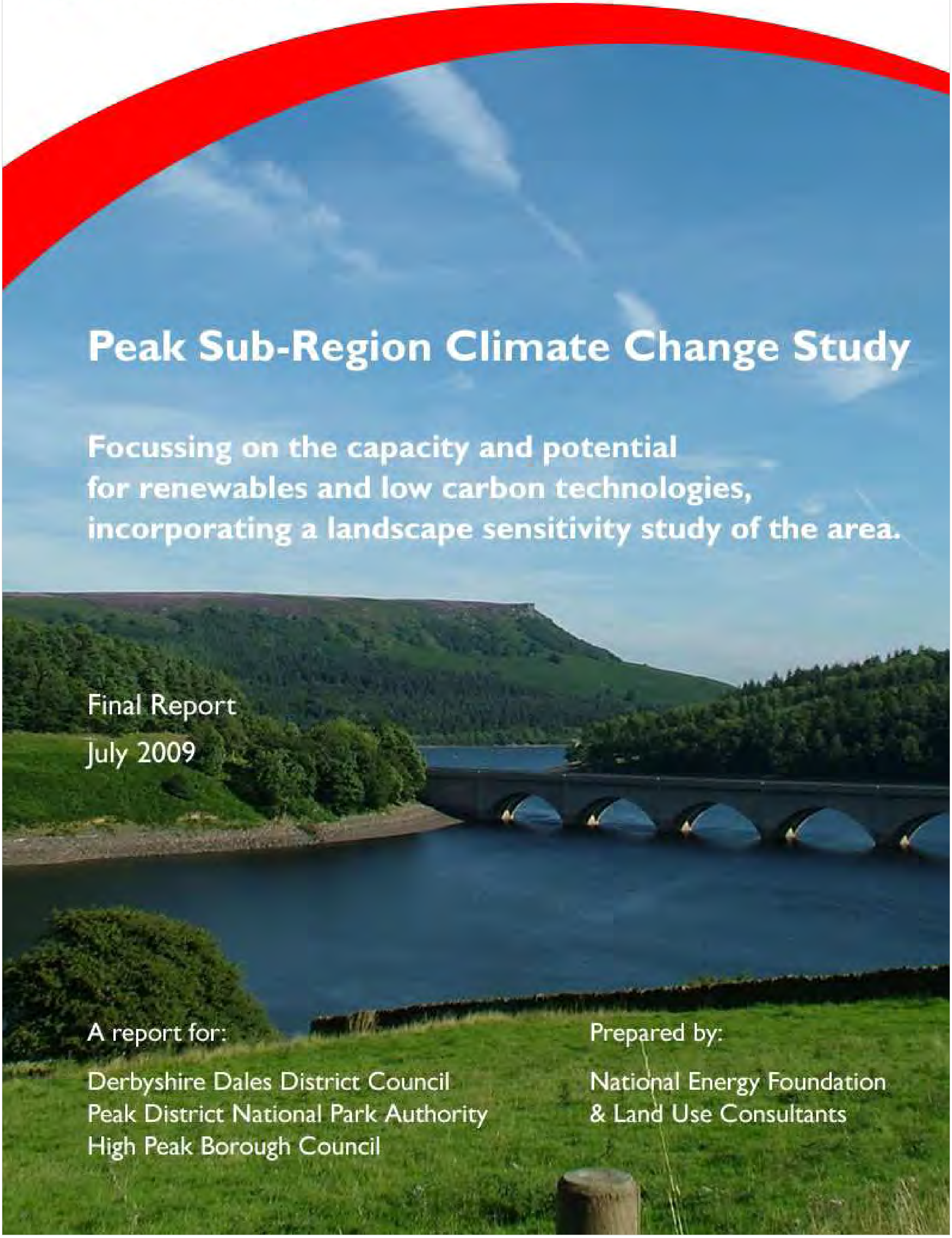

Peak Sub-Region Climate Change Study

Focussing on the capacity and potential for renewables and low carbon technologies, incorporating a landscape sensitivity study of the area.

Final Report

July 2009

A report for:

Derbyshire Dales District Council
Peak District National Park Authority
High Peak Borough Council

Prepared by:

National Energy Foundation
& Land Use Consultants

Peak Sub-Region Climate Change Study

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Final Report
July 2009

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1 EXECUTIVE SUMMARY

This study considers the capacity and potential for decentralised energy supply from renewables and low carbon technologies across the Peak Sub-Region.

The Peak Sub-Region, as defined by the East Midlands Regional Plan, consists of the two local authority administrative areas, namely High Peak Borough Council and the Derbyshire Dales District Council, with the planning administrative area of the Peak District National Park Authority overlying a large part of the two local authority areas.

The particular objectives of this study are:

- To **raise awareness of the issues** surrounding climate change in the respective local planning authority Core Strategy development plan documents;
- To **increase the understanding** of participating Authorities of the capacity of the respective plan areas for accommodating a range of renewable energy and low carbon technologies;
- To **gain a clear understanding** of the real potential for delivering renewable and low carbon technologies in the context of the Core Strategies and
- To **develop a robust evidence base** to support the development of spatial policies relating to the mitigation and adaptation to climate change.

This has been carried out in conjunction with a landscape sensitivity study which has identified 36 landscape types falling across 16 Character Areas within the Peak Sub-Region. The sensitivity of each of the Landscape Types to different renewable technologies and plantings of biomass was assessed, specifically looking at the landscape impacts of large, medium and small-scale wind turbines and of biomass crops – both Short Rotation Coppice (SRC) and Miscanthus (Elephant Grass) that have the potential to have landscape-wide effects.

The assessment therefore recognises the national importance of this landscape and places it within the UK context. It uses a sensitivity score applicable to the whole of the UK, with National Parks at the top end of this scale. The areas within the Peak Sub-Region bordering the Peak District National Park are also deemed to have a greater degree of sensitivity to development when compared to other landscapes, because of their role in providing a setting to the Peak District National Park.

The need for this study in part reflects the guidance in Planning Policy Statement: *Planning and Climate Change (2007).* It refers to the need for planning authorities to provide a framework that promotes and encourages renewable and low carbon energy generation, and to have an evidence-based understanding of the local feasibility and potential for renewable and low carbon technologies, including microgeneration, to supply new development in their area. The study methodology has therefore closely followed the Government's Practice Guidance which supports this Planning Policy Statement.

The study findings and recommendations are detailed in Section 7of this report. A summary of renewable energy contributions and resultant carbon dioxide savings by planning authority area and technology type is outlined in the following tables. The estimates of likely carbon dioxide emission savings have been produced taking into account of whether the renewable technology is used to generate electricity or heat.

A key purpose of the study is to assess the likely energy capacity from a range of renewable energy technologies within the Peak Sub-Region by 2026. The results of the assessments estimate a total capacity for the Peak Sub-Region of 128 GWh/y to 2026. This represents one and a half percent (1.5%) of the East Midland target to 2026 (see Table on following page). This low percentage of contribution is primarily due to the constraints within the Sub-Region from the nationally designated Peak District National Park. This constraint is recognised and acknowledged within the East Midlands Plan as a significant constraint upon large scale renewable energy generation within the Peak Sub-Region, but that there are many opportunities for small scale renewable energy generation

Table 1.1: Estimate of Energy Production from Renewables in the Peak Sub-Region to 2026

Technology	Quantification of potential GWh/y				Target to 2026 GWh/y				East Midlands Targets to 2026 GWh/y	% of EM targets
	PDNP	HPBC	DDDC	Sub Region	PDNP	HPBC	DDDC	Sub Region		
Biomass	92.9	5.9	23.2	**122**	4.64	0.29	1.16	**6**	77	8
Energy Crops	0	0	735	**735**	0	0	37	**37**	1114	3
Anaeorobic Digestion				#	0	0	0	**0**	72	0
Hydro	6	3.4	3.8	**13.2**	6	3.4	3.8	**13.2**	73	18
Heat Pumps	6	669	155	**830**	0.4	50	12	**62**	na	na
Micro Solar Thermal	93	3	49	**145**	0.6	0.02	2.8	**3.4**	na	na
Micro PV	9	2.84	6.96	**18.86**	0.57	0.18	0.44	**1.19**	1018	1
Onshore wind										
Large	0	0	0	**0**	0	0	0	**0**	–	
Medium	0	0	20	**20**	0	0	10	**10**	–	
Small	0.125	0.125	0.75	**1**	0.125	0.125	0.75	**1**	–	
Total Wind	0.125	0.125	20.75	**21**	0.125	0.125	10.75	**11**	460	2.3
Micro wind	11.61	25.85	21	**58.46**		*		**0.5**	1832	0.03
TOTAL	**218**	**710**	**1014**	**1943**	**12.21**	**50.49**	**65.85**	**128.79**	**8339**	**1.5**

Footnotes: * **Contribution estimated for Peak Sub-Region only**

— **East Midlands targets not sub-divided by wind turbine size**

The contributions to the Peak Sub-Regional total capacity by planning area are as follows:

Derbyshire Dales District Planning Area (DDDP) – Approximately fifty percent (50%) of the total renewable energy capacity of the Peak Sub-Region to 2026 is from the Derbyshire Dales District Planning Area, an estimated target of 65 GWh/y by 2026. The main contributors are energy crops, heat pumps and medium scale wind.

The High Peak Borough Planning Area (HPBPA) – The contribution of approximately 50 GWh/y by 2026 constitutes about forty percent (40%) of the Peak Sub-Region renewable energy capacity, the main technology contribution being from heat pumps.

The Peak District National Park (PDNP) – The National Park area contribution is approximately 12 GWh/y by 2026, constituting the remaining ten percent (10%) of the Peak Sub-Region total capacity. The main technology contributors are small scale hydro and biomass.

Carbon Dioxide (CO_2) Savings from Renewables

The estimated carbon dioxide savings arising from these renewable energy contributions are outlined by planning area and technology type on the following Table and summarised by planning area as follows:

Derbyshire Dales District Planning Area – CO_2 saving of 19,420 tonnes

The High Peak Borough Planning Area – CO_2 saving of 13,919 tonnes

The Peak District National Park – CO_2 saving of 4,353 tonnes

Peak Sub-Region – Total CO_2 saving is 37,908 tonnes

Table 1.2: Carbon Dioxide Savings to 2026 (tonnes)

Technology	Carbon Dioxide Savings to 2026 (tonnes)			
	PDNP	HPBC	DDDC	Sub Region
Biomass	1136.8	71	284.2	**1492**
Energy Crops	0	0	9065	**9065**
AD	0	0	0	**0**
Hydro	2580	1462	1634	**5676**
Heat Pumps	98	12250	2940	**15288**
Solar thermal	142.1	4.9	686	**833**
PV	245.1	77.4	189.2	**511.7**
Onshore wind				
Large	0	0	0	**0**
Medium	0	0	4300	**4300**
Small	53.75	53.75	322.5	**430**
Micro wind				**215**
TOTAL	**4353.75**	**13919.05**	**19420.9**	**37908.7**

Presenting the contribution to CO_2 saving from potential renewables as a proportion of the current energy use (and resultant CO_2 emission) in the Peak Sub-Region gives a more localised picture of the role that renewables could play in replacing conventional fossil fuel energy consumption in the future. This figure is estimated to be 1% of current energy use (2006).

The study also makes key recommendations relating to specific renewable energy technologies and to planning policies for renewable and low carbon technologies for the three local authority areas. These are summarised as follows:

Biomass

- The scope for harnessing the products of conservation management within the Peak Sub-Region for use as a biomass resource should be reviewed by the three local authorities with appropriate funding sources investigated.

- As part of a sustained commitment to tackling climate change, the three local authorities, local partners and stakeholders, should continue to assist wherever possible in promoting the expansion of the local biomass resource within their areas, and to promote the use of biomass systems for heating/power generation locally.

Anaerobic Digestion

- To assist in the Government's shared goals for Anaerobic Digestion (AD), the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

Hydro

- There is scope within the Peak Sub-Region for the three local authorities, together with local, regional and national stakeholders, to look for ways to collaboratively facilitate the future development of small/micro hydro installations within the Peak Sub-Region.

Planning policies

- Provision of appropriately worded policy to support the development of anaerobic digestion within the Peak Sub-Region, to include suitable criteria to safeguard the environment and sensitive landscape of the Peak Sub-Region.

- Identification of potential areas for district heating or CHP schemes within the development planning process for the Peak Sub-Region.

- The requirement of an **energy statement** from developers for new development proposals as means of ensuring a proposal's compliance to statutory regulation and planning policy.

- Use of **differential targets** for renewables for domestic and non-domestic properties based on planning use. This approach is in keeping with the published timeline for national Building Regulations, where homes are expected to achieve Code Level 6 (net zero carbon) by 2016, but the government Department for Communities and Local Government do not expect non-domestic properties to achieve equivalent carbon neutrality until 2019.

Table 1.3: Renewable Energy Target

Use	Renewable Energy Target (% of gross demand)
Domestic (>5 dwellings, or >16 bedrooms in total)	14%
Offices, hotels, leisure (>1,000m^2)	10%
Other non-dwellings (>1,000m^2)	6%

2 STUDY BACKGROUND AND BRIEF

2.1 The National Energy Foundation, in conjunction with Land Use Consultants, has prepared this technical report on the capacity and potential for renewable and low carbon technologies for the Peak Sub-Region. The study has been commissioned by Derbyshire Dales District Council (DDDC), the Peak District National Park Authority (PDNPA) and High Peak Borough Council (HPBC).

AIMS AND OBJECTIVES OF THE STUDY

2.2 The study **aims**, as specified by the project brief, are:

1. To assess the capacity and potential for decentralised energy supply by optimising renewables and low carbon technologies across the Peak Sub-Region;

2. To offer spatial planning options for the best means of achieving any identified potential by specific technology type;

3. To clarify the scope for targets for:
    a) standalone technology
    b) development integrated technology; and
    c) microgeneration/retrofit/refurbishment.

2.3 The brief also requires an estimate of existing renewable energy installations within the Peak Sub-Region; an assessment of the potential type, scale and/or threshold of site by which particular forms of renewable or low carbon technologies may be required; and a protocol to enable members of the Sub-Regional partnership to identify and bring forward sites in the future which will provide renewable and low carbon technologies.

2.4 The **objectives** of this study are fourfold:

1. To raise awareness of the issues surrounding climate change in the respective Core Strategy development plan documents;
2. To increase the understanding of participating Authorities of the capacity of the respective plan areas for accommodating a range of renewable energy and low carbon technologies;
3. To gain a clear understanding of the real potential for delivering renewable and low carbon technologies in the context of the Core Strategies;
4. To develop a robust evidence base to support the development of spatial policies relating to the mitigation and adaptation to climate change.

2.5 Overall, the study has, for each of the three planning areas within the Peak Sub-Region:

- Mapped, using Geographical Information Systems (GIS), the existing renewable energy installations broken down by technology type;
- Mapped using GIS, any available and potential renewable resources broken down by category e.g. solar, wind, hydro (available in a separate published map);
- Mapped using GIS, a large amount of environmental data such as landscape types and sensitivity and key environmental designations (available in a separate published map);
- Identified economic/feasibility of the potential resources;
- Identified any potential for the renewable resources to become district/community based schemes;
- Identified how the potential renewable resources can be achieved without detriment to the landscape;
- Identified opportunities for CO_2 emission reduction targets for a range of development types;
- Identified the scope for targets to help bring forward renewable technologies.

BACKGROUND

2.6 The need for this study in part reflects the guidance in Planning Policy Statement: *Planning and Climate Change (2007).* Paragraph 19 refers to the need for planning authorities to provide a framework that promotes and encourages renewable and low carbon energy generation, whilst paragraph 26 refers to the need for planning authorities to have an evidence-based understanding of the local feasibility and potential for renewable and low carbon technologies, including microgeneration, to supply new development in their area.

SCOPE OF THE STUDY

2.7 The study is therefore concerned with the assessing the potential for low carbon and renewable technologies within the Peak Sub-Region. The full range of technologies considered through this study covers:

- Biomass
- Anaerobic digestion
- Small scale hydro
- Standalone wind energy including micro building mounted wind turbines
- Photovoltaics (usually building integrated – roof mounted, including solar slates and tiles)
- Solar hot water
- Ground source heat pumps (via boreholes, trenches, aquifers and surface water)
- Air source heat pumps
- District heating (involving ground source heat pumps or biomass boilers or CHP)

APPROACH

2.8 The study has followed the Working Draft of Practice Guidance to support the Planning Policy Statement: *Planning and Climate Change* (published by Communities and Local Government on 17 December 2007). Section Three of the guidance document provides an outline of procedures for identifying an area's potential for decentralised energy; setting decentralised renewable and local carbon targets in Development Plan Documents, and selecting land for development.

2.9 The study has involved eight main activities:

- Collection of national and local datasets that identify both the renewable resources available (e.g. wind) and the constraints to energy generation such as nature conservation designations and protection of water resources, as well as grid connection issues.
- Review of relevant international, national and local policies and wider literature review on appropriate technologies;
- Discussions with key organisations and individuals on renewables potential including officers of the three Local Authorities;
- A landscape sensitivity study of the Peak Sub-Region, divided into the three planning areas, covering those aspects of renewable energy generation that are likely to have a landscape-wide effect, namely the planting of biomass crops and wind turbine developments;
- Identification of a typical range of development types for housing and commercial development for the three planning authority areas, with accompanying guidance on CO_2 emission reduction targets for such developments;
- Identification of opportunities within the three planning areas for the development of district heating CHP from existing heat/power sources, or from potential new development;
- Identification of relevant funding sources;
- A workshop held in December 2008 to debate the emerging findings from the study, as well as a series of Steering Group meetings.

The Landscape Sensitivity Study

2.10 This has been a major piece of work within the overall study. Its key purpose is to provide a robust evidence base that can underpin future planning policies for the area. It has used as its basis the two Landscape Character Assessments that cover the Sub-Region – the Peak District Landscape Character Assessment (2008) for area within the Peak District National Park; and the Derbyshire county-wide assessment from 2003 ('The Landscape Character of Derbyshire') for the areas of the Derbyshire Dales District and High Peak Borough falling outside the Peak District National Park boundary. These assessments both use the Landscape Character Areas and the Landscape types as their characterisation units, the latter of which can be found across one or more Landscape Character Areas. In total it has identified 36 landscape types falling across 16 Character Areas within the Peak Sub-Region.

