of Energy and Climate Change believe that the increased certainty that this will provide will encourage individual households, communities, businesses, schools, hospitals, universities and a host of other organisations to consider installing small-scale low carbon electricity generation technologies.

- Up to 1.5kW: 34.5p/kWh (20 year duration)
- 1.5 to 15kW: 26.7p/kWh (20 year duration)

FURTHER USEFUL REFERENCES

- BWEA web pages on 'Small Wind Systems': http://www.bwea.com/small/index.html
- Low Carbon Buildings www.lowcarbonbuildings.org.uk/micro/wind/.
- Energy Savings Trust (2004). *Installing small wind-powered electricity generating systems (CE72).*

KEY LANDSCAPE AND PLANNING CONSIDERATIONS

10.48 Proposals for micro wind turbines would need to consider the setting and character of the locality and buildings they are going to serve. Both building-mounted turbines and mast-mounted turbines will introduce modern structures, often into a traditional settlement pattern. They will therefore need to be located in well screened locations/on the rear facade of buildings or below the main roof line, or in the case of new developments, should be integral to the overall design. The following AONB Management Plan objectives and policies should also be considered:

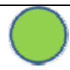
- **Objective PD 1:** All new development in the AONB is of the highest quality, is in keeping with the landscape and conserves its wildlife, historic character and other special qualities.
- **Objective PD 2:** Traditional, local materials and energy- and water-efficient technologies are used widely in all development.
- **Policy PD 1/B:** Seek to ensure that new developments or conversions conserve and enhance natural beauty, particularly by respecting the area's landscape character and the local character of the built environment, and reinforce local distinctiveness.
- **Policy PD 2/A:** Encourage new developments or conversions to use traditional and local materials, to be as carbon-neutral and water efficient as reasonably practicable, and to incorporate appropriate renewable energy sources.

APPROPRIATENESS OF TECHNOLOGY WITHIN BLACKDOWN HILLS AONB

10.49 The development of small-scale renewable energy sources to help reduce carbon emissions within the AONB is a key policy area in the current AONB Management Plan. While having the potential to deliver significant carbon savings this currently often does not happen in practice as their success is highly dependent on being located where there is sufficient wind. Evidence from their use to-date suggests that they often do not perform as expected as they have not been deployed in locations with the necessary wind speeds – location is everything if they are to deliver significant carbon savings. They therefore should only be deployed where they are likely to achieve significant energy generation.

10.50 Of course, technologies are likely to improve and become more efficient over time – therefore this guidance will need to be kept under review.

10.51 In summary, the appropriateness of this technology within the AONB is as follows but this technology should only be applied where wind speeds are appropriate:

Micro turbines (<11m)	

Appendix 1

Landscape Sensitivity Assessment for Wind Turbines

Appendix 1: Landscape Sensitivity to Wind Turbine Development in the Blackdown Hills AONB

APPROACH

Background

1. Wind turbines can have landscape-scale effects because of their height (up to 135 metres); potential deployment in groups (as wind farms); and with the introduction of moving parts (their rotary blades) into the landscape. In other words, a single development may have the potential to alter the character of the landscape over a significant area. For this reason a separate landscape sensitivity study to wind turbine developments has been included in this study and is described in this Appendix.

2. There is currently no agreed method for evaluating the sensitivity or capacity of different types of landscape to development such as wind turbines. However, the approach taken for this study builds on current guidance published by the Countryside Agency and Scottish Natural Heritage in the Landscape Character Assessment Guidance27 and Topic Paper 6 that accompanies the Guidance28, as well as LUC's considerable experience from previous and ongoing studies of a similar nature.

3. It is also in line with the recently published national guidance by Natural England: *Making Space for Renewable Energy: Assessing On-shore Wind Energy Development* (2010). This advocates a three-staged approach:

   - to identify and assess the range of natural environment factors that need to be taken into account;
   - to make a judgement against each of those factors; and
   - to make an overall professional judgement about the impacts that wind energy developments are likely to have on the landscape concerned as a whole.

4. The approach for the Blackdown Hills AONB follows this broad method through the use of carefully selected landscape criteria on which to base the sensitivity assessment.

Scale and approach

5. Because the impacts of wind turbine development are felt on a landscape scale, this assessment has been based on a framework of the six Landscape Character Types (LCTs) that have been identified for the AONB in the most

[27] Countryside Agency and Scottish Natural Heritage (2002) Landscape Character Assessment: Guidance for England and Scotland CAX 84
[28] The Countryside Agency and Scottish Natural Heritage (2002) Landscape Character Assessment Guidance for England and Scotland. Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity.

recent Landscape Character Assessment covering the Blackdown Hills AONB (Diacono, 2008)[29]:

- 1A: Open Inland Planned Plateau
- 1E: Wooded Ridges and Hilltops
- 2A: Steep Wooded Scarp Slopes
- 3A: Upper Farmed and Wooded Slopes
- 3B: Lower Rolling Farmed and Settled Slopes
- 4A: Unsettled Valley Floors

6. The descriptive information contained in this assessment, which applies to East Devon District and the Blackdown Hills AONB as a whole, was supplemented by AONB-specific information provided in an earlier assessment of the protected landscape undertaken in 1989 (by Cobham Resource Consultants on behalf of the Countryside Commission)[30]. This earlier assessment divided the AONB into five 'Visual Character Zones'. The boundaries of the LCTs and Visual Character Zones were overlain using GIS to understand their correlation and bring out the relevant descriptive detail from the two assessments (see **Figure A1.1**). The dove-tailing of the descriptive information by LCT, to formulate key characteristics to inform this assessment, is included in the **Annex** to this **Appendix.**

7. The assessment has looked at three sizes of wind turbine, as follows:

- **Small-scale turbines[31] (under 25m to blade tip)** that are likely to be proposed by householders and businesses interested in generating their own renewable energy through stand-alone wind turbines;
- **Medium-scale turbines (25-90m to blade tip)** that may be proposed by communities, public facilities such as schools and businesses, form part of neighbourhood-scale renewable schemes, or form part of a commercial enterprise; and
- **commercial [large-] scale wind turbines** (usually in the region of 90-135m to blade tip) that are likely to be proposed by the wind industry.

Criteria for determining sensitivity to wind energy development

8. Landscape attributes can be used to indicate the suitability of a landscape to accommodate wind energy development. These sensitivity criteria reflect guidance in the Landscape Character Assessment Guidance and Topic Paper 6.

---

[29] Diacano Associates (2008) East Devon and Blackdown Hills Areas of Outstanding Natural Beauty and East Devon District Landscape Character Assessment & Management Guidelines. Prepared for East Devon District Council, East Devon AONB, Blackdown Hills AONB and Natural England.

[30] Cobham Resource Consultants (1989) The Blackdown Hills Landscape. Prepared for the Countryside Commission, Cheltenham.

[31] Note that this does not include 'micro-turbines' – i.e. building-mounted turbines used by individual households to generate their own electricity. As the size of these turbines does not result in landscape-scale impacts, they are not included in this detailed landscape assessment (but generic guidance is included in the main report).