2.11 The study has specifically looked at the landscape impacts of large, medium and small-scale wind turbines and of biomass crops – both Short Rotation Coppice (SRC) and Miscanthus (Elephant Grass) that have the potential to have landscape-wide effects. In judging landscape effects, the sensitivity study has considered the effects of the individual technologies or plantings on the attributes and characteristics of the landscape that are particularly sensitive to the renewables under consideration.

2.12 The sensitivity of each of the 36 Landscape Types to the different renewable technologies and plantings of biomass was assessed and a 'score' was allocated to reflect the result. Because the Peak District National Park is recognised as a nationally important landscape, in practice none of the sensitivity assessment scores fell below 'moderate', with the majority of Landscape Types being judged as either 'moderate-high' or 'high' sensitivity to both wind turbine developments and bio energy crop planting. The assessment therefore recognises the national importance of this landscape and places it within the UK context – i.e. it uses a sensitivity score applicable to the whole of the UK, with National Parks at the top end of this scale. The areas within the Peak Sub-Region bordering the Peak District National Park are also deemed to have a greater degree of sensitivity to development when compared to other landscapes. This is because of their role in providing a setting to the Peak District National Park. The methodology is described in full in the separate landscape sensitivity study report.

2.13 The specific outputs from this landscape sensitivity study have been:

- Maps that identify the landscape sensitivity of each of the 36 Landscape Types to the individual technologies / plantings.
- Landscape guidance for each Landscape Type setting out the specific circumstances that should guide the siting of individual technologies / plantings.
- Generic landscape guidance for those technologies which are unlikely to have a landscape-scale effect but which may require the development of specific plant (as in anaerobic digestion, biomass plants and small hydro schemes).

2.14 The landscape sensitivity report contains a description of the methodology followed; sensitivity assessment and guidance for wind turbine developments and biomass crops for each Landscape Character Area; and generic landscape guidance for other renewable technologies that require built development. It is included at the end of this document as a separate report.

The Stakeholder Workshop

2.15 The Stakeholder Workshop held in December 2008 was well attended and stimulated lively debate. It included members of the community with an interest in renewables and renewables suppliers and growers, as well as representatives of individual organisations:

2.16 Discussions at the Workshop centred around the opportunities and constraints associated with individual renewable technologies; the general contribution that renewables could make to the Peak Sub-Region; and the potential policies that the three planning authorities should develop in support of appropriate renewable technologies and carbon reduction strategies. As appropriate, views from the Workshop are provided through this report.

OUTPUTS

2.17 In summary, the main outputs of the study provided for each of the three planning authorities are:

- The main report and Appendices providing the detailed evidence base, key findings and recommendations (including the Landscape Sensitivity Assessment);
- Map Info (GIS) data (CD Rom)
- A published ArcReader Map of the GIS layers developed in support of this study (CD Rom)

2.18 As an addition to the study requirements we have included information on the use of peat as a natural carbon sink, a means of sequestering (or fixing) carbon in the atmosphere. Using a modelling method developed by the University of Durham we have sought to estimate the level of carbon capture for the Peak Sub-Region from its peat land areas. A summary of the assessment is included in **Section 5** in the main report with full details provided in **Appendix 3**.

STRUCTURE OF THIS REPORT

2.19 Having set out the policy context and potential policy emphasis **(Section 3)**, the body of this report focuses on the main renewable/low carbon technologies considered through this study namely:

Section 4:	Renewable Energy Contributions (biomass, anaerobic digestion, small/micro hydro, ground/air source heat pumps, solar, wind, district heating, contributions summary, spatial Implications)
Section 5:	Carbon Capture
Section 6:	Setting Targets
Section 7:	Conclusions and Recommendations
Section 8:	Funding Opportunities

Landscape Sensitivity Assessment

Appendices:

Appendix 1:	Renewable Energy Technologies Overview
Appendix 2:	Renewable Energy Feasibility Case Studies
Appendix 3:	Carbon Capture
Appendix 4:	The Renewables Obligation
Appendix 5:	Energy Statement
Appendix 6:	Existing Renewables Installations and CO_2 targets

Two CDs have also been provided by LUC:

Appendix 7:	MapInfo (GIS) Data
Appendix 8:	Published Map

RENEWABLES AND THE PEAK SUB-REGION

2.20 Recognising the Peak District National Park status of part of the Peak Sub-Region, and the role of the adjoining local planning authority areas in contributing to the sustainable development of the Peak Sub-Region as a whole, this study has sought to identify the extent to which renewable and low carbon technologies can positively assist in supporting the environment and local economy whilst also maximising energy outputs. At a generic level renewable technologies can potentially be divided into the following three categories:

- Those technologies that operate in symbiosis with the landscape and help support the existing rural economy, as in anaerobic digestion and aspects of biomass linked to the management of existing woodland and the extension of semi natural woodland within the Peak Sub-Region and the use of existing mills sites to generate hydro power.
- Those technologies that have no or limited impact on the environment and have the potential to make significant renewable energy contributions such as ground and air source heat pumps; solar technologies associated with individual premises; and micro-hydro.
- Those technologies that will have an impact on the environment but nonetheless can make a significant contribution to local energy generation – meeting local demand with local energy provision, as in larger scale biomass plantings and in the capture of wind energy.

2.21 Aside from environmental implications, all local renewable energy sources meeting local energy needs will help support the local economy in terms of broader skills, new jobs and services. In addition, revenue from energy production will be recycled locally rather than exported out of the area by national and multinational energy companies. This is an important benefit to the local economy during the current economic climate.

The communities of the Peak Sub-Region

2.22 Potentially the greatest asset of the Peak Sub-Region in pursuing a low carbon economy is its local communities. Within the Peak Sub-Region there is a very high level of commitment to energy saving and the development of renewable energy resources, as indicated by the work of the Peak District National Park Authority, the High Peak Borough Council and the Derbyshire Dales District Council, as well as many local groups and individuals, that are very well informed on the renewable opportunities available, as well as active in seeking to expand their use as an important part of the local community infrastructure.

3 POLICY CONTEXT

3.1 This section provides the following contextual information for the Peak Sub-Region

- it's principle characteristics and planning areas
- electricity and gas grid network coverage
- existing sustainable energy initiatives and an estimate of the numbers of existing renewable energy technologies in the study area
- key policy drivers for renewable energy from international to local level

THE CHARACTER OF THE STUDY AREA

3.2 The study area comprises the Peak Sub-Region as defined by the East Midlands Regional Plan. It consists of the two local authority administrative areas, namely High Peak Borough Council (HPBC) and the Derbyshire Dales District Council (DDDC), with the planning administrative area of the Peak District National Park Authority (PDNPA) overlying a large part of the two local authority areas. **Figure 3.1** shows geographical extent of the Peak District National Park and the remaining planning administrative areas of the HPBC and DDDC. Each of the three planning areas also contains many environmental designations, the majority within the Peak District National Park - Figure 3.2.

Figure 3.1: The Peak Sub-Region Study Area

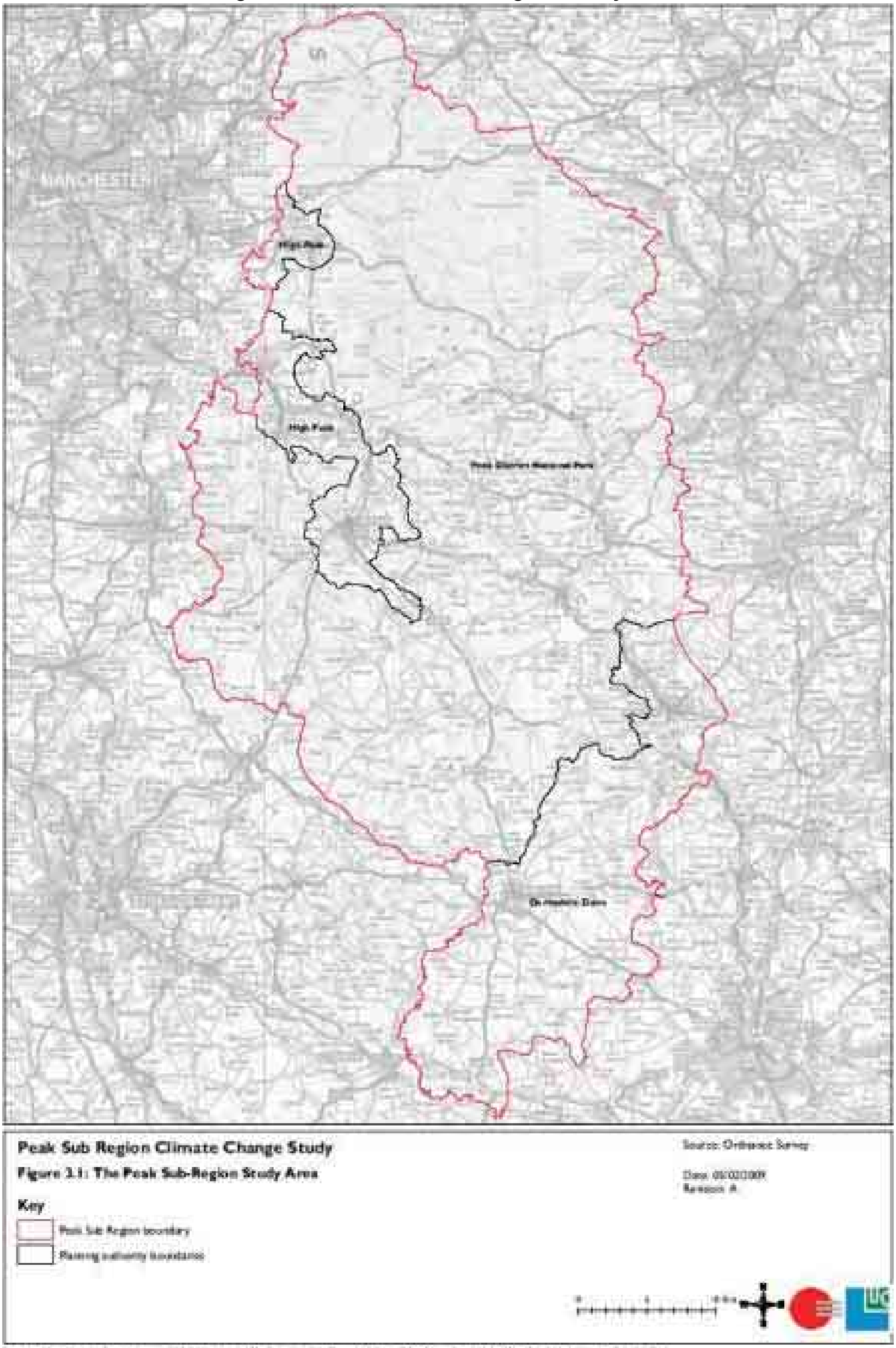
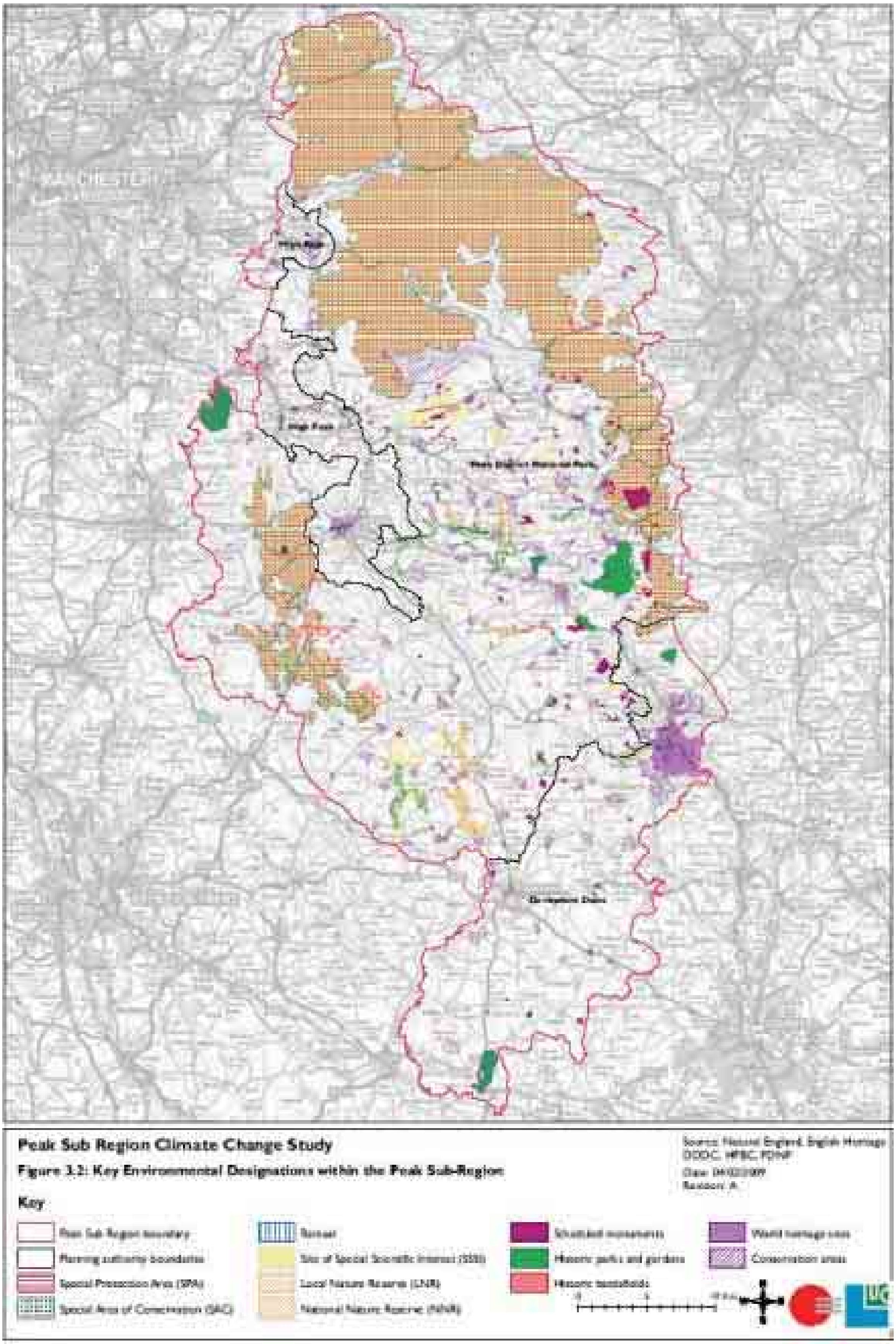


Figure 3.2: Key Environmental Designations within the Peak Sub-Region



The Peak District National Park

3.3 The Peak District National Park sits at the southern end of the Pennines sandwiched between Sheffield and Manchester, covering an area of 1438 square km. It was designated in 1951, which made it the earliest national park in the British Isles and it is the fourth largest National Park in England and Wales.

3.4 Its administrative area covers northern Derbyshire, and parts of Cheshire, Greater Manchester, Staffordshire, and South and West Yorkshire. Much of the area is uplands above 300m, with a high point on Kinder Scout of 636m.

3.5 Topographically, The Peak District National Park contains an amazing variety of landscapes including broad open moorlands, more intimate enclosed farmlands and wooded valleys. The landscapes have been shaped by variations in geology and landform and the long settlement and use of these landscapes by people.

3.6 The landscapes of the Peak District National Park and its surrounding area have been divided into a series of Regional Character Areas representing broad tracts of landscape which share common characteristics. The most well known areas are the Dark Peak, White Peak, South West Peak and Derwent Valley.

3.7 The Park boundaries were drawn to exclude large built-up areas and industrial sites; in particular, the town of Buxton and the adjacent quarries are located at the end of the Peak Dale corridor, surrounded on three sides by the Park. The town of Bakewell and numerous villages are, however, included within the boundaries, as is much of the (non-industrial) west of Sheffield.

3.8 The Peak District National Park area includes the upper reaches of the Goyt and Derwent river valleys; these include a number of reservoirs which add both a distinctive man-made landscape feature and additional opportunities for renewable energy generation.

High Peak Borough planning area

3.9 The High Peak Borough planning area is that part of the Borough that lies outside the Peak District National Park. The main centres of development within the area include the towns of Buxton, Glossop, New Mills, Whaley Bridge and Chapel-en-le-Frith.

Derbyshire Dales District planning area

3.10 The Derbyshire Dales District planning area is that part of the District that lies outside the Peak District National Park. The District is mostly rural in character and comprises attractive areas of countryside interspersed with a large number of villages and hamlets. The District's towns: Matlock, Wirksworth and Ashbourne are markets towns and act as service centres to a wide rural hinterland.

EXISTING SUSTAINABLE ENERGY INITIATIVES IN THE STUDY AREA

3.11 All of the Local Planning authorities within the study area are committed to sustainable development objectives. This includes the need to conserve energy and promote greater use of renewable energy technologies where feasible within their areas. As a result, their local authority websites provide facts sheets and guidance on energy efficiency and the use of renewable technologies. Furthermore, all three authorities are signatories to the Nottingham Declaration on Climate Change which means they are committed towards minimising CO_2 emissions from their own operations as well as in delivery of services in their areas.

3.12 For its part, the Peak District National Park **Management Plan**, published in 2006 indicates how the National Park purposes and associated duty will be delivered through sustainable development. Section 4 of the Plan – 'Climate change and Natural resources' outlines six actions that the Peak District National Park Authority will take to help tackle climate change. Two of the actions relate to renewable energy and state that the Peak District National Park Authority will:

"Promote low carbon technologies, and how they can be adopted in building design, to architects and developers to reduce the extent of climate change";

"Use the existing Sustainable Development Fund to encourage best practice in resource management and energy conservation within the National Park context to reduce the extent of climate change".

3.13 The Peak District National Park Authority also administers a Sustainable Development Fund (SDF) which supports local initiatives and projects, some of which relate to energy awareness, energy efficiency and renewable energy. The Authority is also leading by example through installing energy efficient heating and renewable technology systems in some of its facilities. It has also approved a draft Climate Change Action Plan (December 2008) which include measures to help wildlife and habitats adapt to climate change; protecting heritage; continuing moorland research and restoration for greenhouse gas storage and alleviating the impact of weather extremes such as floods and drought. The Authority will continue supporting "green" community initiatives, eco-friendly transport, energy efficiency and renewable energy schemes such as hydro-power and ground-source heat pumps that do not harm protected landscapes.