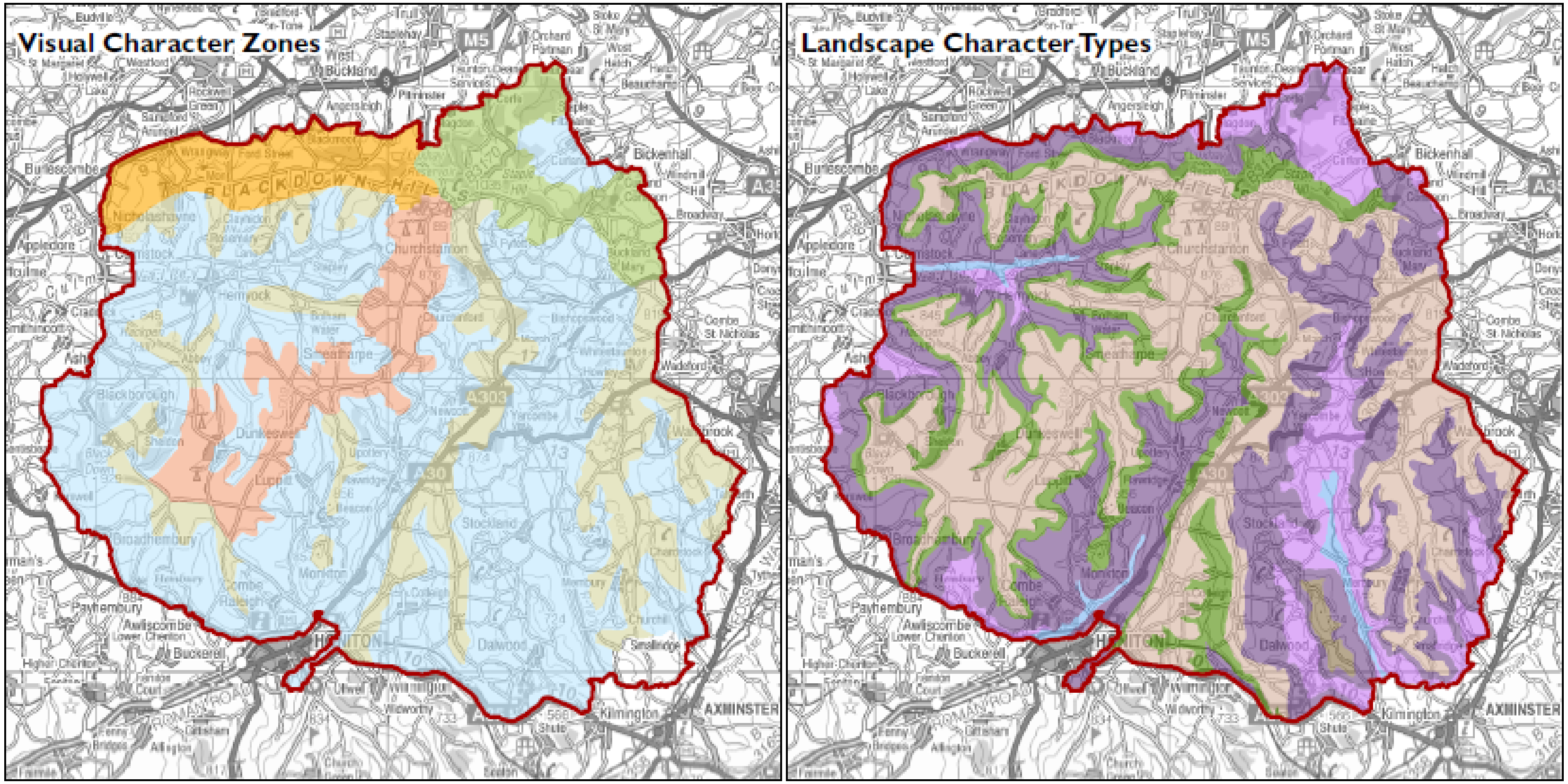
9. Topic Paper 6 suggests that '*...Judging landscape character sensitivity requires professional judgement about the degree to which the landscape in question is robust, in that it is able to accommodate change without adverse impacts on character. This involves making decisions about whether or not significant characteristic elements of the landscape will be liable to loss... and whether important aesthetic aspects of character will be liable to change'*

10. This method recognises that some aspects of the landscape may be more susceptible to change as a result of wind energy development. Criteria for determining the ability of a landscape to accommodate wind turbine development are based on attributes of the landscape most likely to be affected. These are detailed in **Table A1.1** below.

Table A1.1: Criteria for assessing landscape sensitivity

Characteristic/ attribute	Aspects indicating greater ability to accommodate wind energy development		Aspects indicating lower ability to accommodate wind energy development
Wind Turbines			
Scale	Large scale	⟷	Small scale Human scale indicators
Landform	Absence of strong topographical variety Featureless, convex or flat	⟷	Presence of strong topographical variety or distinctive landform features
Landscape pattern and complexity	Simple Regular or uniform	⟷	Complex Rugged and irregular
Settlement and man-made influence	Concentrated settlement pattern Presence of contemporary structures e.g. utility, infrastructure or industrial elements	⟷	Dispersed settlement pattern Absence of modern development, presence of small scale, historic or vernacular settlement
Skylines	Non-prominent /screened skylines Presence of existing modern man-made features	⟷	Distinctive, undeveloped skylines Skyline that are highly visible over large areas or exert a large influence on landscape character Skylines with important historic landmarks
Inter-visibility with adjacent landscapes	Little inter-visibility with adjacent sensitive landscapes or viewpoints	⟷	Strong inter-visibility with sensitive landscapes Forms an important part of a view from sensitive viewpoints
Perceptual aspects (sense of remoteness, tranquillity)	Close to visible or audible signs of human activity and development	⟷	Physically or perceptually remote, peaceful or tranquil

Figure A1.1: Location of Visual Character Zones (Cobham, 1989) and Landscape Character Types (Diacono, 2008)



Blackdown Hills Renewables
Visual Character Zones and Landscape Character Types

0 1.25 2.5 5 Km

Blackdown Hills AONB

Visual Character Zone
- Northern Escarpment
- Wooded Ridge
- Upland Plateau
- Rolling Ridgeland
- Valley

Landscape Character Type
- 1A Open inland planned plateau
- 1E Wooded ridges and hilltops
- 2A Steep wooded scarp slopes
- 3A Upper undulating farmed and wooded slopes
- 3B Lower rolling farmed and settled slopes
- 4A Unsettled farmed valley floors

Date: 03/06/2010

File: J:\CURRENT PROJECTS\4900s\4911 Blackdown Hills Renewables\GIS-graphics\Themes\ArcGIS9-2\4911-001_001_Blackdowns_VCT_LCT.mxd

Sensitivity scores

11. The sensitivity score is based on the different levels of impact that the development of wind turbines are likely to have on the landscape concerned. **Table A1.2** below sets out this sensitivity scoring.

Table A1.2: Sensitivity levels and definitions

Sensitivity Level	Definition
High	Key characteristics of the landscape are highly vulnerable to change from the type of renewable energy being assessed. Such development would result in a significant change in character.
Moderate-high	Key characteristics of the landscape are vulnerable to change from the type of renewable energy being assessed. There may be some limited opportunity to accommodate the renewable energy development without changing landscape character. Great care would be needed in locating turbines/energy crops (as applicable).
Moderate	Some of the key characteristics of the landscape are vulnerable to change from the type of renewable energy being assessed. Although the landscape may have some ability to absorb some development, it is likely to cause some change in character. Care would be needed in locating turbines.
Moderate-low	Few of the key characteristics of the landscape are vulnerable to change from the type of renewable energy being assessed. The landscape is likely to be able to accommodate turbines with only minor change in character. Care is still needed when locating wind turbines to avoid adversely affecting key characteristics.
Low	Key characteristics of the landscape are robust and would not be adversely affected by the development of wind turbines. The landscape is likely to be able to accommodate turbines without a significant change in character. Care is still needed when locating turbines to ensure best fit with the landscape.

Limitations

12. While this approach provides an initial indication of the relative landscape sensitivity of different areas to wind turbine development, it should not be interpreted as a definitive statement on the suitability of a particular landscape for development.

13. The sensitivity assessment is based on an assessment of landscape character using carefully defined criteria, and assumes that it is desirable to conserve existing landscape character. The methodology is based on the key characteristics of the landscape and does not cover nature conservation issues, cultural heritage/archaeological issues associated with designated sites, or visual amenity issues associated with particular viewpoints and viewers – these are issues that will also need to be taken into account at the time when individual proposals are being put forward. Careful verification in the field should also be undertaken to ensure the results of this desk-based assessment are robust.

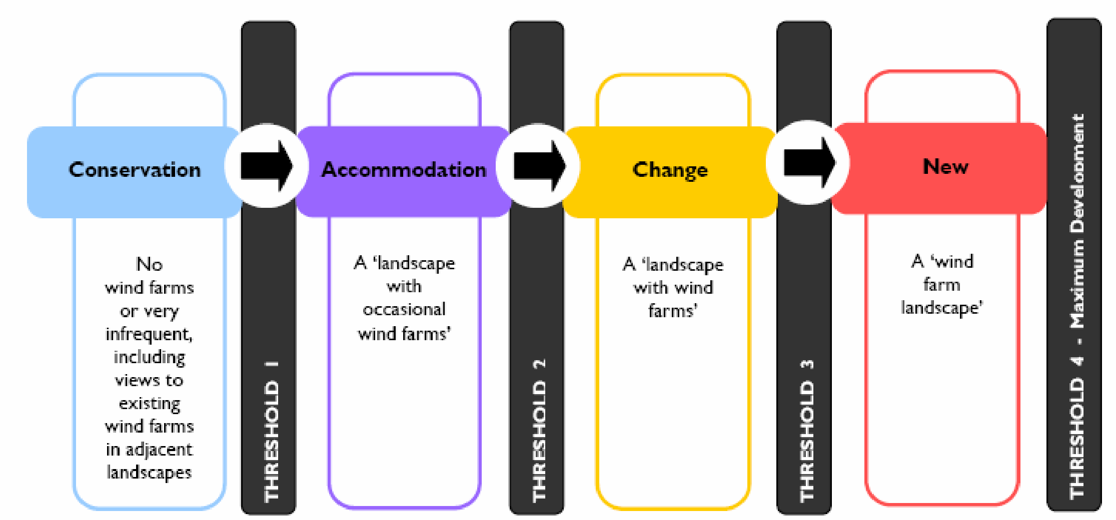
Cumulative impacts relating to wind

14. Planning policy and the development control process can be used to guide renewable energy proposals so as to either keep them apart to avoid cumulative issues, or to cluster them in certain parts of the landscape to avoid development in more valued areas.