3.14 Derbyshire Dales District Council recently adopted a Climate Change Action Plan (March 2008) as a means to steer future action to reduce the Council's carbon footprint.

3.15 High Peak Borough Council was awarded Beacon Status for Sustainable Energy in 2005/6 for its progressive work in tackling climate change. Part of its Beacon Status remit is to assist other local authorities to improve their performance in regard to energy issues. The Council also operates the Eco Management and audit System (EMAS) which includes energy within its portfolio.

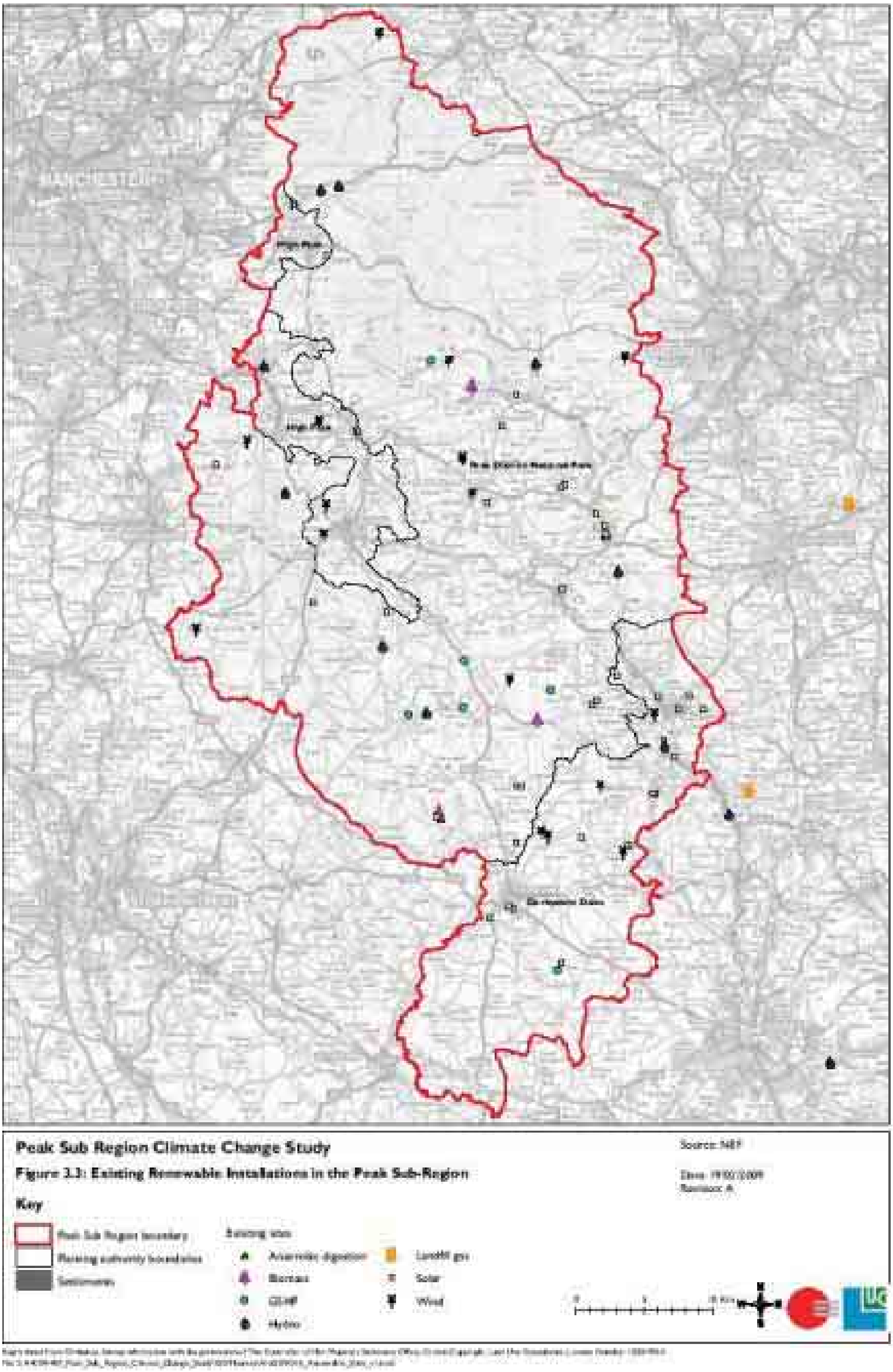
3.16 As a result of these efforts and the knowledge and enthusiasm of local communities and businesses, there are many examples of renewable and low carbon technologies in use throughout the study area. An estimate has been made, as part of this study, on the numbers and types of renewable energy installations within the study area. This information has been derived in the most part from local authority records of planning permissions over recent years. It cannot unfortunately provide a comprehensive source of information as there are certain renewable technologies that do not require planning permission ie., biomass boilers, ground source heat pumps, and micro generation technologies such as solar thermal and solar PV panels which are now allowed as part of the amended Permitted Development Rights (April 2008). Where information on installed technologies has been found from other data sources, these have been included in the estimate. **Table 3.1** and **Figure 3.3** summarise the findings.

Table 3.1: Installed/Approved Renewable Energy Technologies by Planning Area

Planning Area	Type of Technology	Numbers
DDDC	Solar thermal	17
	Solar Photovoltaic	1
	Wind (Microgeneration)	5
	Ground Source Heat Pump (GSHP)	1
	Air Source Heat Pump (ASHP)	0
	Biomass boiler	1
	Anaerobic digestion	0
	Hydro	1
HPBC	Solar thermal	2
	Solar Photovoltaic	0
	Wind (Microgeneration)	4
	GSHP	0
	ASHP	0
	Biomass boiler	0
	Anaerobic digestion	0
	Hydro	1
PDNPA	Solar thermal	22
	Solar PV	0
	Wind (microgeneration)	9
	GSHP	5
	ASHP	0
	Biomass boiler	3
	Anaerobic digestion	1
	Hydro	8

3.17 Analysis of the data shows that as of August 2008 collective existing permitted installations within the study area have an installed or approved capacity totalling around **9 GWh/y** (see **Table 4.16** in **Section 4** of this report).

Figure 3.3: Existing Renewable Installations in the Peak Sub-Region



3.18 The Peak Sub-Region falls into three electrical distribution network operator areas (DNO's):

North East of the Sub-Region is covered by **CE Electric UK (YEDL)**.

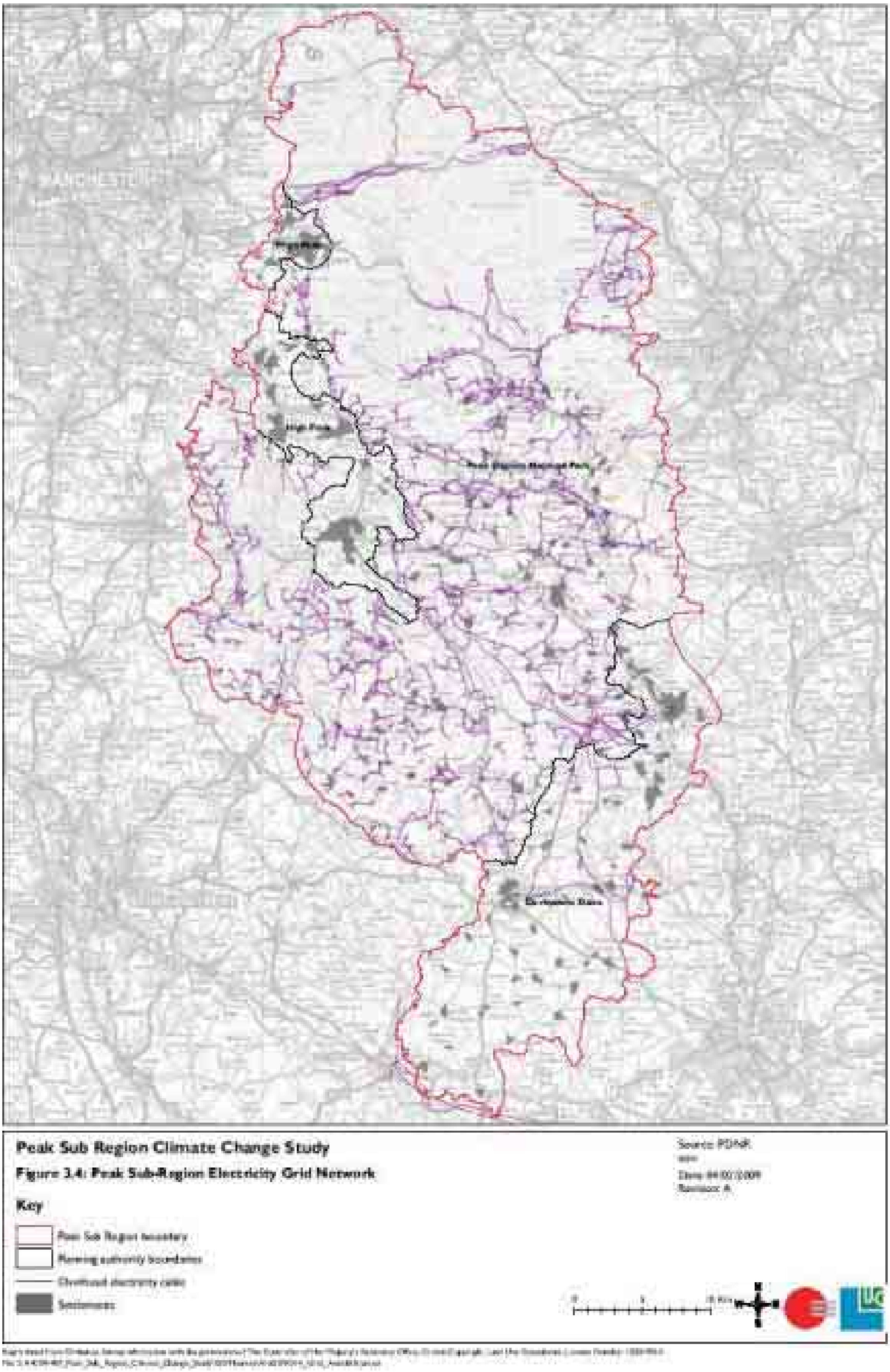
North West of the Sub-Region is covered by **United Utilities (Electricity North West**);

South of the Sub-Region is covered by **E-ON Central Networks East and West;**

Figure 3.4: Distribution Network Operators

Figure 3.5 on the following page highlights the extent of the overhead electricity cable network within the Sub-Region by planning authority area.

Figure 3.5: Peak Sub-Region Electricity Grid Network



NB. Low voltage network data only available for Peak District National Park Area

POLICY DRIVERS

Climate change and the role of renewable energy

3.19 Climate change is arguably the greatest long-term challenge facing the world today. Addressing it is a key concern reflected at all governmental levels. The production of sustainable energy is viewed as providing a primary means of reducing the output of greenhouse gases as well as reducing reliance upon fossil fuel energy production.

3.20 This section of the report briefly outlines the current general policy context and targets with regard to climate change and renewable energy. It goes on to focus on the specific role of planning policy in the promotion of renewable energy/low carbon technologies in the UK and in the study area. It provides a review of the study area's Local Plan policies for the promotion of renewable energy generation and recommendations for change where appropriate.

International context

3.21 EU Greenhouse gas reduction targets: The EU Climate and Energy package, published in January 2008, sets out proposals to achieve a reduction in EU greenhouse gas emissions of 20% by 2020, increasing to 30% in the event of an international agreement on climate change, compared to 1990 levels. In the longer term EU energy policy is for a reduction in greenhouse gas emissions of 80% by 2050, compared to 1990 levels.

3.22 EU Renewable energy target: The EU Renewable Energy target is to source 20% of the EU's total energy use (– a combination of electricity, heat and transport) from renewable sources by 2020. The UK's agreed contribution to the EU target is to increase the share of renewables in the UK energy mix from around 1.5% in 2006 to 15% by 2020.

3.23 EU Energy Efficiency target: The EU's Energy End-Use Efficiency and Energy Services Directive require Member States to achieve a 9% energy saving target by 2016. In line with this, each national government have to produce energy efficiency action plans (EEAPs) in 2007, 2011 and 2014.

3.24 Directive on the energy performance of buildings (EPBD); Directive 2002/91/EC (EPBD, 2003) of the European Parliament and Council on energy efficiency of buildings. The Directive came into force on 4th January 2003 and had to be implemented by the EU Member States at the latest on 4 January 2006.

UK context

3.25 **UK Greenhouse Gas Reduction Targets**: The Climate Change Act 2008 received Royal assent in December 2008, and creates a new legal framework for the UK to reduce, through domestic and international action, its **carbon dioxide emissions to at least 80% below 1990 levels by 2050**. The government will be required to set five-year carbon budgets, which place binding limits on carbon dioxide emissions and set out the trajectory towards this target. Decisions on the carbon budgets for the first three five-year periods 26 – 32% (2008-2012, 2013-2017, 2018-2022) will be informed by advice in the recent report from the independent Committee on Climate Change (CCC) published in December 2008.

3.26 The UK's CO_2 reduction performance, reported on annually by DEFRA, states that UK emissions of the basket of six greenhouse gases covered by the Kyoto protocol were 20.7% lower in 2006 than in the base year 1990. UK net emissions of carbon dioxide were 12.1% lower in 2006 than in 1990[1], but the favourable trend for much of the 1990s appears to have ended recently, as opportunities to decarbonise electricity supply by switching from coal (or heavy fuel oil) to natural gas became exhausted.

3.27 **UK Renewable Energy Targets**: In 2000 the UK set a target for 10% of electricity to come from renewable sources by 2010, with an announcement in 2006 to double that level by 2020. The key mechanism for delivering this growth has been the Renewables Obligation (RO), which requires electricity suppliers to source a prescribed and increasing proportion of their electricity from renewable sources.

[1] 2006 UK Greenhouse Gas emissions, final figures, 31st January 2008 - Statistical Release

3.28 In March 2007 EU leaders, including the UK Government, agreed to adopt a binding target of sourcing 20% of the EU's energy from renewable sources by 2020. In June 2008 the Government launched its draft UK Renewables Strategy, consulting on **a range of possible measures to deliver the UK's share of the EU target.**

3.29 The draft strategy puts forward a range of possible measures to deliver what is viewed as a very ambitious target for the UK. In 2006 only around 1.5% of the UK's final energy consumption came from renewable sources. To achieve the target of 15% will require a step change in a very short time frame to 2020. It has been estimated that it could require investment of at least £100 billion over the next decade.

3.30 Government funded analysis of the potential for renewable deployment in the UK, and results of independent studies of how much of this can be realised by 2020, suggests that reaching this level is achievable, although extremely challenging.

3.31 UK Energy Efficiency targets: The government produced the UK's Energy Efficiency Action Plan in 2007. This sets out a package of policies and measures to deliver improvements in energy efficiency in the UK in order to contribute to the achievement of the UK's climate and energy policy objectives and to meet the 9% energy saving target by 2016 under the European Union's Energy End-Use Efficiency and Energy Services Directive. It is expected that the measures will result in the target of 9% being exceeded, delivering 272.7 TWh in savings by the end of 2016, and equivalent to a saving of 18% over the target period.

The East Midlands Region

3.32 The East Midlands Integrated Regional Strategy (IRS) provides a common regional framework for policy. The East Midlands Energy Strategy (2005) and Joint Framework for Action (2007) have been developed within this framework to ensure integration with regional objectives and linkages with other strategies for the region. The Regional Energy Strategy has adopted a vision of a low carbon future, addressing carbon emissions through reducing current emissions, seeking efficiency, using renewable resources and developing new low carbon technologies.

East Midlands Regional Spatial Strategy – Renewable Energy Policy and Targets

3.33 The East Midlands Regional Spatial Strategy (published in 2005 and also known as RSS8 or the Regional Plan) includes policies for energy reduction and efficiency (Policy 40) and regional priorities for renewables (Policy 41). A regional target of 511MWe by 2010 and 1120MWe by 2020 is set for Combined Heat and Power (CHP); indicative targets for a range of renewable energy technologies are identified by technology and county administrative area to 2010 (Regional Spatial Strategy (RSS) - Appendix 6).

3.34 The 2006 review of the Regional Plan updated these targets to 2026 (Regional Plan - Appendix 5) and included a target for micro-generation. These targets were derived from a study completed during 2005, which built on the earlier renewable resource assessment targets. During the Regional Plan Review Examination in Public (EiP) in 2007, the level of some of the targets, particularly the micro-generation, was called into question and a review of the targets suggested. The Secretary of State's Proposed Changes to the Regional Plan, issued in 2008, upheld the need for early review. The Regional Plan was finally adopted in March 2009 and includes targets for renewable energy generation (**Table 3.2**).

Table 3.2: East Midlands Renewable Energy Targets – 2009

Renewable energy Technology	Current Capacity (2006) GWh/y	Current Capacity (2006) MWe	Target for 2010 GWh/y	Target for 2010 MWe	Target for 2020 GWh/y	Target for 2020 MWe	Indicative Target for 2026 GWh/y	Indicative Target for 2026 MWe
On shore Wind	142	54[1]	319	122	460	175	460	175
Biomass Wet agricultural waste	0	0	42	5	42	5	77	10
Biomass Poultry Litter	0	0	118	15	210	27	210	27
Biomass Energy Crop	38	5	344	46	1,012	136	1,114	150
Hydro	14	3	39	9	62	14	73	16
Micro-generation Wind	0 negligible	0 negligible	9	10[2]	1,832	2,091	1,832	2,091
Micro-generation PV	0 negligible	0	52	59[3]	1,018	1,162	1,018	1,162
Landfill Gas [4]	438	53	438	53	438	53	358	43
Anaerobic Digestion	11	1	39	5	64	8	72	9
Total [5] %	3%		6%		20%		20%	

1) Includes 2 wind farms in construction in 2006 (now in operation).
2) Micro wind corresponds to 2000 installations of 5kw turbines
3) PV corresponds to approximately 2kw PV on half of the new properties to 2010
4) Landfill gas is not a natural renewable resource but it is eligible for renewables obligation certificates. Not that landfill gas contribution will begin to tail off after 2020 due to reduced organic waste going to landfill.
5) In addition to the Regional onshore targets offshore generation targets are 1,315GWh/y for 2010; 3,000GW/y for 2020; and 3,483GW/y by 2026. Percentages are electricity generation as a % of regional electricity consumption.