15. It is likely that the siting of medium- and large-scale wind turbines in groups would result in a significant change in landscape character in many locations within the AONB, as a result of cumulative impacts. This raises the question – what is the level of acceptable change in landscape character within the AONB? The theoretical relationship between different thresholds of landscape change associated with cumulative impacts is illustrated in **Figure A1.2**.

16. Planning Policy Statement 7 clearly states that the conservation of natural beauty within AONBs should be given great weight in planning policies and development management decisions and that major development within these areas should not take place, except in exceptional circumstances. Planning Policy Statement 22 states that planning permission for renewable energy projects should only be granted on sites with nationally recognised designations where it can be demonstrated that the objectives of the designation will not be compromised by the development. As such it will be very important that wind energy developments do not breach the threshold of 'Accommodate'. Indeed, within most areas within the Blackdown Hills AONB the relevant threshold will be that of 'Conservation'; where few, if any wind energy developments are likely to be appropriate if the purposes of designation are to be upheld.

Figure A1.2: Diagrammatic representation of the relationship between different thresholds of landscape change and landscape objectives



Presentation of the results

17. The tables in the next section present the results of the sensitivity assessment for wind turbines in each of the six Landscape Character Types (LCTs) in the AONB.

18. The assessment is presented in a tabular format for each LCT. Reading from left to right across three columns, the table is structured as follows:

- **1st column**: contains the landscape attributes of the landscape type applied against the assessment criteria (as described in **Table A1.1**).
- **2nd column**: summarises the sensitivity judgement and lists the key landscape attributes that would be sensitive to the development of wind turbines. The overall assessment is based on different levels of impact (see **Table A1.2**.).
- **3rd column**: provides specific guidance on the siting of the renewable technology concerned within the landscape type.

19. This approach therefore provides a logical sequence across the columns; linking the generic guidance and assessment 'score' back to the LCT's key landscape attributes

20. A note on cumulative impacts relating to wind energy development is included at the bottom of each assessment table.

21. When formulating the first column the special qualities of the AONB have been considered (taken from page 10 of the AONB Management Plan). Bold text in the summary of key characteristics for each LCT, included in Annex 1, shows which characteristics reflect the defined special qualities of the AONB as a whole.

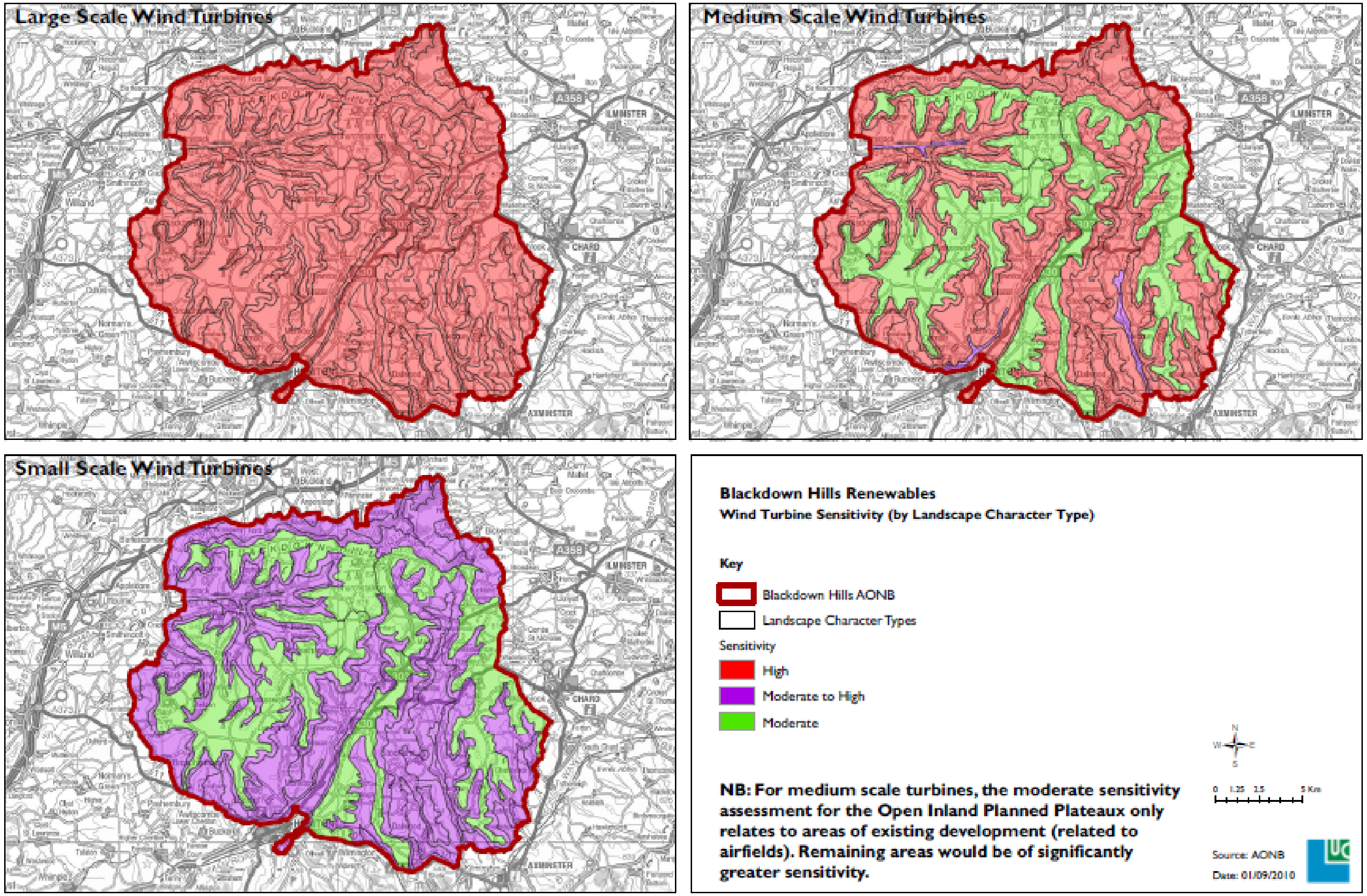
22. Strong consideration was also given in the assessment to intervisibility between different parts of the AONB and locations outside the protected landscape – many of the LCTs are characterised by high ridgelines and hilltops visible from a long distance (e.g. the prominent northern escarpment which forms a strong feature in views from Wellington, Taunton and the M5). Indeed, the 'long views over field-patterned landscapes' are one of the special qualities defining the AONB.

OVERALL RESULTS OF THE ASSESSMENT

23. All parts of the AONB would be highly sensitive to the development of large turbines which would often be strongly visible from a long distance, and out of scale with the small landscape patterns of the AONB – much of which are of medieval origin. Utilising the screening functions of the landscape's undulating topography, as well as high woodland cover, may present some limited opportunities for the siting of medium- or small-scale turbines. Areas of existing brownfield land, commercial and industrial development, particularly relating to airfields within the 1A Plateau LCT, may be deemed as of lower sensitivity to the development of small numbers of medium or small turbines.

24. **Figure A1.3** on the following page gives a spatial representation of the sensitivity assessment across the six Landscape Character Types of the AONB for the three different scales of turbine (large, medium and small).