Review of the East Midlands Regional Renewable Targets post 2010

3.35 The targets for renewable energy post 2010 are to be reconsidered as part of a partial review of the East Midlands Regional Spatial Strategy. A review of targets for energy efficiency and new and renewable energy capacity in the East Midlands Region commenced in December 2008, due to be completed in Spring 2009. The revised targets are expected to be challenging but deliverable for both renewably generated power and heat taking account of the growth agenda within the region and the Government's new aspiration to deliver deep cuts in CO_2 of up to 80% by 2050. The **Draft Revised Regional Plan** with revised renewable energy targets is expected to be published for consultation in **March 2010**.

The Peak Sub-Region – targets for renewables

3.36 The Peak Sub-Region, as defined in the East Midlands Regional Plan, consists of the area covered by the Derbyshire Dales District, the High Peak Borough and the Peak District National Park (the study area). The East Midland region's renewable electricity targets are not sub-divided into Sub-Regional areas, so there are currently no targets for renewable energy generation for the Peak Sub-Region for 2010 and 2020. One of the aims of this study is, therefore, to inform the extent that renewable energy generation within the Peak Sub-Region could make in terms of a contribution to the regional target.

East Midlands Regional Waste Strategy

3.37 The overall regional context for waste policy in the East Midlands is set by the Regional Waste Strategy (2006). One element of the regional hierarchical approach to waste management is energy recovery. This study includes an assessment of the potential energy contribution from anaerobic digestion within the Peak Sub-region, one form of energy recovery from waste.

3.38 There is no specific policy for the promotion of AD within the Strategy, although Policy RWS 3 requires regional and local partners to work together to stimulate demand for sustainable waste management techniques (which include AD).

3.39 The recently adopted **East Midlands Regional Plan (2009)** goes a step further (paragraph 3.3.62), specifically mentioning AD as a additional form of waste recovery which will be needed in the region and which Waste Planning Authorities will need to reflect in their Waste Local Development Plan Frameworks. Guidance on the expected pattern of waste treatment facilities required to deliver the Regional Waste Strategy in relation to the Peak Sub Area is referred to in the Regional Plan is the following paragraph and Policy:

Para 3.3.71 – *The Peak Sub Park has a high quality environment, which includes the Peak District National Park and many internationally and nationally designated sites of nature conservation. This quality and the smaller settlement size across the Sub-area make it inappropriate and unsustainable for the Sub-area to make a significant contribution to the provision of waste management infrastructure in the regional context. There is also limited commercial and industrial development within the National Park. However opportunities may arise, especially related to the larger settlements outside the National Park to accommodate small-scale facilities serving the Sub-area's needs. Where these would not have a significant adverse effect on the environment and local communities, a positive planning approach should be adopted. This should be considered through the policies in the Derbyshire Waste Development Framework, the Peak District National Park Local Development Framework and through the development control process*.

Policy 38 – Regional Priorities for Waste Management states in relation to the Peak Sub -area:
In the Peak Sub-area, especially related to larger settlements outside the Peak District National Park, small-scale facilities serving the Sub-area's needs should be accommodated, where these would not have a significant adverse effect on the environment and local communities or conflict with the National Park's statutory purposes.

Waste facilities should also be sited to avoid the pollution or disturbance of designated nature conservation sites of international importance. Increased traffic levels on roads near to sensitive sites should also be avoided.

PLANNING POLICY FOR RENEWABLE ENERGY GENERATION

UK national planning policy

"Increased development of renewable energy resources is vital to facilitating the delivery of the Government's commitments on both climate change and renewable energy".
"Positive planning which facilitates renewable energy developments can contribute to all elements of the Government's sustainable development strategy".

Source: Planning and Renewable Energy – Communities and Local Government

Planning policy statements

3.40 Planning policy guidance for local and regional government is set out in the governments Planning Policy Statements (PPS). Among the relevant PPSs, the supplement to PPS1, *PPS1: Planning and Climate Change (2007)* sets out specific guidance with regard to renewable energy outlining how regional and local planning can best support achievement of zero carbon targets alongside meeting community needs for economic and housing development. It points to a number of key objectives that planning authorities should follow. These are set out in the below in relation to the relevant paragraph in the guidance.

PPS1 – Planning and Climate Change

3.41 Paragraph 20:

"no requirement for energy development applicants to justify the need for renewable energy or provide energy justification for the particular location proposed";

"ensure any local approach to protecting landscape and townscape is consistent with PPS22 and doesn't preclude the supply of any type of renewable energy other than in the most exceptional circumstances":

"consider identifying suitable areas for renewable and low carbon energy sources";

"expect a proportion of the energy supply of new development to be secured from decentralised and renewable or low carbon energy sources".

3.41.1 Paragraph 26:

"have an evidence based understanding of local feasibility and potential for renewable and low carbon technologies, including microgeneration, to supply new development in their area";

"set target percentage of energy to be used in new development from decentralised and renewable or low carbon technologies where viable ...avoiding prescriptions on types of technologies …and being flexible as to how carbon savings can be secured";

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

"set out the type and size of development to which the target will be applied";

"ensure there is a clear rationale for the target and it is properly tested".

3.42 Other relevant guidance includes PPS 1 - Delivering Sustainable Development. Paragraph 17 'Protection and Enhancement of the Environment' states**, "*The Government is committed to protecting and enhancing the quality of the natural and historic environment, in both rural and urban areas. Planning policies should seek to protect and enhance the quality, character and amenity value of the countryside and urban areas as a whole. A high level of protection should be given to the most valued townscapes and landscapes, wildlife habitats and natural resources. Those with national and international designations should receive the highest level of protection*"**

3.43 Similarly in PPS7 – Sustainable Development in Rural Areas, the guidance highlights the need for planning authorities to "provide for the sensitive exploitation of renewable energy sources" whilst continuing to "ensure that the quality and character of the wider countryside is protected, and having particular regard to any areas that have been statutorily designated for their landscape, wildlife or historic qualities where greater priority should be given to restraint of potentially damaging development" (paragraphs 15 -16).

3.44 *PPS22*: Renewable *Energy* sets out the government's key policies and guidance on renewable energy. The key principle of *PPS22* is that renewable energy developments should be facilitated across England. In regard to national designations the guidance states:

3.45 "In sites with nationally recognised designations (Sites of Special Scientific Interest – SSI's).

"Nature Reserves, National Parks, Areas of Outstanding Natural Beauty, Heritage Coasts, Scheduled Monuments, Conservation Areas, Listed Buildings, Registered Historic Battlefields and Registered Parks and Gardens) planning permission for renewable energy projects should only be granted where it can be demonstrated that the objectives of designation of the area will not be compromised by the development, and any significant adverse effects on the qualities for which the area has been designated are clearly outweighed by the environmental, social and economic benefits" *(Paragraph 11).*

"Small-scale developments should be permitted within areas such as National Parks, Areas of Outstanding Natural Beauty and Heritage Coasts provided that there is no significant environmental detriment to the area concerned" *(Paragraph 12).*

3.46 The guidance clearly indicates that a careful balance has to be struck in terms of encouraging and making provision for renewable and low carbon technologies without detriment to important national priorities, such as the protection and enhancement of national parks.

Planning orders

3.47 *The Town & Country Planning (General Permitted Development) Order (amended 2008)* extends general permitted development rights to most domestic microgeneration technologies, including solar thermal and photovoltaic panels. Certain restrictions still apply however regarding size, height, protrusion from the roof and in relationship to the curtilage of the dwelling. In Conservation Areas and World Heritage Sites microgeneration equipment on buildings will only be permissible if not placed on the principal elevation, or facing onto, or visible from, the highway.

3.48 At present micro-wind turbines and air source heat pumps are not included in the Order pending further consultation by Government. The Consultation version anticipated roof mounted and free standing micro wind turbines would be permitted for detached properties not in Conservation Areas. It is uncertain at this stage when guidance for these microgeneration technologies will be forthcoming.

Note*: The permitted development rights are not extended to Listed Buildings which are covered by other planning regulations*.

Regional Planning Policy

3.49 The East Midlands Regional Plan (RSS8), (March 2009) provides a broad strategy for the East Midlands up to 2026. There are three policies within the Regional Plan that seek to promote renewable energy generation, namely:

Policy 1*: sub section i) "…maximising 'resource efficiency' and the level of renewable energy generation;'*
Policy 2*: '…securing energy from decentralised and renewable or low carbon energy technologies*
Policy 8*: Spatial Priorities in and around the Peak Sub-Area*
Policy 40*: Regional Priorities for Low Carbon Energy Generation (reproduced in the following box).*

Policy 8

Spatial Priorities in and around the Peak Sub-area

The preparation of policies and programmes in and around the Sub-area should:

- *help to secure the conservation and enhancement of the Peak District National Park, respecting the statutory purposes of its designation;*
- *address the social and economic needs of the Park's communities, for example, by the provision of appropriate business premises and affordable housing and;*
- *protect and enhance natural and cultural heritage of the Sub-area, in particular the Special Areas of Conservation covering the South Pennine Moors, Peak District Dales, the Bee's Nest and Green Clay Pits, Gang Mine and the Peak District Moors and the Peak District Moors Special Protection Area.*

Wherever practicable, routes for long distance traffic should be developed to avoid the National Park. However, access to the National Park and across it by public transport and other non-car modes should be improved.

Policy 40

Regional Priorities for Low Carbon Energy Generation

Local Authorities, energy generators and other relevant public bodies should promote:

- *the development of Combined Heat and Power (CHP) and District Heating (DH) infrastructure necessary to achieve the regional target of 511 MWe by 2010 and 1120 MWe by 2020.*
- *the development of a distributed energy network using low carbon and renewable resources.*

In order to help meet national targets low carbon energy proposals in locations where environmental, economic and social impacts can be addressed satisfactorily should be supported. As a result, Local Planning Authorities should:

- *safeguard sites for access to significant reserves of coal mine methane;*
- *identify suitable sites for CHP plants well related to existing or proposed development and;*
- *encourage their provision in large scale schemes*
- *consider safeguarding former power station and colliery sites for low carbon energy generation;*
- *support the development of distributed local energy generation networks; and*
- *develop policies and proposals to achieve the indicative regional targets for renewable energy.*

In establishing criteria for onshore wind energy, Local Planning Authorities should give particular consideration to:

- *landscape and visual impact, informed by local Landscape Character Assessments;*
- *the effect on the nature and cultural environment (including biodiversity, the integrity of designated nature conservation sites of international importance, and historic assets and their settings);*

- *the effect on the built environment(including noise intrusion);*
- *the number and size of turbines proposed;*
- *the cumulative impact of wind generation projects, including 'intervisibility';*
- *the contribution of wind generation projects to the regional renewables target; and*
- *the contribution of wind generation projects to national and international environmental objectives on climate change.*

In establishing criteria for new facilities required for other forms of renewable energy, Local Planning Authorities should give particular consideration to:

- *the proximity of the renewable energy resource;*
- *the relationship with the existing natural and built environment;*
- *the availability of existing surplus industrial land in close proximity to the transport network; and*
- *the benefits of grid and non grid connected 'micro-generation'.*

3.50 Following the Adoption of the revised RSS8 (East Midlands Regional Plan[2]) on 12 March 2009, the Peak District National Park Structure Plan has been replaced by RSS8.The Peak District National Park Structure Plan (adopted 1994) remains material to planning decisions in support of the Peak District National Park Local Plan (Note: this relates to those Structure Plan Policies "saved" beyond 27 September 2007).

3.51 In relation to the Peak Sub-Area the Plan states:

The Sub-area is mainly within or close to the Peak District National Park and large scale renewable generation will always be difficult to accommodate as a result. However there are many opportunities for small scale hydro and some opportunities for small wind generation. The Peak District National Park Authority has produced supplementary guidance to encourage appropriate renewable energy installations. (Para 3.3.91)

[2] http://www.goem.gov.uk/goem/planning/regional-planning/?a=42496

LOCAL PLANNING POLICY WITHIN THE PEAK SUB-REGION

3.52 Policies which seek to promote and control renewable energy generating development within the Peak Sub-Region are outlined below for the three Local Authority areas within the study, the Peak District National Park, High Peak Borough Council and Derbyshire Dales District Council.

Peak District National Park

3.53 Law relating to Planning in National Parks: Environment Act 1995 s61 and s62

3.54 The Peak District National Park Authority has two statutory purposes

- To conserve and enhance the natural beauty, wildlife and cultural heritage of the National Park; and
- To promote opportunities for the understanding and enjoyment of the special qualities by the public and a further statutory duty as a National Park Authority

3.55 In pursuing these purposes, to seek to foster the economic and social well-being of local communities.

3.56 In addition, Section 62 (2) of the Environment Act requires that 'In exercising or performing any functions in relation to, or so as to affect land in a National Park, any relevant authority shall have regard to the purposes specified in ….this Act and, if it appears there is a conflict between these purposes, shall attach greater weight to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the area comprised in the National Park.

3.57 In March 2007 the English National Park Authorities Association produced a Position Statement regarding renewable energy within National Parks. It states:

> English NPAs are strong supporters of energy efficiency and renewable energy projects that respect the special qualities of National Parks. We welcome and promote small scale community schemes, and many NPAs are demonstrating how energy efficiency and the use of renewable energy can be achieved without damaging the special qualities of National Parks through their own patterns of energy use. We aspire to be exemplars in this respect and are committed to being carbon neutral NPAs by 2012. We will, however, also object with equal vigour to those developments that threaten the qualities of the National Parks or the experience of them- whether inside or outside the boundary of the designated area.

3.58 The planning policies of the Peak District National Park must therefore fit within this legal framework, ensuring that policies to encourage renewable energy technologies within the Park area to take account of the statutory purposes and duty of the National Park.

3.59 The current planning policies for the Peak District National Park are contained in the Peak District National Park Development Plan, made up of a Structure Plan (adopted 1994) and a Local Plan (adopted 2001). Policies relevant to renewable energy generation essentially ensure that only small scale schemes appropriate to local need (including those benefiting the wider community) are likely to be compatible with the overall policy (Structure Plan Policy GS1) of conserving and enhancing the valued characteristics of the Peak District.

3.60 The relevant policies are as follows:

> ***Structure Plan – Conservation Policy 17: Energy***
>
> *Major development to generate or store energy will not be permitted other than in exceptional circumstances.*
>
> *Small scale development to generate or store energy to meet a local need will normally be permitted provided that it does not detract from the appearance of the landscape or the building it serves.*
>
> ***Local Plan – Policy LU4: Renewable energy generation***
>
> *Development of renewable energy source will be permitted provided that the development and all ancillary works including transmission lines can be accommodated with harm to the valued characteristics or other established uses of the area;*
>
> *Transmission lines should always be placed underground.*
>
> *Wind farms will not be permitted.*

3.61 In 2003, the Peak District National Park Authority published **Supplementary Guidance for Energy, Renewables and Conservation**, supplementing the above policies by identifying those technologies most likely to be acceptable within the Park. It emphasises in line with policy that they should all be small scale serving only local need and achieved in ways which are sensitive to the special character of the area. It also provides detailed guidance on appropriateness of installations in terms of sizing, siting, degree of permanence and attachment, and in relation to the four main environments within the Peak District National Park, ie. open landscapes, built, farm and industrial environments. The technologies considered to be compatible with policy by virtue of their scale, resource base and appearance comprise:

- Solar photovoltaic
- Solar thermal
- Small scale wind
- Small scale hydro
- Biomass (wood, wastes)
- Ground source heat pumps
- Combined heat and power (CHP)
- Hydrogen fuel cells

3.62 The recent extension of general permitted development rights for most microgeneration technologies (referred to earlier) means that some of the contents of the SPG are now outdated, although the broad principles in respect to statutory designation remain the same. The Peak District National Park Authority has also recently published a Design Guide as an SPG. It contains a section on Sustainable Design (Chapter 6) referring to the SPG for Energy Renewables and Conservation as the source for guidance for renewable energy.

3.63 In summary, the Local Plan polices to date are designed to allow for small scale renewable technologies providing their impact does not conflict with the purposes of the Peak District National Park. The Park Authority is now in the process of consulting on Refined Options for its Core Strategy (Jan 09), part of the Local Development Plan Framework for the PDNPA. It is required to address the requirements of planning for renewable energy outlined in Supplement to PPS1, Planning and Climate Change and other relevant PPSs, as outlined earlier in **paras 3.40 – 3.47** of this report, for which this study will provide background evidence.

3.64 As part of the Consultation process on the Local Development Framework, the Peak District National Park Authority held a series of community workshops and a stakeholder workshop on issues and options for future planning of new development in September 2008, having taken on board consultation comments and views from previous consultations in 2007. The Authority is now in the process of seeking the community's views on refined options for the Core Strategy which will be the Framework's main policy document and which sets out the themes affecting possible development including Climate Change.

3.65 Section Four of this report provides an assessment of the potential for a prescribed range of renewable and low carbon technologies within the Peak District National Park. The outcome of these assessments provides an important evidence base for informing the Core Strategy consultation options and is summarised under the heading of Spatial Implications at the end of Section Four. Section Six assesses the potential for targets for contributions from renewable energy in new developments within the Peak District National Park.

High Peak Borough local development plan area

3.66 The High Peak Saved Local Plan Policies (2007) apply to areas of the High Peak Borough that lie outside of the Peak District National Park. The relevant policy for considering renewable energy development in the area is Policy 76 set out in Chapter 10 (Community Facilities).

Policy 76: CF 10 – Renewable Energy

Planning permission will be granted for renewable energy development, provided that:

- The benefits of the renewable development outweigh any adverse impacts; and
- The proposals demonstrate that any harm to the Environment or local amenity either individually or cumulatively is minimised or can be kept to an acceptable level.

In all cases consideration will be given to the impact of proposals on:

- the environment and local amenity
- the appearance of the landscape
- flora, fauna and other nature conservation interests
- noise, shadow flicker and vibration levels including electromagnetic interference
- air and water quality
- features and areas of natural, cultural, historical and archaeological interest

The reduction of the emissions of greenhouse gases and the wider social and economic benefits of a proposal where the proposal is for a major renewable energy development any adverse environmental impact and effect on the local amenity must be outweighed by the national, regional and local benefits that could result from the development.

Particular care will be taken in assessing proposals for developments in areas with special designations. In the following sites planning permission will only be granted in certain circumstances:

- in European statutory nature conservation sites provided it can be demonstrated that the integrity of the site will not be adversely affected or there are no alternative sites and there are imperative reasons of overriding public interest necessitating the development.
- in sites of special scientific interest, national nature reserves, scheduled ancient monuments, conservation areas, listed buildings and registered parks and gardens where it can be demonstrated the special character of the area will not be compromised by the development and any significant adverse impacts are clearly outweighed by the benefits of the development.

All proposals shall include a satisfactory scheme which will ensure the site is restored to its original condition once the generating operations have ceased where appropriate the proposal will be accompanied by an environmental impact assessment.

Local Development Plan Framework

3.67 The Borough is now in the process of producing its Local Development Plan Framework which will consist of a portfolio of Local Development Documents that set out the spatial planning strategy for the Borough. It is required to address the requirements of planning for renewable energy outlined in Supplement to PPS1, Planning and Climate Change and other relevant PPSs, as outlined earlier in **paras 3.40 – 3.47** of this report, for which this study will provide background evidence.

3.68 The preparation of the Core Strategy commenced with a consultation discussion paper published in November 2007. Having taken on board consultation comments and views, the Borough proposes, jointly with Derbyshire Dales District Council, to publish and issue an options paper for public consultation in March 2009.

3.69 The Borough has sought to gain the community's views on a range of planning issues including where new growth should be located, where regeneration should be focussed and how renewable energy technologies should be facilitated, all of which are relevant to this study. Three questions posed which relate to renewable energy are reproduced below with a summary of responses received.

Question 19: Would you like to see more energy generated in the High Peak coming from renewable sources?

Question 20: Do you think renewable energy should come from large scale energy generation schemes, such as a wind farms or biomass power plants, or small scale renewables incorporated into buildings such as solar panels, or both?

Question 21: Do you think all new development should have some of its energy supplied from renewable sources?

Summary of responses

Question 19: The overwhelming response was 'yes', that more energy generation in the High Peak should come from renewable sources as long as safeguards were used to prevent inappropriate development.

Question 20: The majority response was that there should be a combination of large scale and small scale renewables where appropriate and viable.

Question 21: All responses were 'yes'.

3.70 As part of the development of the Core Strategy, and in response to National, Regional Planning Policy and public responses, the Borough propose a draft policy requiring the following:

- an **energy statement** for major developments (i.e. for 10 dwellings or > 0.5ha) and floor area of > 500m^2 for all other development,
- a requirement for all major developments (thresholds as above) to achieve a **10% reduction in CO_2 emissions** from the use of on site renewable energy technology.

3.71 Section Four of this report provides an assessment of the potential for a prescribed range of renewable and low carbon technologies within the planning area of the Borough. The outcome of these assessments provides an important evidence base for informing the Core Strategy consultation options and is summarised under the heading of Spatial Implications at the end of Section Four. Section Six assesses the potential for targets for contributions from renewable energy in new developments within the Borough.

Derbyshire Dales District local plan area

3.72 The Derbyshire Dales Local Plan (DDLP) sets out the Council's land use planning policies and proposals for the area outside of the Peak District National Park. The Plan was adopted in 2005 and puts in place policies and proposals to guide the development of land for the period up to 2011. The relevant policies for considering renewable energy development in the area are Policy CS5 Renewable Energy Installations, and Policy CS6 Wind Turbine Generator Development set out in Chapter 8 (Infrastructure and Community Facilities). These are set out below:

Policy CS5 - Renewable Energy Installations

Planning permission for renewable energy installations will be granted where:

(a) it can be demonstrated that the benefits of renewable energy production outweigh any adverse impact the proposed development has on the immediate and wider environment and;

(b) the proposal does not create unacceptable problems in terms of the relationship between the proposal and neighbouring uses and;

(c) the proposal is sited so as to minimize the amount of harm to the immediate or wider landscape.

The Council will seek to impose conditions requiring the removal of the renewal energy installation in the event that it is no longer required for renewable energy production and the restoration of the site to its original condition.

Policy CS6 - Wind Turbine Generator Development

Planning permission will only be granted for wind turbine generators and ancillary buildings and equipment where:

(a) it can be demonstrated that the proposed development does not have an unacceptable adverse impact upon the immediate or wider landscape and;

(b) The proposed development would not create unacceptable problems in terms of the relationship between the proposal and neighbouring uses and;

(c) Safe and satisfactory access for construction and maintenance traffic can be provided without permanent damage to the immediate and wider environment.

(d) The Council will seek to impose conditions requiring the removal of the wind turbine generator and ancillary buildings and equipment in the event that it is no longer required for wind energy production and the restoration of the site to its original condition.

Local development plan framework

3.73 The Local Planning Authority is working on a joint Core Strategy with High Peak Borough Council which is expected to be adopted in 2011 and will replace the saved policies in the adopted Derbyshire Dales Local Plan. The Local Development Plan is required to address the requirements of planning for renewable energy outlined in Supplement to PPS1, Planning and Climate Change and other relevant PPSs, as outlined earlier for which this study will provide background evidence.

3.74 A joint Core Strategy Issues and Options paper was published in March 2009. The chapter of particular relevance to this study is Chapter 13 Climate Change. This seeks the public's views on questions of sustainable design and construction, the promotion of energy efficient buildings, and increasing the role of renewable and low carbon energy.

3.75 **Section 4** of this report provides an assessment of the potential for a prescribed range of renewable and low carbon technologies within the Derbyshire Dales District Planning Area. The outcome of these assessments provides an important evidence base for informing the Core Strategy consultation options and is summarised under the heading of Spatial Implications at the end of **Section 4**. **Section 6** assesses the potential for targets for contributions from renewable energy in new developments within the District.

4 RENEWABLE ENERGY CONTRIBUTIONS IN THE STUDY AREA

BIOMASS

Types of biomass

4.1 The main types of biomass fuel used in medium and household technologies are sawn logs, woodchips and pellets. The NEF Logpile website[3] contains a national database of wood fuel suppliers. There are no suppliers within the Peak Sub-Region itself, but there are several within a 50 mile radius of the Peak Sub-Region's key towns, namely Huddersfield, Chesterfield, Oldham, Congleton, Uttoxeter and Alfreton.

4.2 **Woodchips:** In the Peak Sub-Region the main current sources are forest residues (mostly supplied by local forest contractors) and waste from the wood processing industry. The local suppliers of woodchips are based in Chesterfield, Manchester, Congleton and Rossington, South Yorkshire.

4.3 The market for woodchip is growing rapidly but in the Peak Sub-Region the wood fuel supply chain is still at an early stage of development. The potential for expanding this fuel source therefore depends on continuing improvements in the reliability and quality of supply, development of demand and effective marketing. Lack of markets is currently the biggest constraint. 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 wood chippers. These are typically beyond the means of most small woodland owners. All suggest the need for cooperative ventures between woodland owners and potentially between them and local communities, sharing the cost of the capital investment.

4.4 **Pellets:** Pellet production is capital intensive with production of 30-40,000 tonnes a year necessary to be economic under present conditions. Current markets near the Peak Sub-Region are well below this. The nearest pellet suppliers to the area are based in Huddersfield and Rossington, South Yorkshire. National suppliers can also be used, but relatively long transport distances have implications for sustainability, although they are an important step in establishing a local market. In the longer term a more local supply should have a competitive advantage as costs will be reduced.

The raw materials available within and around the Peak Sub-Region

Existing woodland

4.5 The most important biomass resource within the Peak Sub-Region is existing woodlands. **Figure 4.1** shows that woodland cover within the three planning areas is relatively sparse due to clearance for agriculture to the point where virtually all ancient woodland is fragmented, concentrated mainly along river valleys, with many on difficult or inaccessible terrain. There has also been historical replacement of native trees with planted conifers and broadleaves up to the early 1980s, but the extent of such plantations are small. **Table 4.1** shows woodland cover by type and area. The total woodland cover in the Sub-Region is 12888 hectares, 75 percent of which is within the Peak District National Park, 20 percent with Derbyshire Dales District planning area, and 5 percent in the High Peak Borough planning area.

[3] http://www.nef.org.uk

Figure 4.1: Existing Woodland within the Peak Sub-Region

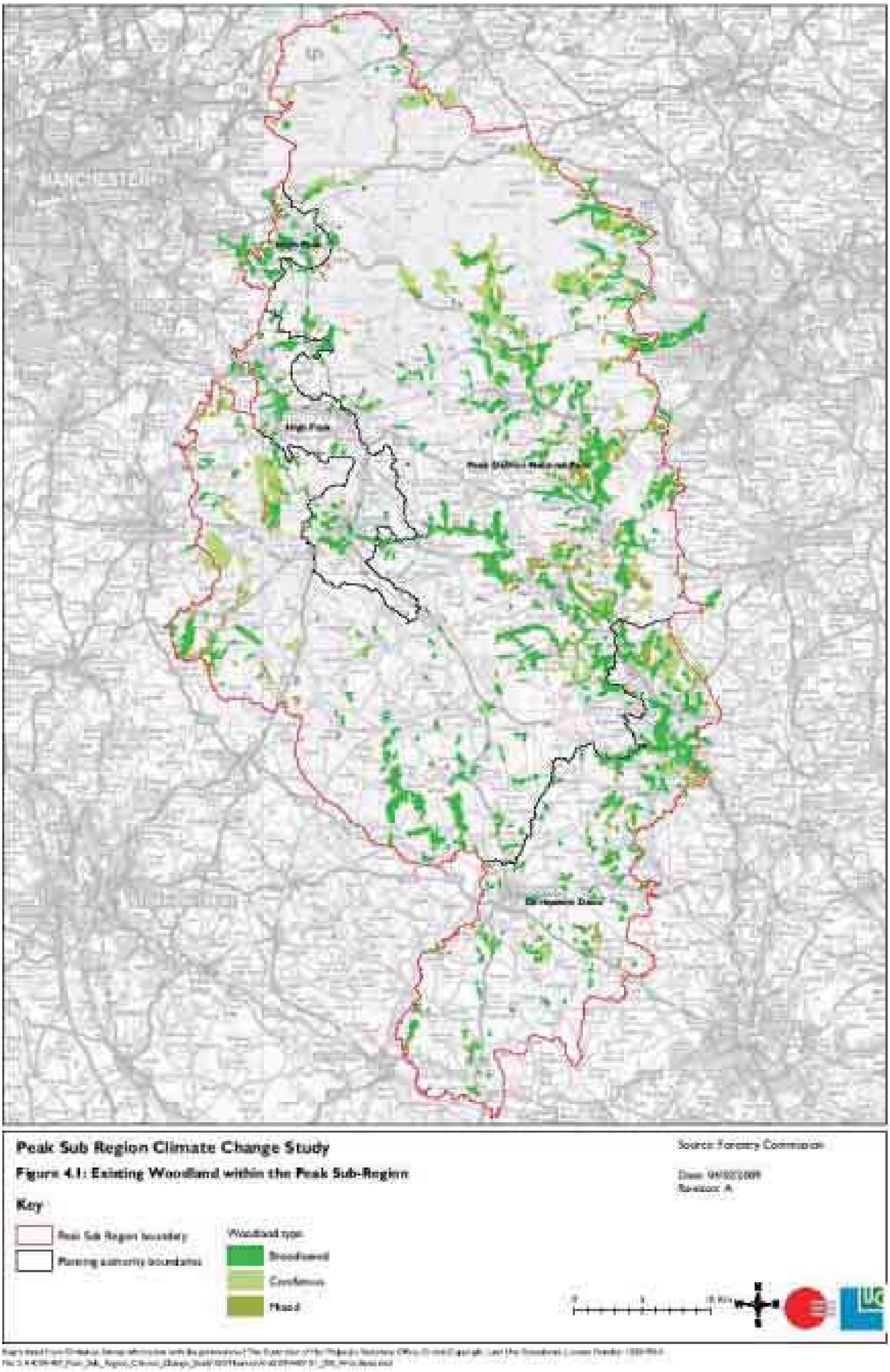


Table 4.1: Woodland Cover in the Peak Sub-Region by Planning Area

Woodland Type	Peak District National Park Area (ha)	High Peak Borough planning area Area (ha)	Derbyshire Dales District planning area Area (ha)	TOTAL
Broadleaved	4405.31	569.78	1394.89	6369.98
Coniferous	3038.95	2.52	583.67	3625.14
Mixed	1578.12	9.79	277.33	1865.24
Shrub / Young trees	241.27	41.28	159.85	442.4
Felled / Ground prepared for planting	189.71	0	15.60	205.31
Ancient Woodland only	325.09	12.46	42.86	380.41
Total	**9778.44**	**635.83**	**2474.20**	**12888.46**

Source: Forestry Commission Woodland Inventory 2002 (all woodland over 2ha)

4.6 In the Peak District National Park, the management of woodland habitats is guided by the Peak District National Park Biodiversity Action Plan. The composition of non coniferous woodlands is outlined in **Table 4.2**.

Table 4.2: Woodland Types in the Peaks District National Park

Habitat type & location	Characteristics	Land area at 2001	Land area by 2015
Upland Ashwood White Peak	LBAP Priority habitat 80% of which is SSSI or other nature designations	900ha	Restored 2400ha New planting 6000ha
Upland oak/birchwoods Dark Peak cloughs and valley sides	LBAP priority habitat 30% of which are SSSI or other nature designations	2050 – 2200ha	2350 – 2500ha
Wet woodlands Dark Peak and SW Peak	LBAP Priority habitat	200-250ha	Restore18ha New planting 30ha (by 2020)
Lowland wood-pasture and Parkland Chatsworth Old Park Lyme Park	LBAP Priority habitat	110ha	

4.7 The main woodland owners within the Peak District National Park are the National Trust, Woodland Trust, the Peak District National Park Authority, Forestry Commission and Severn Trent Water plus other smaller conservation bodies. In recent years government incentives through the Forestry Commission and MAFF/Defra and other funding sources have encouraged woodland owners to better manage woodlands, as well as restore and create woodlands. The Upper Derwent Valley Woodlands Regeneration Project is a key local example where three major landowners used European funding to produce an integrated conservation management plan for the area. The Management Plan was published in 2006 and provides a common management approach, including sustainable woodland practices for the area. In addition, where alternative incomes from woodland products can be made, these are being encouraged as long as the area is accessible and the new business encourages appropriate woodland management, subject to planning constraints.

4.8 A recent study of woodlands within the Peak District National Park, conducted by the Park Authority and members of Sustainable Youlgrave, estimate that local woodlands make up 278 hectares. If all these woodlands were managed sustainably, it is estimated that the amount of waste wood generated could be 1,100 tonnes. In reality only a small proportion of this figure is likely to be realised, although it is recognised that there is potential for more waste wood to produced in the future given the right incentives to woodland owners.

4.9 The current contribution to the local supply of biomass is small and localised, but has a role in displacing conventional fossil fuel systems within the Park and reducing CO_2 emissions.

4.10 The management of woodland habitats in the High Peak Borough planning area is guided by the Peak District Biodiversity Action Plan. In the Derbyshire Dales District planning area, guidance is provided by the Lowland Derbyshire Local Biodiversity Partnership[4] (2001) – Lowland Biodiversity Action Plan [online], and in particular its action plan for wood lands, Woodlands Habitats in Lowland Derbyshire (2006). The woodland types of the two planning areas are upland ashwoods, oak and birchwoods, lowland mixed broad woodland, wet woodland, lowland wood pasture, and parkland including veteran trees.

4.11 Here, as in the Peak District National Park, woodland is now confined to small and isolated blocks typically less than 10 hectares. Mixed broadleaved woodland survives on slopes too steep to farm or on patches of sandy or ill-drained soil. The distribution of parkland woodland is very scattered, and wet woods are in flood plains, but also found near ponds and lakes and within mineral workings. It can therefore be assumed that any contribution to biomass supply from woodland management is likely to be localised.

Waste material from the wood processing industry

4.12 Another source of biomass in the Peak Sub-Region is waste material from the wood processing industry. This includes waste sawdust, shavings, chipwood and wood off-cuts from sawmills, furniture manufacturing, and joinery workshops. There are three saw mills within the Peak Sub-Region, all of which are within the Derbyshire Dales District Council area. One is located at Draycott-in-the-Clay near Ashbourne and the other two located in the Matlock area. There are also a number of other mills around the periphery of the Peak Sub-Region in Chesterfield, Belper, and Sheffield.

Conservation arisings

4.13 The products of conservation management (coppice poles, bracken, reeds, heath etc) have the potential to be used as a biomass source for energy production, either for burning or in anaerobic digestion (Chapter 4). Such materials currently have no commercial use and go to waste. They do have variable calorific value but do not compete with established wood markets and agricultural commodities in their production. The main issue is finding a constant supply, especially as conservation sites tend to be small and fragmented and often on difficult terrain requiring bespoke machinery. Despite these difficulties, utilisation of these resources, especially at the local level, could make a difference especially if community involvement is secured, as labour will be a key input. As an example, PLANED – Pembrokeshire Local Action Network for Enterprise and Development has investigated the potential for landowners and farmers to divert conservation arisings in the Pembrokeshire area. Funding for this type of community project could come from EU LEADER funding or the Peak District National Park's Sustainable Development Fund.

Energy crops

4.14 **Energy crops** do not have the same level of environmental benefit as the management of existing woodlands but are important in developing a sufficient quantity of biomass to support local schemes.

4.15 **Short Rotation Coppice (SRC):** Defra currently uses an online map[5] to identify areas of existing energy crops by region, planted under the 2000 – 2006 Energy Crops Scheme. The relevant maps show that currently there is no SRC grown in the Peak Sub-Region.

4.16 **Miscanthus:** The Defra online map of existing areas of energy crop production identifies one area of miscanthus production in the Derbyshire Dales District planning area, south of Little Cubley within the southern tip of the District.

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[4] The Lowland Derbyshire Local Biodiversity Partnership includes High Peak Borough Council, Derbyshire Dales District Council and the Peak District National Park Authority.

[5] See http://www.defra.gov.uk/farm/crops/industrial/energy/opportunities/index.htm for sources.

Opportunities and constraints for biomass feedstocks

4.17 To identify the scope for biomass within the Peak Sub-Region the study has mapped and assessed a number of opportunities and constraints for each of the three local planning areas, taking particular account of:

- Existing woodland resource and future management
- Government advice on optimum sittings for energy crops
- Landscape sensitivity.

4.18 Below consideration is given to the future opportunities and constraints for the different biomass feedstocks, for each of the planning areas within the Peak Sub-Region. This is followed by consideration of the suitability of different scales of biomass plant. Clearly the two inter-relate.