Figure A1.3: Overview of the results of the Landscape Sensitivity Assessment for wind turbines, for each Landscape Character Type [Note: these maps only give a general overview of the assessment. The information in the following tables should be referred to for more specific details. For medium-scale turbines the moderate sensitivity assessment for the 1A Open Inland Planned Plateau LCT only relates to areas of development associated with brownfield land (the airfields). Remaining areas would be of significantly greater sensitivity]



LANDSCAPE SENSITIVITY ASSESSMENT FOR LANDSCAPE CHARACTER TYPES WITHIN THE AONB

LCT 1A: OPEN INLAND PLANNED PLATEAU **Visual Character Zones: Rolling Ridgeland (41%), Upland Plateau (24%), The Valleys (24%), Northern Escarpment (6%), Wooded Ridge (5%)**		
Landscape attributes	**Sensitivity Judgement & Key Landscape Sensitivities**	**Guidance**
Scale – Large-scale landscape owing to its open plateau character and expanses of woodland cover. **Landform** – Gently undulating plateau contrasting with steep ridges and a prominent north-facing escarpment forming the northern edge of the AONB. **Landscape pattern and complexity** – The simple and uniform character of regular pasture fields across much of the plateau contrasts with more varied areas of mixed and coniferous woodland, gorse, bracken, valley mire and remnant heath on ridges and slopes. **Settlement and man-made influence** – A sparsely settled landscape with isolated farmsteads and clusters of vernacular buildings at crossroads, linked by long straight roads. Airfields with radar structures (e.g. Dunkeswell), the television mast above Stockland and modern development on the fringes of Dunkeswell village introduce a modern influence in parts. The Wellington Monument is a prominent local landmark sitting above the northern escarpment. **Skylines** – Undeveloped skylines often characterised by windswept trees, mature beech avenues and woodland. This is broken by the presence of the television mast above Stockland and infrastructure relating to airfields on the plateau. **Inter-visibility with adjacent landscapes** – The	The large landscape scale and simple landform of the plateau, uniform character of regular pastoral fields, the presence of industrial and commercial development within airfields, and the occurrence of vertical structures such as radars and the television mast above Stockland, could indicate lower levels of sensitivity to wind turbine development within parts of this LCT. However, the complexity of its land cover (frequent conifer and mixed woodland blocks, along with gorse, bracken, wetlands and remnant heath), its visibility from major centres of population, sparse settlement pattern, and relative sense of tranquillity across much of the landscape increase sensitivity to wind turbines. This landscape type is therefore considered to have a **high** sensitivity to the development of large scale wind turbines and a **moderate** sensitivity to medium and small scale wind turbines. The key landscape attributes that could be sensitive to any scale of wind turbine development are: • the prominent and distinctive landform of the northern escarpment and wooded ridges; • long views across the open plateau, • strong Parliamentary field patterns; • undeveloped skylines and the local landmark feature of the Wellington Monument; • sparse settlement pattern and overall lack of	• This landscape would not be suitable for the development of large scale turbines. Any proposed development of medium or small-scale turbines should follow the guidance below. • Areas of existing industrial and commercial development (e.g. airfields) might offer some potential for a limited number of medium or small-scale turbines. • Avoid siting turbines on prominent ridgelines and the north-facing escarpment – locations which would be highly visible from locations both within and outside the AONB. • Ensure the location of turbines does not detract from the famous local landmark of the Wellington Monument. • Utilise the screening effects of the area's woodlands to incorporate development into its landscape setting. • Avoid areas of fragile vegetation (particularly heathland, mire and ancient woodland) which are difficult to restore. • Protect long, uninterrupted views across the open plateau. • Keep development away from the most tranquil parts of the landscape. • Consider landform when developing proposals of more than one turbine - ensure layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints. • Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful

LCT 1A: OPEN INLAND PLANNED PLATEAU Visual Character Zones: Rolling Ridgeland (41%), Upland Plateau (24%), The Valleys (24%), Northern Escarpment (6%), Wooded Ridge (5%)		
elevated northern escarpment is prominent in views from Wellington, the M5 and Taunton outside the AONB. These areas of development are also visible in views from the northern part of this LCT. The open, flat character of the plateau affords long views across the LCT and beyond to other surrounding towns. **Perceptual aspects** – Strong sense of tranquillity owing to a sparse settlement pattern, detracted from by the recent expansion of Dunkeswell village, commercial development within airfields and the presence of the prominent television mast above Stockland.	modern development; • high visibility from settlements outside the AONB	location and screening of ancillary buildings or use of existing buildings.
A note on cumulative issues: Although this landscape may be able to accommodate a limited number of medium-scale and small-scale turbines, sensitively sited according to the above guidance, the landscape would become progressively more sensitive to development of multiple turbines in this open landscape, which includes nationally important heathland and wetland sites. Any multiple developments would need to take into account of the above guidance, respect the scale of the landscape and be judged on its own merits, being informed by an assessment of cumulative landscape and visual impacts.		

LCT 1E: WOODED RIDGES AND HILLTOPS Visual Character Zones: The Valleys (100%)		
Landscape attributes	**Sensitivity Judgement & Key Landscape Sensitivities**	**Guidance**
Scale – Small hills and ridges with an intimate sense of enclosure owing to frequent woodland cover and a strong network of hedgebanks. **Landform** – Undulating hills and ridges (Beacon Hill, Horner Hill and Danes Hill) forming the western slopes above the Yarty Valley. **Landscape pattern and complexity** – An irregular pattern of small to medium scale pastoral fields, with some larger areas of arable on hill summits. Ancient woodlands, valley mires and patches of mixed woodland contribute to landscape complexity. **Settlement and man-made influence** –This is a remote landscape with low levels of development – isolated vernacular farmsteads are linked by narrow winding lanes. **Skylines** – Undeveloped skylines often framed by woodland. **Inter-visibility with adjacent landscapes** – The high hilltops afford long views of distant wooded ridgetops in other parts of the AONB. The hilltops themselves also form distinctive backdrops to views from across the AONB and outside (e.g. Axminster). **Perceptual aspects** – Strong sense of remoteness and tranquillity due to an overall absence of built development.	The overall small scale and complexity of this landscape, along with its strong medieval field patterns, valued woodland and mire habitats, absence of modern development and high intervisibility with other parts of the AONB result in heightened levels of sensitivity to all sizes and scales of wind turbines. This landscape type is therefore considered to have a **high** sensitivity to the development of large and medium scale wind turbines and a **moderate to high** sensitivity to small scale wind turbines. The key landscape attributes that could be sensitive to any scale of wind turbine development are: • the complex landform of prominent hills and ridges; • small landscape scale owing to woodland cover and historic enclosure patterns; • undeveloped skylines often characterised by woodland; • very sparse settlement pattern and overall lack of modern development; • intervisibility with other parts of the AONB and settled areas outside the protected landscape; • high levels of tranquillity and remoteness.	• This landscape would be highly sensitive to the development of large and medium-scale wind turbines. Limited development of small-scale turbines should follow the guidance below. • Avoid siting turbines on prominent hilltops and ridges – locations which would be highly visible from other parts of the AONB and centres of population outside – e.g. Axminster. • Utilise the screening effects of the area's woodlands and hill slopes to incorporate development into its landscape setting. • Avoid areas of fragile vegetation (particularly mire and ancient woodland) which are difficult to restore. • Protect key views to and from other undeveloped wooded skylines. • Consider landform when developing proposals of more than one turbine - ensure layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints. • Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or use of existing buildings.

LCT 1E: WOODED RIDGES AND HILLTOPS
Visual Character Zones: The Valleys (100%)

A note on cumulative issues: Although this landscape may be able to accommodate a limited number of small-scale turbines, sensitively sited according to the above guidance, the landscape would become progressively more sensitive to development of multiple turbines. Any multiple developments would need to take into account the above guidance, respect the scale of the landscape and be judged on its own merits, being informed by an assessment of cumulative landscape and visual impacts.

LCT 2A: STEEP WOODED SCARP SLOPES Visual Character Zones: The Valleys (63%), Rolling Ridgeland (15%), Wooded Ridge (10%), Northern Escarpment (9%), Upland Plateau (3%)		
Landscape attributes	**Sensitivity Judgement & Key Landscape Sensitivities**	**Guidance**
Scale – Medium-large scale landscape with sweeping slopes and ridgelines emphasised by extensive woodland cover. Small fields enclosed by thick hedges give a sense of intimacy in-between wooded areas. **Landform** – Steeply sloping land forming upper valley slopes / ridges immediately below the plateau edge. **Landscape pattern and complexity** – Complex landscape with large tracts of mixed and coniferous plantations along with dense oak, beech and pine woods on upper slopes. Patches of heathland, mire, unimproved grassland and scrub, along with a dense network of thick hedges and frequent hedgerow trees around pastoral fields, contribute to landscape diversity. **Settlement and man-made influence** – Lightly settled with isolated farms and clusters of traditional buildings linked by winding lanes with some sections marked by mature beech avenues. Iron Age hillforts on prominent ridgelines contribute to an historic sense of place. **Skylines** – Undeveloped skylines often characterised by woodland. **Inter-visibility with adjacent landscapes** – Hill summits afford expansive views across and beyond the AONB. The hills and ridges of this LCT also often form a wooded backdrop to views from other parts of the protected landscape and	Although the area's extensive woodland cover may provide a screening function to wind turbine development in this landscape, the complexity of its land cover, the absence of modern development, characteristic wooded skylines, strong intervisibility with other parts of the AONB and locations outside the protected landscape, historic sense of place and high levels of tranquillity all present significant constraints to this type of renewable energy development. This landscape type is therefore considered to have a **high** sensitivity to the development of large and medium scale wind turbines and a **moderate to high** sensitivity to small scale wind turbines. The key landscape attributes that could be sensitive to any scale of wind turbine development are: • the visual prominence of the landscape's high slopes and ridges; • the intimate scale of medieval fields bounded by thick hedges; • undeveloped skylines characterised by woodland; • very sparse settlement pattern and overall lack of modern development; • presence of Iron Age hillforts occupying prominent positions; • intervisibility with other parts of the AONB	• This landscape would be highly sensitive to the development of large and medium-scale wind turbines. Limited development of small-scale turbines should follow the guidance below. • Avoid siting turbines on prominent ridgelines and the northern escarpment – locations which would be highly visible from other parts of the AONB and centres of population outside. • Utilise the screening effects of the area's woodlands and sloping topography to incorporate development into its landscape setting. • Avoid areas of fragile vegetation (particularly heathland and ancient woodland) which are difficult to restore. • Ensure the location of turbines does not affect the character or setting of Iron Age hillforts at Melmbury Castle and on Dumpdon Hill. • Protect key views to and from other undeveloped wooded skylines. • Consider landform when developing proposals of more than one turbine - ensure layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints. • Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or use of existing buildings.