4.19 In summary, the development of all biomass sources in the Peak Sub-Region is critically dependent on the availability of grant support and advice, and the development of markets and infrastructure. A significant spur was provided by the rising cost of conventional fuels in 2007-08. Without grant support, the majority of larger biomass energy schemes are still not viable. The section on Funding provides a comprehensive list of funding sources for renewables including support for biomass.

PEAK DISTRICT NATIONAL PARK

Within the context of the **Peak District National Park** the biomass sources with the greatest potential will be:

Existing woodland – broadleaved, coniferous and mixed totalling 9021 ha

- **Existing managed woodland and bringing into management woodlands that are currently unmanaged** and the extension of these woods. So long as sufficient dead wood is left to allow natural cycles, this will help meet community energy needs and biodiversity objectives and offers an additional income stream to farmers and landowners. This will be best suited to the production of sawn logs and wood chip. Grants for woodland management are available under the Forestry Commission's 'English Woodlands' grant scheme, with grant based on an approved long term management plan which meets the minimum standards under the UK Woodland Assurance Scheme.

- **Forest residues** from the management of commercial plantations sold as woodchip or pellets.

- **Wood waste** from the wood processing industry although much of this currently goes into the manufacture of chipboard.

- **Conservation arisings** which would provide a commercial use for what is currently waste material, although the scattered nature of these materials would suggest that they will be best suited to local / community biomass schemes rather than sold as a commercial energy source, at least in the foreseeable future.

Energy crops

The Government recognises that the impacts of energy crops can vary at a local level. In 2005, Defra set up a working group that comprised representatives from English Nature, Countryside Agency, Rural Development Service (now Natural England), Forestry Commission, English Heritage, Environment Agency, Government Offices and the Rural Development Agencies to develop and produce a set of regional maps identifying opportunities and optimum sitings for energy crops (short rotation coppice (SRC) and miscanthus). This work was referred to in the Government's Response to the Biomass Task Force and completed at the end of 2006.

These maps are to be used as a tool to provide guidance to those seeking to develop energy crops. They show the best areas for growing the crops plus the areas where this is not appropriate or care would need to be taken from an environmental point of view. Joint Character Areas (JCA's) provide information about the impact of energy crops within that JCA. A brief description of the areas (and their conclusions) that relate to the Peak District National Park are outlined below:

JCA No. 51 - Dark Peak
Physical constraints mean that the Dark Peak is largely unsuitable for growing energy crops. Small areas of energy crops on shallow slopes or in sheltered valleys may present opportunities, provided the effects of scale and pattern are carefully considered.

JCA No. 52 - White Peak
Physical constraints mean that the White Peak is largely unsuitable for growing energy crops. Small areas of energy crops on shallow slopes or in sheltered valleys may present opportunities provided the effects of scale and pattern are carefully considered.

JCA No. 50 - Derbyshire Peak Fringe and Lower Derwent
The Peak Fringe is an undulating, well wooded pastoral landscape. Energy crop planting on the lower arable land in the south of the area could be more easily accommodated than on the higher land with its characteristic stone walling.

Landscape sensitivity assessment

For **Miscanthus planting,** which would introduce an intensively farmed, monoculture crop into the landscape, potential is limited. The Sub-Region is characteristically a pastoral landscape, with few areas of intensive arable cultivation which might indicate suitability for this type of energy crop. Within the Peak District National Park (**Figure 4.2**) only one small area within the 'Enclosed Gritstone Upland' (5) type falls below 'high' in the sensitivity assessment – where there are some small areas of arable cultivation but this is unlikely to be suitable within local farming systems.

Short Rotation Coppice (SRC) has greater potential within the Sub-Region where it can be linked to existing woodlands and forestry plantations. Nevertheless, given the overall sensitivity of the landscape within the Peak District National Park these areas would be better planted as actively managed native woodland but with the clear intention of using it for biomass production for community use. **Figure 4.3** highlights that many parts of the landscape are well-wooded, indicating 'moderate' or 'moderate-high' sensitivity to SRC but with clear potential for woodland / SRC planting if landscape and biodiversity guidelines are followed. Indeed the Peak District National Park Biodiversity Action Plan points to the need to bring areas of existing native upland ash, oak and birch woods back under management, and new woodland planting (including through PAWS restoration) could provide stimulus to this objective. The well-treed and sheltered 'Riverside Meadows' landscape type (8) shows the most potential in landscape terms for SRC within the Peak District National Park, although the damp soils and potential of flooding mean that the area may not be suitable for any type of woodland planting that requires mechanical harvesting.

BIOMASS CONTRIBUTION

The Peak District National Park area can play an increasing, but limited role, in improving biomass resource from existing and expanded woodlands in terms of production of logs and other useful forest residues. Landowners and farmers could also seek to divert conservation arisings which would provide a commercial use for what is currently waste material in the area.

The potential output from forestry residues, small round wood, thinnings etc that could be derived from the total area of woodland within the National Park (9021 ha), could be about 26,160 tonnes per annum, potentially generating[6] about 92.9 GWhr of energy per year. This assumes sustainable management of the whole of the woodland stock. In reality, only a small proportion of this figure is likely to be realised, although it is recognised that there is potential for more waste wood to produced in the future given the right incentives to woodland owners. **The study has assessed a conservative figure of 5% of the total woodland area being sustainably managed up to 2026, generating 1,308 tonnes of waste wood, and generating a figure of 4.64 GWh of energy per year. This could result in carbon savings of 1,137 tonnes by 2026.**

In terms of energy crops, the landscape of the Peak District National Park is considered to be very sensitive and predominantly unsuitable for energy crops. **The study has therefore assessed that there will be no contribution from energy crops within the National Park.**

[6] Biomass Energy Centre – Potential output of biofuels per hectare per annum (2009)

Figure 4.2: Landscape Sensitivity to Miscanthus Planting

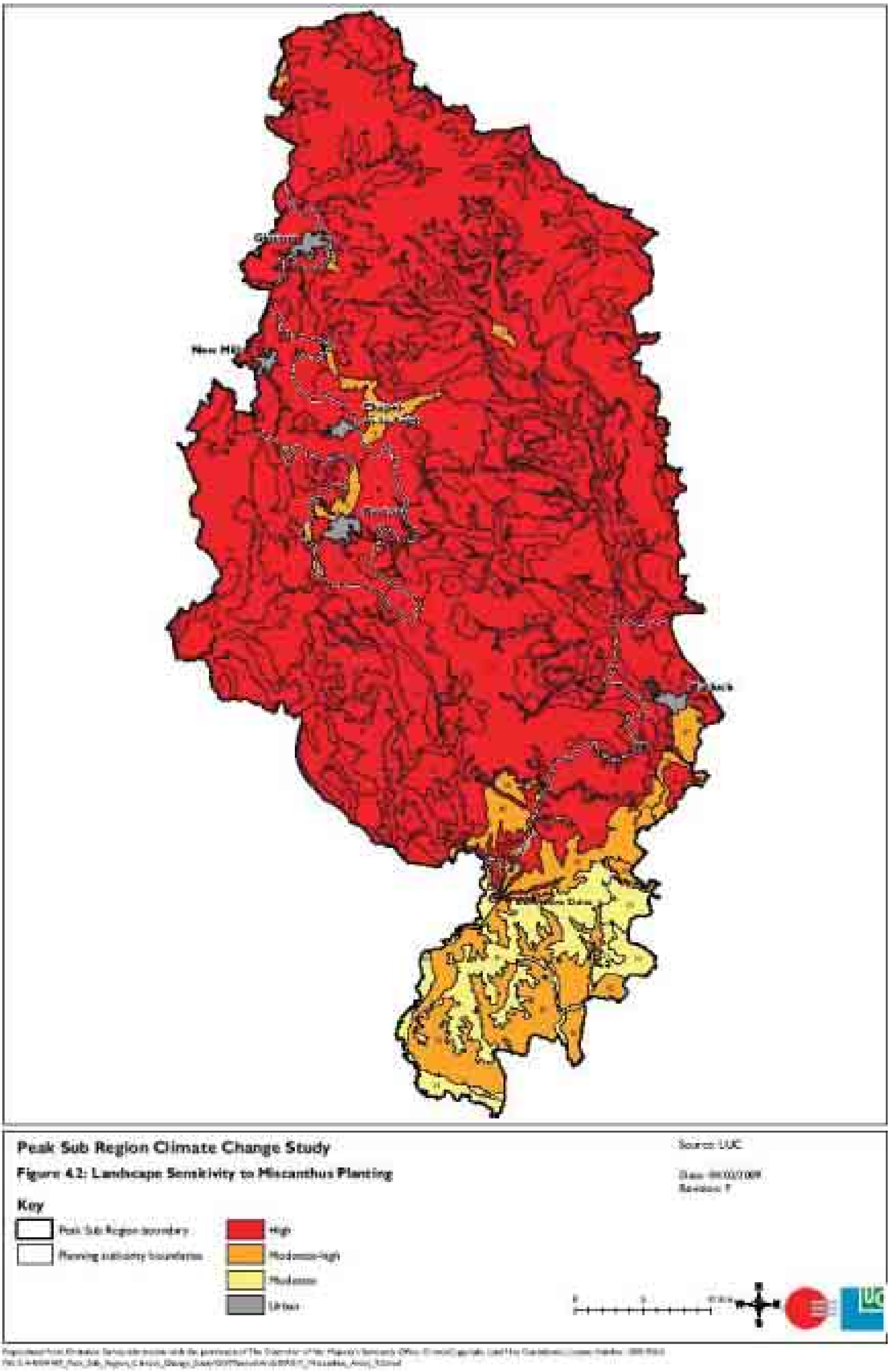
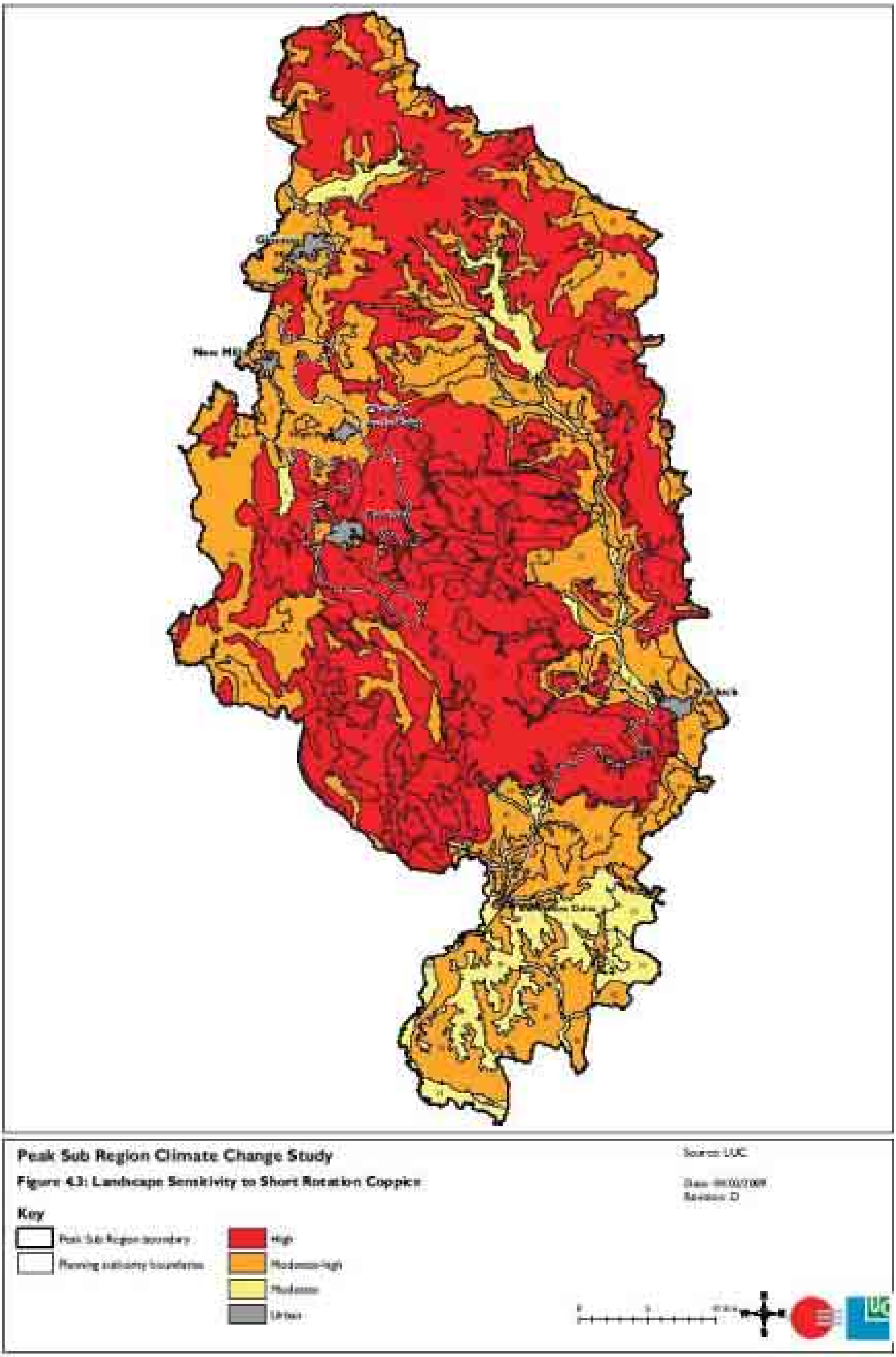


Figure 4.3: Landscape Sensitivity to Short Rotation Coppice



HIGH PEAK BOROUGH PLANNING AREA

In the High Peak Borough planning area the biomass sources with the greatest potential are also the same as the Peak District National Park. The only difference relates to energy crops. This is outlined below.

The Government's 'opportunities and optimum sitings for energy crops' (short rotation coppice (SRC) and Miscanthus) covers the High Peak planning area in the following Joint Character Area (JCA):

JCA No. 54 - Manchester Pennine Fringe
This area, transitional between urban valley bottoms and Pennine uplands is generally unsuitable for biomass crops, but there could be limited opportunities in lower urban fringe areas for SRC to be planted without an adverse effect on landscape character.

Landscape sensitivity

Miscanthus - The landscape sensitivity assessment results for SRC and Miscanthus concur with the Government's Opportunities and Optimum sitings conclusions above. The intensively farmed, monoculture crop of Miscanthus has no planting potential in the area due to the landscape's predominantly high sensitivity to the crop (**Figure 4.2**)

Short Rotation Coppice (SRC) (**Figure 4.3**) has very limited planting potential in the wooded valley bottom area south of New Mills. Elsewhere the area around Buxton is predominantly of high landscape sensitivity to SRC, and moderate to high in the remainder of the Borough.

BIOMASS CONTRIBUTION

The High Peak Borough planning area can play an increasing, but limited role, in improving biomass resource from existing and expanded woodlands in terms of production of logs and other useful forest residues. Landowners and farmers could also seek to divert conservation arisings which would provide a commercial use for what is currently waste material in the area.

The potential output from forestry residues, small round wood, thinnings etc that could be derived from the total area of woodland within the Borough planning area (580ha), could be about 1682 tonnes per annum, potentially generating[7] about 5.9 GWhr of energy per year. This assumes sustainable management of the whole of the woodland stock. In reality, only a small proportion of this figure is likely to be realised, although it is recognised that there is potential for more waste wood to produced in the future given the right incentives to woodland owners. **The study has assessed a conservative figure of 5% of the total woodland area being sustainably managed up to 2026, generating 84 tonnes of waste wood, and generating a figure of 0.29 GWh of energy per year. This could result in carbon savings of 71 tonnes by 2026.**

In terms of energy crops, the landscape of the High Peak planning area is considered to be very sensitive and predominantly unsuitable for energy crops. **The study has therefore assessed that there will be no contribution from energy crops within the High Peak planning area.**

[7] Biomass Energy Centre – Potential output of biofuels per hectare per annum (2009)

DERBYSHIRE DALES PLANNING AREA

In the Derbyshire Dales District planning area the biomass sources with the greatest potential are also the same as the Peak District National Park. The only difference relates to energy crops. This is outlined below.

The Government's 'opportunities and optimum sitings for energy crops' (short rotation coppice (SRC) and miscanthus) covers the Derbyshire Dales District planning area in relation to the following Joint Character Areas (JCA):

JCA No. 50 - Derbyshire Peak Fringe and Lower Derwent
The Peak Fringe is an undulating, well wooded pastoral landscape. Energy crop planting on the lower arable land in the south of the area could be more easily accommodated than on the higher land with its characteristic stone walling.

JCA No. 68 - Needwood & South Derbyshire Claylands
An area of gently undulating landscape with extensive areas of large arable fields. Plantings of SRC and Miscanthus could be beneficial in these areas, where they could provide diversity to the landscape structure.

Landscape Sensitivity Assessment

Miscanthus – Landscape sensitivity to Miscanthus planting is highest in the north of the District's planning area with large swathes in the south considered moderate to high sensitivity, and moderate sensitivity (**Figure 4.2**). The Peak Sub-Region's only Miscanthus plantation is located south of the village of Little Cubley within an area of moderate landscape sensitivity.

Short Rotation Coppice (SRC) – Five of the landscape types within the Derbyshire Dales District planning area are assessed as having 'moderate' sensitivity to the development of SRC, based on the presence of existing woodlands. Elsewhere, the landscape has a moderate to high sensitivity, with a zone of high sensitivity around the fringe of the Peak District National Park from the Brassington area in the west to the edge of Matlock to the east. (**Figure 4.3**).

BIOMASS CONTRIBUTION

The Derbyshire Dales District planning area can play an increasing, but limited role, in improving biomass resource from existing and expanded woodlands in terms of production of logs and other useful forest residues. Landowners and farmers could also seek to divert conservation arisings which would provide a commercial use for what is currently waste material in the area.

The potential output from forestry residues, small round wood, thinnings etc that could be derived from the total area of woodland within the District planning area (2254ha), could be about 6536 tonnes per annum, potentially generating[8] about 23.2 GWh of energy per year. This assumes sustainable management of the whole of the woodland stock. In reality, only a small proportion of this figure is likely to be realised, although it is recognised that there is potential for more waste wood to produced in the future given the right incentives to woodland owners. **The study has assessed a conservative figure of 5% of the total woodland area being sustainably managed up to 2026, generating 326 tonnes of waste wood, and generating a figure of 1.16 GWh of energy per year. This could result in a carbon saving of 284 tonnes by 2026.**

In terms of energy crops, the landscape of the south of the district is considered to provide opportunities for both SRC and miscanthus planting which could contribute in the future to an increase in local biomass production and supply. The study has estimated from the GIS mapping the following

[8] Biomass Energy Centre – Potential output of biofuels per hectare per annum (2009)

potential tonnage and energy output from energy crops in the Derbyshire Dales District planning area:

Table 4.3: Energy Crops – Potential Contribution

Type	Annual production potential (tonnes)	Equivalent GWh/y	5% of potential production GWh/y
Short Rotation Coppice	80,000	335	16.75
Miscanthus	95,000	400	20
Total		735	36.75

In reality, the change from traditional farming to energy crop farming is likely to be slow to take place, and not all of the area identified as having potential will be converted to energy crop production**. The study has assessed a conservative estimate of 5% of the potential production actually being viable in the Sub-Region. This could generate a total of approximately 37 GWh/y of energy up to 2026, a carbon saving of 9065 tonnes.**

Opportunities and constraints for biomass plants

4.20 In terms of biomass plants themselves, the opportunities and constraints are as follows.

Large-scale biomass plants

4.21 Overall, a large scale biomass plant generating heat and electricity is unlikely to be feasible or appropriate within the three planning areas within the Peak Sub-Region.

4.22 A plant of this scale would either need to be developed on land designated for industrial development, or as part of a significant farm complex, avoiding visually prominent locations, well connected by road, and not adversely affecting settlement structure. A plant of this scale would have to be considered on its merits and could only be justified within the Peak Sub-Region if it resulted in drawing on local wood resources, yet the production of biomass in the Peak Sub-Region and its hinterland is currently small scale and diverse in terms of feedstock types. Future production of wood and energy crops locally is much better suited to supplying local needs and is unlikely to achieve the scale required to provide sufficient feedstock for a large-scale plant.

Medium-scale biomass plants

4.23 There is considerable scope to expand the use of medium-scale biomass heating systems within the Peak Sub-Region across all sectors, including commercial premises, tourism facilities/accommodation complexes; community facilities (schools, leisure centres, public buildings) when existing heating systems are in need of replacement. The boilers and their associated storage facilities are small in scale and can easily be accommodated into the traditional settlement structure within the Peak Sub-Region. The number of existing biomass systems in operation within the Peak Sub-Region is highlighted geographically by type in **Table 4.4.**

Table 4.4: Existing/proposed biomass plant in the Peak Sub-Region

Planning Area	Area	Existing/Proposed	Size (kW)
Peak District National Park	Castleton	Installed	75
“	Castleton (Losehill)	Installed	50
“	Pikehall (Old Barn)	Installed	50
“	Robin Hood	Installed	75
“	Ilam	Proposed	Unknown
Derbyshire Dales	Middleton	Installed	75
“	Bonsall	Proposed	50
	Sudbury Hall	Installed	2 x 150 (300)

4.24 Community biomass schemes that use local wood fuel bring significant reductions in CO_2 emissions (**Table 4.5)** which shows the CO_2 saved by replacing gas or oil fired heating with a biomass boiler). It will also provide a much needed stimulus to the existing local wood and energy crop supply chain and, in turn, will help diversify and strengthen the local land-based economy. Nevertheless, for all these benefits to be realised, such schemes must use local wood-based feedstocks rather than wood fuels transported long distances from within the UK or imported from abroad.

4.25 Typical building types and boiler sizes are as follows:

- Small Community Centre (500m²) Boiler size 30kW
- Small Hotel (1000m²) Boiler size 60kW
- Caravan site community centre (100m²) Boiler size 15kW
- Primary School (4000m²) Boiler size 200kW
- Swimming Pool Centre (1600m²) Boiler size 300kW
- Small office/commercial premises (1000m²) Boiler size 50kW

Table 4.5: Carbon savings achieved through the use of biomass boilers

Building Type	Typical floor area (m²)	Fossil fuel typical practice Energy consumption figures (kWh/m²/yr)	Typical yearly consumption (kWh/yr)	CO_2 conversion factor (kg/CO_2/kWh)	CO_2 Emission (kg/yr)
Small Community Centre	500	250	125,000	0.194 (gas)	24,250
				0.265 (oil)	33,125
				0.234 (LPG)	29,250
				0.025 (biomass)	**3,125**
Small Hotel	1000	360	360,000	0.194 (gas)	69,840
				0.265 (oil)	95,400
				0.234 (LPG)	84,240
				0.025 (biomass)	**9,000**
Caravan site Community Centre	100	250	25,000	0.194 (gas)	4,850
				0.265 (oil)	6,625
				0.234 (LPG)	5,850
				0.025 (biomass)	**625**
Primary School	4000	164	656,000	0.194 (gas)	127,264
				0.265 (oil)	173,840
				0.234 (LPG)	153,504
				0.025 (biomass)	**16,400**
Swimming Pool Centre	1600	1336	2,137,600	0.194 (gas)	414,694
				0.265 (oil)	566,464
				0.234 (LPG)	500,198
				0.025 (biomass)	**53,400**
Small Office/Commercial Premises	1000	151	151,000	0.194 (gas)	29,294
				0.265 (oil)	40,015
				0.234 (LPG)	35,334
				0.025 (biomass)	**3,775**

Household-scale biomass boilers

4.26 Household biomass boilers potentially offer considerable benefits for reduced CO_2 outputs, the environment and local economy. The issue therefore is the degree to which they are likely to be adopted.

4.27 Although domestic biomass heating systems (boilers) are a well established technology, uptake to date across the UK has been minimal primarily because of the market domination of gas condensing boilers, but also due to issues such as long payback periods, fuel availability, fuel storage, and reduced flexibility, compared to gas or oil systems. The estimated number of installations across England, Wales and Scotland by 2007 was between 500 and 600. This is a very small number compared with other renewable heating systems, such as solar hot water with 90,000 installations.

4.28 Notwithstanding this, the potential for renewable systems in locations where the gas network is not yet available will be greater. Within the Peak Sub-Region there are many rural households that are not connected to the mains gas network, the majority of which will be using stored propane gas or oil for heating. For these, the rising cost of these fossil fuels may make biomass heating systems an attractive option. Other renewables such as solar hot water and heat pumps will also be realistic and competitive alternatives.

Conclusions

4.29 There is considerable scope to expand the use of medium-scale biomass heating systems within the Peak Sub-Region across all sectors, including commercial premises, tourism facilities/accommodation complexes; community facilities (schools, leisure centres, public buildings) when existing heating systems are in need of replacement and particularly where there is no gas grid connection. Similarly, household biomass boilers potentially offer considerable benefits for reduced CO_2 outputs, the environment and local economy.

4.30 There are a number of issues that could restrict the rate at which this happens such as long payback periods, fuel availability, fuel storage, and reduced flexibility, compared to gas or oil systems. Notwithstanding this, the increasing price of fossil fuels, improvements in systems and storage facilities, and market adjustment to demand will help to offset these issues over time.

Recommendations

As part of a sustained commitment to tackling climate change, the three planning authorities and their local partners and stakeholders should continue to assist wherever possible in promoting the expansion of the local biomass resource within their areas, and to promote the use of biomass systems for heating/power generation locally. This will help in the longer term to overcome some of the obstacles outlined above, as will advances in heating technologies by improving flexibility of use compared to gas or oil systems.

ANAEROBIC DIGESTION

4.31 AD is a method of waste treatment that produces gas with high methane content from organic materials such as agricultural, household and industrial residues and sewage sludge (feed stocks). The methane can be used to produce heat, electricity, or a combination of the two, and can be used locally or injected into the grid for heat and power and for transport fuel. Other benefits include the diversion of organic waste, especially food waste, from landfill; the reduction of methane emissions from agriculture, and the production of a digestate which provides organic fertiliser and soil conditioner for agriculture and land use.

4.32 The process can be carried out in a small scale system, for example located on a farm and operated by farmers, or serve businesses (or clusters of businesses) with large food waste arisings. Alternatively it can be carried out in large centralised systems, for example to treat municipal food waste being diverted from landfill by local authorities or manures and slurries from several farms.

4.33 The benefits of AD as a renewable heat and energy source are now widely recognised and Government is working to facilitate a much greater uptake of anaerobic digestion by local authorities, businesses and farming. Its recent document, 'Anaerobic Digestion – Shared Goals'[9], outlines a number of shared goals that businesses, regulators, Government and other stakeholders aim to achieve to facilitate cost-effective, innovative and beneficial use of anaerobic digestion in England by 2020. For example, the National Farmers Union vision for AD sets an aspiration of 1,000 farm-based AD plants by 2020, alongside 1000 larger waste-linked AD facilities in which farmers may also have an interest.

4.34 There is clear government intention for a significant increase in the number of AD plants of all sizes and types across the UK in future years. Regulators, such as local planning authorities are expected to ensure that the regulatory framework encourages a growth in the use of AD in a way that is both cost effective and beneficial to the environment. PPS 22 (Technical Annex[10]) highlights the following areas where the development of an AD plant will generate planning issues:

- *Site selection, transport and traffic*
- *Feedstocks and product storage*
- *Odour*
- *Emissions to ground and water courses and to air.*

Proposals for AD plants must ensure that the above issues comply with regional and local planning policies on waste and renewable energy and any development proposal may also need to demonstrate compliance in more detail through the production of an Environmental Impact Assessment.

Opportunities and constraints for AD within the Peak Sub-Region

4.35 To identify the scope for anaerobic digestion within the Peak Sub-Region the study has mapped and assessed a number of opportunities and constraints taking particular account of:

- Feedstock availability
- Key environmental designations
- Landscape sensitivity to AD plants
- Regional Waste Management guidance
- Regional Waste Policy as set out in Policy 38 of the RSS Derbyshire Municipal Waste Strategy.

A general overview of these opportunities and constraints as listed is provided for the Peak Sub-Region as a whole, and discussed in detail for each of the three local planning authority areas.

[9] Anaerobic Digestion – Shared Goals (DEFRA) February 2009
[10] Planning for Renewable Energy – A Companion Guide to PPS22

Feedstock availability within the Peak Sub-Region

4.36 The following feedstocks have the potential to be used in anaerobic digestion:

- **Household / commercial waste residues:** This includes biodegradable domestic waste, food and catering waste that might alternatively go to landfill or food processing waste collected by local communities or from tourism providers.

  The Peak Sub-Region lies within the Western Sub-Area as defined in the Derbyshire Waste Management Strategy. Despite being the largest in terms of land area, the western sub-area gives rise to less than 20% of municipal waste in the county. Much of the area lies within the Peak District National Park and is, therefore, subject to particular conservation constraints. Additionally, due to the isolated nature of many towns and villages in High Peak and the Derbyshire Dales, both the collection and transportation of waste and recyclables proves costly and problematic. Currently, municipal waste and recyclables are transported to sites outside the area because of the shortfall in local disposal and recycling facilities.

  Green waste is suitable for composting or for use in thermal waste management processes including AD. In the Western Sub-Area, green waste is collected from Household Waste Recycling Centres and from the kerbside. Collection of kitchen waste is expected to commence in the near future since this will make more material available for composting and increase the amount of diversion from landfill.

- **Farm wastes:** this includes slurry and bedding from the indoor housing of animals which reaches its peak supply in winter. The continuing availability of waste slurry is dependent on the future of farming in the area. Price volatility and the threat of animal diseases, e.g. bluetongue and bovine tuberculosis, undermine the confidence of livestock farmers. Nevertheless, increasing concerns about national food security suggest a strengthening in the price of agricultural commodities in the short to mid-term. This may be accompanied by greater co-operation between farmers to capture more end value in the market place. It is also likely to be accompanied by continuing farm amalgamations, which may be beneficial for more centralised slurry production.

- **Agricultural crops:** The types of crops specifically grown by farmers for the purpose of supplementing AD plants during the summer months include whole-crop silage (maize), grass leys, and sugar beet. In many European countries grass (or maize) is grown specifically for anaerobic digesters under central government subsidy. In the Peak Sub-Region this is unlikely to be an option as grass is more valuable as animal feed than grown for energy generation. There would therefore need to be a considerable rise in the value of energy crops for this change to occur.

- **Alternative plant materials**: Other sources of vegetation waste that are used as a feedstock for AD include:

  - Hedge arisings and weeds which have the potential to be used as top-up feedstock.
  - Algal blooms and blanket weed from bodies of water (although these would not be generally encouraged to form).
  - Harvested heathers and bracken from heathland, as an alternative to burning in-situ to rejuvenate the heathland, although mechanised cutting is likely to be difficult given the often steep and rocky terrain.
  - Wild rushes and reeds from the annual removal of dead growth.

  Given a suitably located AD plant, most of these conservation arisings would be better suited to anaerobic digestion than use in biomass, as no pre-processing (or drying) is required for AD feedstock. Most AD units rely on a range of feedstock taking advantage of differential availability during the year. There is no data currently available to quantify the extent of this resource within the Peak Sub-Region.

- **Sewage sludge:** Most UK water companies are now investigating the opportunities for AD at their sewage treatment works. Severn Trent Water and United Utilities are the companies responsible for sewage services for the Peak Sub-Region. Long term intentions are to maximise opportunities for power generation from sewage sludge as stated in both company's Strategic Direction Statements (outlined below). However, there is no specific data currently provided by either company to quantify the extent of this resource within the Peak Sub-Region at this time.

"We have a strong position compared with the rest of the water sector on power generation from sludge treatment processes. We intend to retain this leadership position. There are some clear opportunities to increase power generation at sewage works from sewage sludge treatment. There are also potential opportunities from energy crops, wind turbines, electricity generation from burning dried sewage sludge, and additional hydroelectric power. We will actively explore all of these options".

Severn Trent Strategic Direction Statement 2010 – 2035 'Focus on Water', Dec 07
Reducing Severn Trent's Carbon Footprint

"To deliver our targets of reducing carbon emissions by 26 per cent by 2012, we are expanding our renewable energy generation and exploring how we can make greater use of sewage gas as a heat, energy and fuel source".

United Utilities Energy & Climate Change Statement. 2009

Key environmental designations

4.37 As outlined earlier in the report, the Peak Sub-Region contains many international and national environmental designations, the majority of which could be adversely affected by the siting of an AD plant, its feedstocks and product storage and its potential emissions to ground and water courses. The extent of these designations is shown in Figure 3.2

Landscape sensitivity to AD plants

4.38 The accompanying Landscape Sensitivity Assessment provides generic guidance for the siting of this type of plant within the Peak Sub-Region. This is reproduced below as follows:

- There may be opportunities for accommodating small scale anaerobic digester plants dealing with farm manure or slurry on or adjacent to existing farm buildings or for small scale anaerobic digester plants on some appropriate operational waste sites.
- Larger digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites.
- Avoid locating installations in prominent locations such as on exposed skylines.
- Ensure existing landmarks (for example church towers and spires) remain prominent and that installations do not detract from existing landmarks.
- Ensure installations are not prominent in key views, particularly from the open moorland landscapes.
- Ensure installations do not affect the historical value of industrial features and remains, or the ecological value of semi-natural habitats.
- Ensure installations do not adversely affect the character and appearance of any Conservation Areas.
- Suitable materials should be used to facilitate the integration of structures with their surroundings, for example, the cladding of buildings and finish colour.

Waste Management Guidance for AD facilities

4.39 Regional guidance on the suitability of waste management facilities within the Sub-Region, such as AD, is provided by the Regional Waste Strategy (2006) and the Regional Plan (2009) (paragraphs 3.37 – 3.39 of this report). In summary the guidance states that the quality of the environment and the smaller settlement size across the Sub-area make it inappropriate and unsustainable for the Sub-area to make a significant contribution to the provision of waste management infrastructure in the regional context and Regional Policy exempts the National Park from waste targets and the need to manage the waste rising in the National Park.

4.40 It does however state that in the Peak Sub-area particularly related to the larger settlements outside the National Park, small scale facilities serving the Sub-areas needs to be accommodated, where these would not have a significant adverse effect on the environment and local communities or conflict with the National Park statutory purposes. This should be considered through the policies in the Derbyshire Waste Development Framework, the Peak District National Park Local Development Framework and through the development control process. The policy context for policy 38 points out that opportunities may arise, especially related to the larger settlements outside the National Park to accommodate small-scale facilities serving the Sub-area's needs. Where these would not have a significant adverse effect on the environment and local communities, a positive planning approach should be adopted.

4.41 Derbyshire County Council's Waste Strategy, 'Looking after Derbyshire's Waste' July 2006 identified two best practicable environmental options (BPEOs) for the future disposal of Derbyshire's municipal waste (this does not include commercial or agricultural waste). It proposes to process the residual waste (i.e. that which remains once all recyclable waste has been removed) either by energy recovery or by anaerobic digestion, or a combination of the two. This will require a number of sites to be located throughout the County with the exception of the Peak District National Park. The requirement is for the following number and sizes of facilities: two large, three medium, and six small. The location of these facilities is to be identified through the preparation of the Derbyshire Waste Core Strategy which is under preparation, so it remains unclear at the moment whether any sites will be located in the High Peak and the Derbyshire Dales planning areas.

PEAK DISTRICT NATIONAL PARK

POTENTIAL FOR ANAEROBIC DIGESTION

Existing AD plant

A small bio digester has recently been granted planning permission in Ilam.

Feedstock Availability

Household/Commercial waste residues - The majority of the Peak District National Park lies within the Western Sub-Area as defined in the Derbyshire Waste Management Strategy. There is no data within the strategy document specific to the Peak District National Park in terms of the amount of green waste arising from municipal waste. The most detailed data available relates to the High Peak Borough and Derbyshire Dales District areas only. There is also no information on commercial waste residues, ie. agricultural and food production waste for the National Park area.

Farm Wastes

The Peak District National Park is a livestock producing area with a large number of small dairy farms.

Table 4.6 below highlights the estimated numbers of livestock for the Peak District National Park[11].

Table 4.6: Estimated Livestock nos. for the Peak District National Park (2007)

	Approximate head	Potentially collectable waste (tonnes/year)
Cattle and Calves	94,500	1,130,000
Goats	318	<1,000
Sheep	403,000	71,000
Pigs	21,500	28,000
Poultry	270,000	11,250

Agricultural Crops - Less than 1% of the Peak District National Park agricultural land is used to grow crops, and most of this is used for wheat or winter barley, so currently the production of AD

[11] Peak resources. Gemini report[11]; Defra June Agricultural Survey 2007

crops is likely to be negligible.