LCT 2A: STEEP WOODED SCARP SLOPES Visual Character Zones: The Valleys (63%), Rolling Ridgeland (15%), Wooded Ridge (10%), Northern Escarpment (9%), Upland Plateau (3%)		
beyond. The northern escarpment allows long views to Wellington and the M5 and beyond to Taunton, and is itself very prominent in views from these developed areas. **Perceptual aspects** – Strong sense of tranquillity due to the landscape's lightly settled character.	and settled areas outside the protected landscape; • high levels of tranquillity.	
A note on cumulative issues: Although this landscape may be able to accommodate a limited number of small-scale turbines, sensitively sited according to the above guidance, on these elevated scarp slopes and ridgelines, which include nationally important heathland, mire, unimproved grassland, ancient woodland sites and important archaeological remains, the landscape would become progressively more sensitive to development of multiple turbines. Any multiple developments would need to take into account the above guidance, respect the scale of the landscape and be judged on its own merits, being informed by an assessment of cumulative landscape and visual impacts.		

LCT 3A: UPPER FARMED AND WOODED SLOPES Visual Character Zones: The Valleys (80%), Wooded Ridge (7%), Northern Escarpment (7%), Rolling Ridgeland (6%)		
Landscape attributes	**Sensitivity Judgement & Key Landscape Sensitivities**	**Guidance**
Scale – Small, medieval fields and frequent woodlands and copses evoke an intimate feel to the landscape. **Landform** – Undulating topography including upper valley slopes, ridges and the steep north-facing escarpment. **Landscape pattern and complexity** – A complex landscape with small irregular pastoral fields enclosed by thick hedgebanks and frequent hedgerow trees linking to frequent woodlands and copses. Patches of heath and gorse, spring-line mires, unimproved grassland, wet woodland and coniferous plantations complete the landscape mosaic. **Settlement and man-made influence** – Lightly settled with occasional farmsteads and hamlets clustered at crossroads and connected by winding rural lanes (some straight sections lined by mature beech avenues). **Skylines** – Undeveloped skylines often characterised by woodland and mature beech avenues. The Wellington Monument forms a prominent landmark feature overlooking the northern escarpment. **Inter-visibility with adjacent landscapes** – Extensive views often afforded from valley summits – these in turn form undeveloped wooded skylines in views from other parts of the AONB and outside. The north-facing escarpment	Although the area's woodland cover and undulating topography may provide screening functions to wind turbine development in this landscape, the small landscape scale with strong medieval origins, complexity of its land cover, the absence of modern development, characteristic wooded skylines, strong intervisibility with other parts of the AONB and locations outside the protected landscape, and high levels of relative tranquillity all present significant constraints to this type of renewable energy development. This landscape type is therefore considered to have a **high** sensitivity to the development of large and medium scale wind turbines and a **moderate to high** sensitivity to small scale wind turbines. The key landscape attributes that could be sensitive to any scale of wind turbine development are: • the visual prominence of the landscape's high slopes, escarpment and ridges; • the intimate scale of medieval fields bounded by thick hedges; • the complex and valued land cover patterns of pasture, hedges, copses, woodlands, heath, gorse and spring-line mires; • undeveloped skylines characterised by woodland; • sparse settlement pattern and overall lack of	• This landscape would be highly sensitive to the development of large and medium-scale wind turbines. Limited development of small-scale turbines should follow the guidance below. • Avoid siting turbines on prominent ridgelines and the northern escarpment – locations which would be highly visible from other parts of the AONB and centres of population outside. • Utilise the screening effects of the area's woodlands and sloping topography to incorporate development into its landscape setting. • Avoid areas of fragile vegetation (particularly heathland, spring-line mire, unimproved marshy grasslands and ancient woodland) which are difficult to restore. • Ensure the location of turbines does not affect the character or setting of the Wellington Monument, and detract from views to this feature. • Protect key views to and from other undeveloped wooded skylines. • Consider landform when developing wind farm proposals of more than one turbine - ensure layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints. • Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or

LCT 3A: UPPER FARMED AND WOODED SLOPES Visual Character Zones: The Valleys (80%), Wooded Ridge (7%), Northern Escarpment (7%), Rolling Ridgeland (6%)		
has a strong long-range intervisibility with development outside the AONB (Wellington, M5 and Taunton). **Perceptual aspects** – Strong sense of relative tranquillity and remoteness owing to the landscape's lightly settled character and absence of modern intrusion.	modern development; • the local landmark feature of the Wellington Monument; • intervisibility with other parts of the AONB and settled areas outside the protected landscape; • high levels of relative tranquillity and remoteness.	use of existing buildings.
A note on cumulative issues: Although this landscape may be able to accommodate a limited number of small-scale turbines, sensitively sited according to the above guidance, the landscape would become progressively more sensitive to development of multiple turbines with its strongly visible upper valley slopes, which include nationally important sites of heathland, unimproved marshy grassland, bog and mire. Any multiple developments would need to take into account the above guidance, respect the scale of the landscape and be judged on its own merits, being informed by an assessment of cumulative landscape and visual impacts.		

LCT 3B: LOWER ROLLING FARMED & SETTLED SLOPES Visual Character Zones: The Valleys (78%), Wooded Ridge (17%), Northern Escarpment (5%)		
Landscape attributes	**Sensitivity Judgement & Key Landscape Sensitivities**	**Guidance**
Scale – Small to medium scale fields with frequent hedgerow trees, tree clumps and tall earth banks providing a sense of shelter and intimacy to the landscape. **Landform** – Gently rolling landform sloping up from the valley sides, punctuated by small hills, dry valleys and steep-sided combes, topped by wooded ridges. **Landscape pattern and complexity** – Pastoral landscape with patches of scrub and marsh forming a mosaic with often overgrown hedges, wildflower-rich banks, tree clumps, copses and historic watermeadows. **Settlement and man-made influence** – Numerous isolated farmsteads distributed throughout, with scattered historic hamlets (of chert, cob, dressed stone, thatch and tile) clustered at river crossing points linked by winding roads. **Skylines** – Northern slopes include glimpses of the Wellington Monument – a distinctive skyline feature. Most skylines are characterised by woodland, hedgerow trees and outgrown hedgebanks, including distinctive mature beech avenues. **Inter-visibility with adjacent landscapes** – Strong intervisibility with the open valley floors below and the wooded hilltops and ridges above. Although outside the AONB, the north-facing	Although the area's tree and woodland cover and sheltered topography may provide screening functions to wind turbine development in this landscape, the small landscape scale, mosaic of pasture, scrub, watermeadows and trees, historic settlement pattern and traditional local vernacular, intervisibility with adjacent landscapes inside and outside the AONB and distinctive wooded skylines all present heightened levels of sensitivity to this type of renewable energy development. This landscape type is therefore considered to have a **high** sensitivity to the development of large and medium scale wind turbines and a **moderate to high** sensitivity to small scale wind turbines. The key landscape attributes that could be sensitive to any scale of wind turbine development are: • the small scale of fields and varied landscape pattern of pasture, copses, trees, marsh and scrub; • the presence of historic watermeadows; • important glimpses of the Wellington Monument; • sparse and historic settlement pattern and overall lack of modern development; • intervisibility with other parts of the AONB and settled areas outside the protected	• This landscape would be highly sensitive to the development of large and medium-scale wind turbines. Limited development of small-scale turbines should follow the guidance below. • Avoid siting turbines on the landscape's higher ridgelines and the northern escarpment slopes – locations which would be highly visible from other parts of the AONB and centres of population outside. • Utilise the screening rolling and sheltered landform to incorporate development into its landscape setting. • Avoid locating turbines and related infrastructure within or across the landscape's historic watermeadows. • Ensure the location of turbines does not affect the character or setting of the Wellington Monument, and detract from views to this feature from the locations across the northern escarpment. • Ensure proposed turbine locations respect the landscape's traditional buildings and historic settlement pattern. • Protect key views to and from other undeveloped wooded skylines within the AONB. • Consider landform when developing proposals of more than one turbine - ensure layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints. • Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks

LCT 3B: LOWER ROLLING FARMED & SETTLED SLOPES Visual Character Zones: The Valleys (78%), Wooded Ridge (17%), Northern Escarpment (5%)		
lower slopes of the escarpment are dominated by views of Wellington, the M5 and Taunton in the distance. **Perceptual aspects** – Strong sense of tranquillity and remoteness owing to the landscape's lightly settled, historic character.	landscape; • undeveloped wooded skylines, some characterised by avenues of mature beech; • high levels of tranquillity and a strong historic sense of place.	for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or use of existing buildings.
A note on cumulative issues: Although this landscape may be able to accommodate a limited number of small-scale turbines, sensitively sited according to the above guidance, the landscape would become progressively more sensitive to development of multiple turbines. This is particularly apparent on some of the more visible slopes (particularly along the prominent northern escarpment). Any multiple developments would need to take into account the above guidance, respect the scale of the landscape and be judged on its own merits, being informed by an assessment of cumulative landscape and visual impacts.		

LCT 4A: UNSETTLED FARMED VALLEY FLOORS Visual Character Zones: The Valleys (100%)		
Landscape attributes	**Sensitivity Judgement & Key Landscape Sensitivities**	**Guidance**
Scale – Open valley landforms emphasised by large-scale fields. **Landform** – Broad and open flat valley landforms framed by steep wooded slopes. **Landscape pattern and complexity** – Large fields of pasture and arable bounded by thick hedges. Wet meadows, orchards, riparian vegetation and riverside trees contribute to landscape interest. **Settlement and man-made influence** – Numerous isolated farmsteads linked by a network of small winding roads crossing watercourses via bridges and fords. Villages are nestled in valley bottoms. **Skylines** – Church spires often form strong vertical features within the open valleys. **Inter-visibility with adjacent landscapes** – Open views are afforded along the valley lengths, with intermittent views outside defined by glimpses of distant wooded ridges. The lower sections of the Otter Valley include views of development and related infrastructure at Honiton. The valleys are overlooked by the surrounding wooded ridges and hills. **Perceptual aspects** – Overarching sense of peace and tranquillity within the sheltered valley landscapes.	The valleys' large scale, enclosed character and proximity to areas of modern development and infrastructure (in the case of the lower River Otter) may indicate lower levels of sensitivity to wind turbines than other parts of the AONB. However, the landscape's peaceful and tranquil character, long views along valley lengths, intervisibility with surrounding wooded slopes and ridges, and historic settlement character all heighten levels of sensitivity to this type of renewable energy development. This landscape type is therefore considered to have a **high** sensitivity to the development of large and medium scale wind turbines and a **moderate to high** sensitivity to small scale wind turbines. The key landscape attributes that could be sensitive to any scale of wind turbine development are: • intervisibility with surrounding wooded slopes and ridges; • the historic settlement pattern; • the presence of human-scale elements including orchards and riverside trees contributing to local distinctiveness; • church spires forming distinctive vertical elements within the open valley landscapes; • strong feelings of peace and tranquillity.	• This landscape would be highly sensitive to the development of large and medium-scale wind turbines. Limited development of small-scale turbines should follow the guidance below. • Utilise the screening effects of the area's steep wooded valley sides to minimise views of development. • Avoid areas of fragile vegetation (particularly watermeadows) which are difficult to restore. • Ensure the location of turbines does not detract from views to village church spires – characteristic local landmarks within the valley landscapes. • Protect intermittent views to surrounding wooded slopes and ridges. • Consider landform when developing proposals of more than one turbine - ensure layouts reflect the shape of the landform to avoid visual confusion. Aim to achieve good composition from key viewpoints. • Minimise the effects of accompanying infrastructure and ancillary development by making use of existing tracks for the access tracks, burying cabling underground, careful location and screening of ancillary buildings or use of existing buildings.

LCT 4A: UNSETTLED FARMED VALLEY FLOORS
Visual Character Zones: The Valleys (100%)

A note on cumulative issues: Although this landscape may be able to accommodate a limited number of small-scale turbines, sensitively sited according to the above guidance, the landscape would become progressively more sensitive to development of multiple turbines. Any multiple developments would need to take into account the above guidance, respect the scale of the landscape and be judged on its own merits, being informed by an assessment of cumulative landscape and visual impacts.

Annex: Key characteristics of LCTs in the Blackdown Hills AONB

The grey box at the end of each LCT section summarises the key characteristics used to inform this assessment, drawing on information from both the Diacono (2008) and Cobham (1989) Landscape Character Assessments (LCA) for the AONB. Bold text indicates those key characteristics which reflect the 'Special Qualities' of the nationally designated landscape, as summarised on page 10 of the current AONB Management Plan.

1A: OPEN INLAND PLANNED PLATEAUX

Visual Character Zone coverage

Rolling Ridgeland	41%
Upland Plateau	24%
The Valleys	24%
Northern Escarpment	6%
Wooded Ridge	5%

Key characteristics (summarised from the Diacono LCA)

- High open gently rolling plateau, visible from a wide area
- Rectangular field pattern of medium to large scale fields
- Some unenclosed areas of relic commons (now copses) and small conifer plantations
- Predominantly pastoral (dairy) farming on heavy soils with some areas of mixed cultivation
- Well trimmed hedges on narrow earth banks
- Sparsely scattered boundary trees, usually beech with oak towards plateau edge
- Very uniform appearance
- Beech is frequent, with mature stands often lining roads
- Long straight roads in centre, with narrow winding minor roads towards the edge
- Isolated farmsteads and clusters of buildings at crossroads; 20th century settlement associated with airfields
- Extensive views sometimes obscured by woodland on boundary with scarp slope

Key characteristics (summarised from the Cobham LCA)

Rolling ridgeland

- Rolling ridges with frequent views adding variety to the landscape – the near horizon dropping rapidly to reveal tree tops and distant views of other wooded ridges
- Small blocks of mixed and coniferous woodland
- Oak woodlands often unmanaged and lined with primroses in spring
- Improved pasture fields surrounded by wedge-shaped beech hedgebanks
- Simple and well-managed farmed landscape, with patches of bracken and gorse surrounding deciduous woodland on steep-sided high ground (e.g. Hackpen and Dumpdon Hills)
- Straight roads running along ridgetops often lined with avenues of beech and Scots pine

The valleys

- Undulating topography in the upper courses of the valleys (where they are incised)

- Heavily wooded upper valley slopes (often unmanaged beech and oak, as well as coniferous plantations), with some patches of moorland on summits.
- Pastoral character, with small rough fields surrounded by thick hedges, hedgerow trees, tree clumps and scrub.
- Combe valleys marked by trees snaking down valley slopes and long fields of unimproved pasture running along contours
- Numerous isolated farmsteads connected by small winding roads marked by twisting double hedgerows
- Extensive views from valley slopes to distant, wooded ridges
- Membury Castle (Iron Age hillfort) standing on a prominent ridgeline near Axminster (Yarty Valley)

Upland plateau

- Very gently undulating land, often affording distant views to other plateau landscapes
- Improved pasture fields with some patches of arable, enclosed by a strong pattern of low hedgebanks of beech or hawthorn with occasional windswept beech or oak trees
- Small blocks of coniferous plantation
- Infrequent farms prominently surrounded by large and mainly modern agricultural buildings
- Plateau crossed by long, straight roads with wide verges edged by low hedgebanks restricting views
- The airfield at Dunkeswell and prominent television mast above Stockland form detracting features in an otherwise open, undeveloped landscape
- Expansion of the village of Dunkeswell (new housing and industrial development) visible from the plateau

Northern escarpment (this LCT covers the top of the escarpment)

- Dramatic steep and well-wooded north-facing escarpment with a linear topography – emphasised by straight ridgetop road
- Patches of gorse, bracken and scrub give way to dense beech, oak and pine woodland on steep upper slopes
- Varied land use with small flat fields surrounded by neat hedgebanks with isolated windswept trees. Distinctive area of open sheep pasture on Leigh Hill sheltered by bands of Scots pine
- Complex and colourful landscape with few buildings – detracted from by traffic on roads climbing the narrow roads up the escarpment
- Northward views dominated by the M5, Wellington and related infrastructure
- Local landmark of the Wellington Monument standing on a prominent high bluff

Wooded ridge (from the fringes of Luxhay Reservoir to the edges of Buckland St Mary)

- Intricate landscape of small hills and incised valleys
- Well-wooded landscape with small secluded fields enclosed by woodland, often coniferous plantations particularly on northern slopes
- Some fields of improved pasture but mainly rough fields (including marshy pasture) bounded by overgrown hedgerows, derelict fences and scrub, with wildflowers on banks
- Magnificent beech avenues set on mossy banks – key features of the area

Summary of key characteristics for this study

- High open plateau contrasting with densely wooded ridges and the prominent linear escarpment which sits above the northern edge of the AONB

- **Frequent blocks of mixed and coniferous woodland, as well as dense oak, beech and pine woodlands surrounded by patches of gorse, bracken and heath on steeper slopes**
- Simple, uniform landscape of improved pastoral fields, some areas of rough pasture on slopes and patches of arable
- **Strong pattern of regular Parliamentary fields surrounded by neat beech hedges with isolated windswept oak and beech trees**
- **Mature beech avenues forming distinctive features of the area, often lining roads**
- **Isolated farmsteads and clusters of buildings (constructed of chert, cob, dressed stone, thatch and tile) at crossroads, linked by long straight roads which become more winding towards the edge.**
- **Frequent views afforded through gaps in tree cover** and from the higher summits of the plateau and escarpment (including intervisibility with Wellington, Taunton and the M5 to the north)
- **Local landmark of the 19th century Wellington Monument standing on a prominent bluff above the northern escarpment**
- Intrusions from airfields, radar structures and the television mast above Stockland, along with the recent expansion of Dunkeswell village.

1E: WOODED RIDGES AND HILLTOPS

Visual Character Zone coverage

The valleys 100%

Key characteristics (summarised from the Diacono LCA)

- Small visually distinct hills and associated small ridges, outliers of the plateaux
- Small to medium irregular fields, with occasional large open fields on the summit
- Species-rich hedgebanks and tree rows, ancient woodland and spring-line mires
- Mixed woodland and some pasture; hilltop fields may be arable
- Narrow winding lanes enclosed by hedges on earth banks
- Limited views out
- High and remote
- Unsettled with some areas having no access roads/rights of way

Key characteristics (summarised from the Cobham LCA)

The valleys (Western slopes of the River Yarty)

- Undulating topography forming the upper slopes of the valley
- Pastoral character, with hedges, hedgerow trees, tree clumps and scrub
- Combe valleys marked by trees snaking down valley slopes
- Numerous isolated farmsteads connected by small winding roads marked by twisting double hedgerows
- Extensive views from valley slopes to distant, wooded ridges

Summary of key characteristics for this study

- Undulating hills and ridges (Beacon Hill, Horner Hill, Danes Hill) forming western slopes above the Yarty Valley
- **Heads of combe valleys marked by trees snaking down valley slopes; areas of mixed woodland on hill summits**
- **Small to medium irregular medieval fields bounded by species-rich hedgebanks, with occasional large open fields on hill summits**

- Mainly pastoral character, with some hilltop arable fields
- **Ancient woodlands and spring-line mires**
- **High and remote, with isolated vernacular farmsteads linked by narrow winding lanes enclosed by twisting double hedgebanks**
- **Views from hill summits to other wooded ridges**; off hill summits views are restricted

2A: STEEP WOODED SCARP SLOPES

Visual Character Zone coverage

The Valleys	63%
Rolling Ridgeland	15%
Wooded Ridge	10%
Northern Escarpment	9%
Upland Plateau	3%

Key characteristics (summarised from the Diacono LCA)

- A narrow band of steeply sloping land immediately below the plateau edge
- Mixed woodland and semi-improved or unimproved pasture
- Pastoral cultivation, with an intricate irregular field pattern enclosed by a network of earth banks with bushy hedges and frequent hedgerow trees
- Springline mires and many patches of semi-natural habitats, including wetland scrub, heathland, wet woodland and ancient semi-natural woodland
- Narrow winding lanes with well treed banks
- Lightly settled with occasional farm buildings and hamlets clustered at cross roads.
- Occasional long views out over adjoining valleys

Key characteristics (summarised from the Cobham LCA)

The Valleys

- Undulating topography in the upper courses of the valleys (where they are incised)
- Heavily wooded upper valley slopes (often unmanaged beech and oak, as well as coniferous plantations), with some patches of moorland on summits.
- Pastoral character, with small rough fields surrounded by thick hedges, hedgerow trees, tree clumps and scrub.
- Combe valleys marked by trees snaking down valley slopes and long fields of unimproved pasture running along contours
- Numerous isolated farmsteads connected by small winding roads marked by twisting double hedgerows
- Extensive views from valley slopes to distant, wooded ridges.
- Membury Castle (Iron Age hillfort) standing on a prominent ridgeline near Axminster (Yarty Valley)

Rolling Ridgeland (covers various locations within the LCT)

- Rolling ridges with frequent views adding variety to the landscape – the near horizon dropping rapidly to reveal tree tops and distant views of other wooded ridges
- Small blocks of mixed and coniferous woodland
- Oak woodlands often unmanaged and lined with primroses in spring
- Improved pasture fields surrounded by wedge-shaped beech hedgebanks
- Simple and well-managed farmed landscape, with patches of bracken and gorse surrounding deciduous woodland on steep-sided high ground (e.g. Hackpen and Dumpdon Hills)

- Straight roads running along ridgetops often lined with avenues of beech and Scots pine
- Prominent Iron Age hillfort on Dumpdon Hill

Wooded ridge (in the north-eastern corner of the AONB)

- Intricate landscape of small hills and incised valleys
- Well-wooded landscape with small secluded fields enclosed by woodland, often coniferous plantations particularly on northern slopes
- Some fields of improved pasture but mainly rough fields (including marshy pasture) bounded by overgrown hedgerows, derelict fences and scrub, with wildflowers on banks
- Lower slopes defined by expansive pastoral fields with mature in-field and hedgerow oaks
- Magnificent beech avenues set on mossy banks – key features of the area

Northern escarpment (this LCT covers parts of the escarpment summits)

- Dramatic steep and well-wooded north-facing escarpment with a linear topography
- Patches of gorse, bracken and scrub give way to dense beech, oak and pine woodland on steep upper slopes
- Varied land use with small flat fields surrounded by neat hedgebanks with isolated windswept trees.
- Complex and colourful landscape with few buildings – detracted from by traffic on roads climbing the narrow roads up the escarpment
- Northward views dominated by the M5, Wellington and related infrastructure

Upland plateau (this LCT covers some of the outer edges of the plateau)

- Very gently undulating land, often affording distant views to other plateau landscapes
- Improved pasture fields with some patches of arable, enclosed by a strong pattern of low hedgebanks of beech or hawthorn with occasional windswept beech or oak trees
- Small blocks of coniferous plantation
- Infrequent farms prominently surrounded by large and mainly modern agricultural buildings
- Plateau crossed by long, straight roads with wide verges edged by low hedgebanks restricting views

Summary of key characteristics for this study

- Steeply sloping land forming upper valley slopes / ridges immediately below the plateau edge
- **Well-wooded landscape with mixed and coniferous plantations and dense oak, beech and pine woods particularly on upper slopes**
- **Patches of heathland and scrub on higher slopes contributing to landscape diversity**
- **Mainly pastoral character with a strong pattern of mainly small fields enclosed by thick hedges (often beech) and frequent hedgerow trees**
- **Lightly settled with isolated farm buildings and clusters of buildings (constructed of chert, cob, dressed stone, thatch and tile) at crossroads – linked by winding lanes and some straight roads marked by beech avenues**
- **Distinctive Iron Age hillforts occupying prominent ridgelines – e.g. on Dumpdon Hill and Membury Castle above the Yarty Valley**
- **Expansive views from hill summits** – those from the northern escarpment dominated by development and infrastructure relating to Wellington, Taunton and the M5

3A: UPPER FARMED AND WOODED SLOPES

Visual Character Zone coverage

The Valleys	80%
Wooded Ridge	7%
Northern Escarpment	7%
Rolling Ridgeland	6%

Key characteristics (summarised from the Diacono LCA)

- Undulating upper valley slopes below the scarp slope
- Well treed pastoral farmland, with arable cultivation on lower slopes
- Small to medium size fields with irregular boundaries
- Deciduous woods and copses, especially on hilltops and upper slopes
- Very wide, usually low, species-rich hedges on earth banks with many hedgerow trees
- Dispersed settlement pattern of isolated farms and small villages
- Very winding narrow lanes
- An intimate and intricate landscape with views out confined by vegetation
- Remote, with isolated farms and occasional large houses and little 20th century development

Key characteristics (summarised from the Cobham LCA)

The valleys

- Undulating topography in the upper courses of the valleys (where they are incised)
- Heavily wooded upper valley slopes (often unmanaged beech and oak, as well as coniferous plantations), with some patches of moorland on summits
- Pastoral character, with small rough fields surrounded by thick hedges, hedgerow trees, tree clumps and scrub
- Combe valleys marked by trees snaking down valley slopes and long fields of unimproved pasture running along contours
- Numerous isolated farmsteads connected by small winding roads marked by twisting double hedgerows
- Extensive views from valley slopes to distant, wooded ridges. Views of transmission lines, main roads and urban development outside the area from some lower valley locations
- Prominent Iron Age hillfort of Hembury Castle standing above the Otter Valley

Wooded ridge (in the north-eastern corner of the AONB)

- Intricate landscape of small hills and incised valleys
- Well-wooded landscape with small secluded fields enclosed by woodland, often coniferous plantations particularly on northern slopes
- Some fields of improved pasture but mainly rough fields (including marshy pasture) bounded by overgrown hedgerows, derelict fences and scrub, with wildflowers on banks
- Lower slopes defined by expansive pastoral fields with mature in-field and hedgerow oaks
- Magnificent beech avenues set on mossy banks – key features of the area

Northern escarpment (this LCT covers the steep north-facing slope)

- Dramatic steep and well-wooded northern escarpment with a linear topography
- Lower slopes regularly incised by dry valleys and streams fringed with alder
- Includes the Luxhay Reservoir

- Steep slopes falling away from the escarpment into a vast, lowland plain outside the AONB
- Varied land use with small flat fields surrounded by neat hedgebanks with isolated windswept trees
- Small, marshy fields on lower slopes bounded by banks of scrubby ash and hazel; fields are larger and hedges neater at the bottom of the scarp
- Complex and colourful landscape with few buildings – detracted from by traffic on roads climbing the narrow roads up the escarpment
- Lower slopes dominated by views of the M5, Wellington and related infrastructure
- Views to the prominent local landmark of the Wellington Monument, which looks over the slopes of the escarpment

Rolling ridgeland (covers various locations within the LCT)

- Rolling ridges with frequent views adding variety to the landscape – the near horizon dropping rapidly to reveal tree tops and distant views of other wooded ridges
- Small blocks of mixed and coniferous woodland
- Oak woodlands often unmanaged and lined with primroses in spring
- Improved pasture fields surrounded by wedge-shaped beech hedgebanks
- Simple and well-managed farmed landscape, with patches of bracken and gorse surrounding deciduous woodland on steep-sided high ground (e.g. Hackpen and Dumpdon Hills)
- Straight roads running along ridgetops often lined with avenues of beech and Scots pine

Summary of key characteristics for this study

- Undulating topography including upper valley slopes, ridges and the steep north-facing escarpment
- **Frequent woodlands and copses especially on higher slopes, mainly beech and oak with some coniferous plantations**
- Predominantly pastoral character, with mainly **small irregular medieval fields enclosed by thick hedgebanks and frequent hedgerow trees**
- **Spring-line mires, wet woodland and patches of heath and gorse**
- **Lightly settled with occasional farms and hamlets clustered at cross-roads and connected by winding rural roads (some straight sections lined with mature avenues of beech)**
- **Extensive views often afforded from valley summits** – views from the northern escarpment dominated by Wellington, Taunton, the M5 and associated infrastructure
- **Local landmark feature of the Wellington Monument** overlooking the north-facing slopes of the AONB

3B: LOWER ROLLING FARMED AND SETTLED SLOPES

Visual Character Zone coverage (Cobham)

The valleys:	78%
Wooded ridge:	17%
Northern escarpment :	5%

Key characteristics (summarised from the Diacono LCA)

- Gently rolling landform, sloping up from valley floor

- Small to medium sized irregular fields with wide, low hedges and distinctive tall earth banks
- Pastoral land use (predominantly dairy; some forage crops), often with wooded appearance
- Many hedgerow trees, copses and streamside tree rows, with orchards around farmsteads
- Settled, with varied building ages, styles and settlement size
- Much use of stone as building material
- Winding, often sunken lanes
- Streams and ditches
- Tranquil and intimate

Key characteristics (summarised from the Cobham LCA)

The valleys (Yarty & Culm)

- Undulating topography in the upper courses of the valleys (where they are incised), whilst lower valley sections are broad and open, with flat bottoms but steep sides
- Pastoral upstream sections, with hedges, hedgerow trees, tree clumps and scrub. Larger fields of pasture and arable found downstream
- Combe valleys marked by trees snaking down valley slopes
- Watermeadows found on lower valley slopes, e.g. in the Culm Valley
- Numerous isolated farmsteads connected by small winding roads marked by twisting double hedgerows
- Extensive views from valley slopes to distant, wooded ridges. Views of transmission lines, main roads and urban development outside the area from some lower valley locations

Wooded ridge (north-eastern corner of the AONB)

- Intricate landscape of small hills and incised valleys
- Well-wooded landscape with small secluded fields enclosed by woodland, often coniferous plantations particularly on northern slopes
- Some fields of improved pasture but mainly rough fields (including marshy pasture) bounded by overgrown hedgerows, derelict fences and scrub, with wildflowers on banks
- Lower slopes defined by expansive pastoral fields with mature in-field and hedgerow oaks
- Magnificent beech avenues set on mossy banks – key features of the area

Northern escarpment (northern edge of the AONB (slopes of the escarpment))

- Dramatic steep and well-wooded northern escarpment with a linear topography
- Lower slopes regularly incised by dry valleys and streams fringed with alder
- Steep slopes falling away from the escarpment into a vast, lowland plain outside the AONB
- Small, marshy fields bounded by banks of scrubby ash and hazel; fields are larger and hedges neater on the lowest slopes
- Complex and colourful landscape with few buildings – detracted from by traffic on roads climbing the narrow roads up the escarpment
- Lower slopes dominated by views of the M5, Wellington and related infrastructure

Summary of key characteristics for this study

- Undulating land sloping up from the main valleys, including small hills, dry valleys and incised combes
- **Copses, tree clumps and wet woodland lining streams**

- Pastoral land use (mainly improved, but some rough grassland and watermeadows)
- **Small to medium sized irregular medieval fields with thick hedgebanks and frequent hedgerow trees** (larger fields on lower slopes/in downstream valley sections)
- **Numerous isolated farmsteads and scattered hamlets (constructed of chert, cob, dressed stone, thatch and tile) at river crossing points, linked by winding roads marked by hedgebanks and beech avenues**
- Lower escarpment slopes dominated by views of development at Wellington, as well as related infrastructure such as the M5 and longer views to Taunton
- **Glimpses of the Wellington Monument also afforded from the northern extent of the LCT**

4A: UNSETTLED FARMED VALLEY FLOORS

Visual Character Zone coverage

The Valleys	100%

Key characteristics (summarised from the Diacono LCA)

- Open and small scale flat landform, often with distinct vegetated floodplain edge
- Shallow watercourses screened by riparian vegetation
- Hedges, not banks, generally on the boundary with rising land
- Pastoral land use with variable field sizes, with wet meadows, orchards and some large arable fields
- Narrow winding lanes along the edge of the floodplain, edged by bushy hedgerows with bridges or fords crossing watercourses
- Unsettled and tranquil, with some visual intrusion from road traffic
- Open internally, with views out screened by boundary vegetation

Key characteristics (summarised from the Cobham LCA)

The valleys

- Broad and open valleys in their lower courses, with flat bottoms but steep sides
- Large fields of pasture and arable
- Watermeadows found on lower valley slopes, e.g. in the Culm Valley
- Numerous isolated farmsteads connected by small winding roads marked by twisting double hedgerows
- Peaceful villages nestled in valley bottoms, with church spires forming prominent features
- Extensive views from valley slopes to distant, wooded ridges. Views of transmission lines, main roads and urban development outside the area from some lower valley locations impact on the overriding sense of tranquillity

Summary of key characteristics for this study

- Broad and open flat valley landforms framed by steep wooded slopes
- **Rivers and streams lined by trees and riparian vegetation**
- Generally large fields of pasture and arable, with wet meadows and orchards
- **Numerous isolated farmsteads connected by small winding roads marked by thick double hedges**, crossing watercourses via bridges and fords
- **Peaceful villages nestled in valley bottoms** – church spires forming prominent features
- **Open views along valleys**, whilst intermittent views outside are defined by glimpses of distant wooded ridges

- Overarching sense of peace and tranquillity
- The lower section of the River Otter include views of transmission lines, main roads and urban development related to Honiton

Blackdown Hills AONB

The Blackdown Hills Area of Outstanding Natural Beauty is managed by a partnership of national agencies, local authorities, conservation organisations and community groups who work together to conserve and enhance this special place.

The work of the AONB Partnership is funded by Natural England, Devon and Somerset County Councils; East Devon, Mid Devon and South Somerset District Councils, and Taunton Deane Borough Council.

Blackdown Hills AONB
St Ivel House
Station Road
Hemyock
Cullompton
EX15 3SJ

Should an alternative format of the publication be required,
please contact **01823 680681** or email **blackdownhills@devon.gov.uk**

www.blackdownhillsaonb.org.uk