***Alternative Plant Materials* -** As outlined earlier in this section there is no data currently available to quantify the extent of this resource within the Peak District National Park.

Sewage sludge – As outlined earlier in this section there is no data currently available to quantify the extent of this resource within the Peak District National Park.

Key environmental designations

Figure 3.2 highlights the large number and area of both ecological and heritage sites within the Peak District National Park which would be very sensitive to the siting of AD plants and associated feed stock and product storage facilities. These are therefore key constraints to the siting of such facilities within the Park area.

Landscape sensitivity

The Landscape Sensitivity Study concludes that throughout the Peak Sub-Region and within the Peak District National Park, there may be opportunities for accommodating small scale anaerobic digester plants dealing with farm manure or slurry on or adjacent to existing farm buildings. The remaining generic guidance outlined earlier in paragraph 4.38 would also need to be applied to prevent adverse impacts upon the sensitive nature of the landscape.

Currently, the Derbyshire Waste Strategy, 'Looking after Derbyshire's Waste' July 2006 states that that any processing of residual waste either by energy recovery or by anaerobic digestion, or a combination of the two will not be located within the Peak District National Park.

Contribution from anaerobic digestion

There are waste arisings within the Peak District National Park which could be used in the future as an energy resource for the development of AD. However, due to the current limited information regarding the quantity of various feed stocks for AD within the Peak District National Park it is not possible to make a meaningful assessment of the likely contribution the AD could make towards the Regional target.

To assist in the Government's shared goals for AD, the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

There are also three key constraints which restrict the scope for AD plants within the National Park. These are key environmental designations, landscape sensitivity and the waste policy of the East Midlands Regional Plan which has regard to the statutory designation of the National Park. The Regional Plan nevertheless requires a positive planning approach to be adopted by the Peak District National Park Authority and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

In conclusion the study has assumed that any contribution from AD in the Peak District National Park is likely to be negligible at this stage unless further detailed investigation in the future reveals otherwise.

HIGH PEAK BOROUGH PLANNING AREA

POTENTIAL FOR ANAEROBIC DIGESTION

Existing AD plant

There are no known AD plants within the High Peak Planning Area.

Feedstock Availability

Household/Commercial waste residues - The High Peak Planning Area lies within the Western Sub-Area as defined in the Derbyshire Waste Management Strategy. There is no breakdown of municipal green waste data within the strategy document specific to the High Peak Borough outside of the Peak District National Park. The data relates to the whole of the Borough area only. There is also no information available on commercial waste residues, i.e. agricultural and food production waste for the High Peak Planning Area.

Farm Wastes

The High Peak Planning Area is a livestock producing area with a number of small dairy farms. There is no data available regarding the approximate head of livestock in the area. According to DEFRA, the local nature of the data would risk exposing details and locations of individual farms which Census data is unauthorised to provide. It is not possible therefore to estimate any potential collectable waste from farms in the High Peak Planning Area.

Agricultural Crops – Similarly for agricultural crops, Census data is suppressed at the local level to prevent disclosure of information about individual farm holdings.

***Alternative Plant Materials* -** As outlined earlier in this section there is no data currently available to quantify the extent of this resource within the High Peak Planning Area.

Sewage sludge – As outlined earlier in this section there is no data currently available to quantify the extent of this resource for the High Peak Planning Area.

Key environmental designations

Figure 3.2 shows that the number of ecological and heritage sites within the High Peak Planning Area is small which would indicate fewer constraints for the location of AD facilities.

Landscape sensitivity

The Landscape Sensitivity Study concludes that throughout the Peak Sub-Region and the High Peak Planning Area, there may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites. The remaining generic guidance outlined earlier in paragraph 4.38 would also need to be applied to prevent adverse impacts upon the sensitive nature of the landscape.

Larger digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. Again, the same provisos required to prevent adverse impacts to the landscape of the High Peak Planning Area would need to be applied. In addition, the Regional Plan 2009 states (in relation to waste management facilities generally), that where opportunities may arise, these are more likely to relate to the larger settlements outside the Peak District National Park, such as the larger settlements within the High Peak Planning Area. Furthermore, the Derbyshire Waste Strategy, 'Looking after Derbyshire's Waste' July 2006 states that that any processing of residual waste either by energy recovery or by anaerobic digestion, or a combination of the two will require a number of sites to be located throughout the County. The requirement is for the following number and sizes of facilities, two large, three medium and six small. The location of these facilities is to be identified through the preparation of the Derbyshire Waste Core Strategy which is under preparation, so it remains unclear at the moment whether any sites will be identified within the High Peak Planning Area.

Contribution from anaerobic digestion

There are waste arisings within the High Peak Planning Area which could be used in the future as an energy resource for the development of AD. However, due to the current limited information regarding the quantity of various feed stocks for AD within the area it is not possible to make a meaningful assessment of the likely contribution the AD could make towards the Regional target.

To assist in the Government's shared goals for AD, the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

There is also the key constraint of landscape sensitivity which restricts the scope for AD plants within the High Peak Planning Area. The Regional Plan nevertheless requires a positive planning approach to be adopted by the planning authorities within the Peak Sub-Region and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

In conclusion the study has assumed that any contribution from AD in the High Peak Planning Area is likely to be negligible at this stage unless further detailed investigation in the future reveals otherwise.

DERBYSHIRE DALES PLANNING AREA

POTENTIAL FOR ANAEROBIC DIGESTION

Existing AD plant

There are no known AD plants within the Derbyshire Dales District Planning Area.

Feedstock Availability

Household/Commercial waste residues - The Derbyshire Dales District Planning Area lies within the Western Sub-Area as defined in the Derbyshire Waste Management Strategy. There is no breakdown of municipal green waste data within the strategy document specific to the Derbyshire Dales District outside of the Peak District National Park. The data relates to the whole of the District area only. There is also no information available on commercial waste residues, i.e. agricultural and food production waste for the Derbyshire Dales Planning Area.

Farm Wastes

The Derbyshire Dales Planning Area is a livestock producing area with a number of small dairy farms. There is no data available regarding the approximate head of livestock in the area. According to DEFRA, the local nature of the data would risk exposing details and locations of individual farms which Census data is unauthorised to provide. It is not possible therefore to estimate any potential collectable waste from farms in the Derbyshire Dales Planning Area.

Agricultural Crops – Similarly for agricultural crops, Census data is suppressed at the local level to prevent disclosure of information about individual farm holdings.

Alternative Plant Materials **-** As outlined earlier in this section there is no data currently available to quantify the extent of this resource within the Derbyshire Dales Planning Area.

Sewage sludge – As outlined earlier in this section there is no data currently available to quantify the extent of this resource for the Derbyshire Dales Planning Area.

Key environmental designations

Figure 3.2 shows that the number of ecological and heritage sites within the Derbyshire Dales Planning Area is small which would indicate fewer constraints for the location of AD facilities, with the exception of the Derwent Valley World Heritage Site in the east of the area.

Landscape sensitivity

The Landscape Sensitivity Study concludes that throughout the Peak Sub-Region and the Derbyshire Dales Planning Area, there may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites. The remaining generic guidance outlined earlier in paragraph 4.38 would also need to be applied to prevent adverse impacts upon the sensitive nature of the landscape.

Larger digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. Again, the same provisos required to prevent adverse impacts to the landscape of the Derbyshire Dales Planning Area would need to be applied. In addition, the Regional Plan 2009 states (in relation to waste management facilities generally), that where opportunities may arise, these are more likely to relate to the larger settlements outside the Peak District National Park, such as the larger settlements within the Derbyshire Dales Planning Area. Furthermore, the Derbyshire Waste Strategy, 'Looking after Derbyshire's Waste' July 2006 states that that any processing of residual waste either by energy recovery or by anaerobic digestion, or a combination of the two will require a number of sites to be located throughout the County. The requirement is for the following number and sizes of facilities, two large, three medium and six small. The location of these facilities is to be identified through the preparation of the Derbyshire Waste Core Strategy which is under preparation, so it remains unclear at the moment whether any sites will be identified within the Derbyshire Dales Planning Area.

Contribution from anaerobic digestion

There are waste arisings within the Derbyshire Dales Planning Area which could be used in the future as an energy resource for the development of AD. However, due to the current limited information regarding the quantity of various feed stocks for AD within the area it is not possible to make a meaningful assessment of the likely contribution the AD could make towards the Regional target.

To assist in the Government's shared goals for AD, the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

There is also the key constraint of landscape sensitivity which restricts the scope for AD plants within the Derbyshire Dales Planning Area. The Regional Plan nevertheless requires a positive planning approach to be adopted by the planning authorities within the Peak Sub-Region and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a planning policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

In conclusion the study has assumed that any contribution from AD in the Derbyshire Dales Planning Area is likely to be negligible at this stage unless further detailed investigation in the future reveals otherwise.

SMALL AND MICRO SCALE HYDRO

Opportunities and constraints within the Peak Sub-Region

4.42 To identify the scope for small and micro hydro energy sources within the Peak Sub-Region the study has mapped and assessed a number of opportunities and constraints for each of the three local planning areas, taking particular account of:

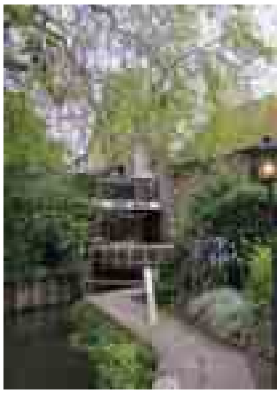
- local surveys and assessments;
- water resource;
- topography;
- key environmental designations;
- the ease of connection to the Grid;
- landscape sensitivity.

4.43 A general overview of these opportunities and constraints as listed is provided for the Peak Sub-Region as a whole, and then discussed in detail for each of the three local planning authority areas.

Local surveys and assessments

4.44 The use of water power is long established within the Peak Sub-Region, with many traditional water mills used during the industrial revolution, and large scale reservoirs built in the 20th century, providing drinking water for growing towns and cities in the area, some of which have incorporated small hydro plants built in more recent years.

4.45 The legacy of old mills remains, either disused, or converted to other uses, but some have recently been restored to fully functioning, modern technology small/micro hydro schemes. The Friends of the Peak District, funded by the Peak District National Park Sustainable Development Fund have undertaken an assessment of existing and potential hydro sites within the Peak Sub-Region and beyond, using a range of volunteer expert knowledge and skills. In addition, both Sever Trent Water and United Utilities, the water companies for the Peak Sub-Region, are in the process of investigating future potential for hydro, looking at impounding reservoirs; flows in water distribution networks; sewage treatment outfalls to rivers, and run of river (reservoir inlets).



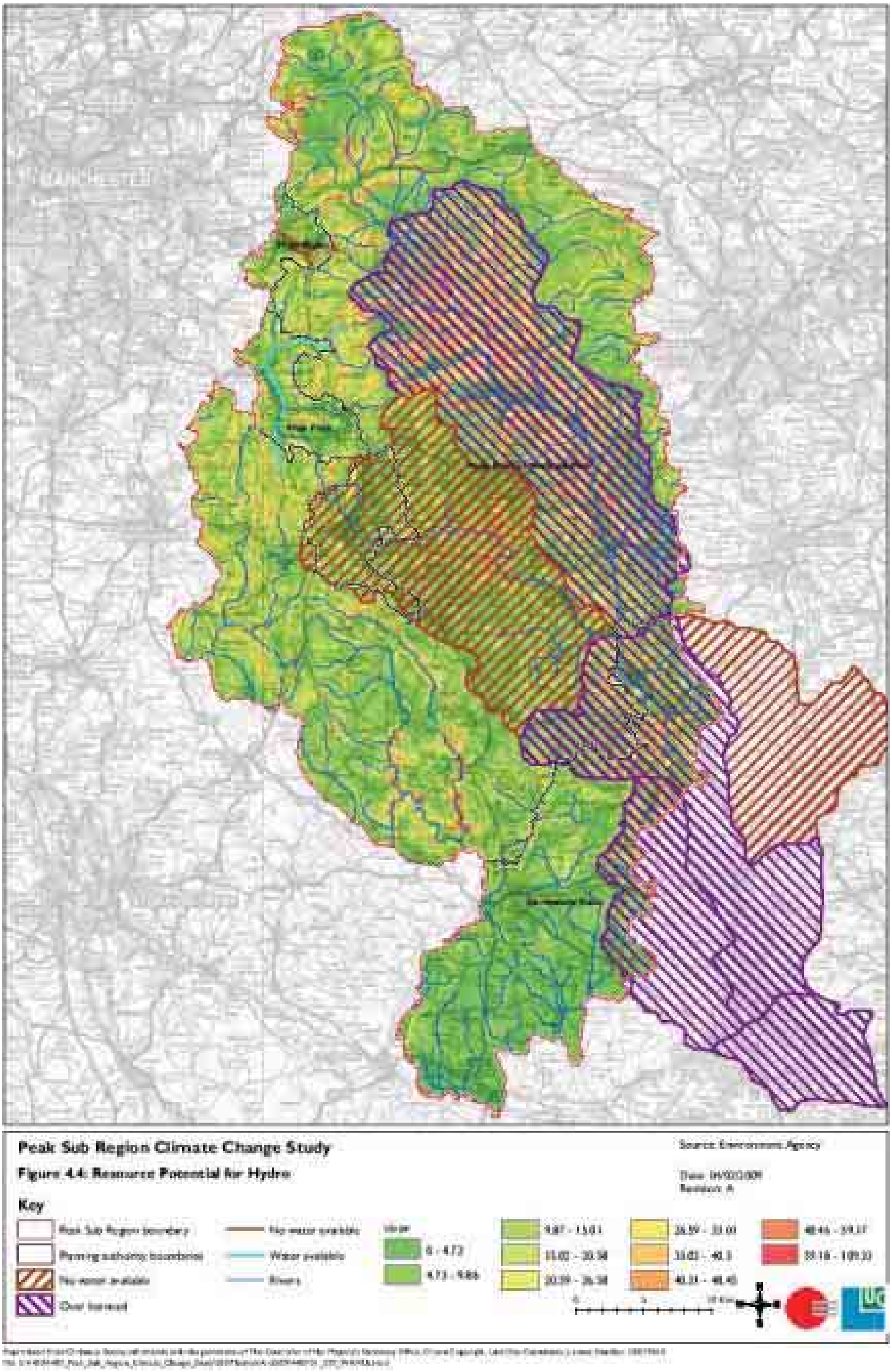
4.46 This study has also drawn on information on potential hydropower sites in the East Midlands[12] where a number of potential sites were identified within the Peak District National Park and the Derbyshire Dales Planning Area. There were none identified in the High Peak Planning area. All of the sites within the Peak District National Park have subsequently been reviewed by the more recent assessment work undertaken by the Friends of the Peak District referred to above.

Water resource

4.47 The availability of water (i.e. sufficient flow) is a key factor in locating a viable hydro site. The Environment Agency measures the flow in most significant rivers and streams in the UK. Some of this data is available online, or where there is more detailed local data this can be purchased from the Agency. The most accurate and reliable flow measurement method however, is to install a temporary measuring weir.

[12] Viewpoints on Sustainable Energy in the East Midlands: A study of Current Energy Projects and Future Prospects – Final Report and Appendices – LUC & IT Power, March 2001.

Figure 4.4: Resource Potential for Hydro



4.48 All hydro schemes are required to apply for an abstraction licence from the Environment Agency. The Agency is unlikely to grant a licence if the flow of the water course is altered and affects directly, or indirectly important ecological habitats, or if the area of abstraction is in an area with limited water availability identified by the Agency as being 'Over Abstracted', having 'No Water Available', or 'Over licensed', see **Figure 4.4.**

River catchments within the Peak Sub-Region

4.49 The surface waters of the Peak Sub-Region fall within four Environment Agency Catchment Area Management plan areas (CAMS):

- **Derwent CAM**
  The Derbyshire Derwent catchment covers an area of approximately 1200km^2. The river rises on Howden Moor in the Peak District National Park, following a southerly course to its confluence with the River Trent south east of Derby. The upper, moorland reaches of the River Derwent are impounded forming Howden, Derwent and Ladybower public water supply reservoirs, with a combined capacity of 46,982 Mega litres (Ml). Major tributaries of the River Derwent include the rivers Noe, Wye, Amber and Ecclesbourne and the Markeaton Brook.

  CAMS area is of high conservation value with several sites across the catchment nominated by Natural England for protection under the European Habitats and Birds Directives. There are also many Sites of Special Scientific Interest, water-dependent sites including the alkaline fens of the Wye Valley which support many plants which are scarce in the UK.

- **Etherow and Goyt CAM**
  The River Etherow drains the Pennines to the east of Stalybridge flowing west through Hollingworth, and joins the River Goyt north of Marple. The upper reaches of the Etherow are dominated by the Longdendale reservoirs, five consecutive reservoirs stretching for approximately 7 km, providing public water supplies. The major tributary to the Etherow is Glossop Brook, which drains the Pennines to the east of Glossop, meeting the Etherow south of Hadfield. Other significant tributaries include Hollingworth Brook and Arnfield Brook, which drain the area north of Hollingworth, and Chisworth Brook, which originates south west of Glossop.

  The River Goyt rises on Whetstone Ridge, to the south west of Buxton at an altitude of 520m. The river flows to the north through Errwood and Fernilee reservoirs, before flowing through the towns of Whaley Bridge, Furness Vale, New Mills and Marple, and heading west towards its confluence with the River Tame. The Goyt has three main tributaries; Black Brook, which drains the Chapel-en-le Frith area, the River Sett, which drains the Hayfield area, and the River Etherow. The total area of the Etherow/Goyt catchment is 365 km^2. The Peak Forest Canal begins in Whaley Bridge and follows the River Goyt for much of its length before joining the Macclesfield Canal in the lower catchment.

4.50 In the east of the CAMS area there are significant areas of open countryside, which provide valuable wildlife habitats and recreation opportunities.

- **Don CAM**

The River Don flows east from its headwaters in the Pennines and is joined by the River Rother at Rotherham and then joins the River Ouse near Goole. There are a number of reservoirs in the upper reaches of the Don; many are used for public water supply, while others release water to maintain flows downstream.

- **Dove CAM**

The Dove catchment drains an area of approximately 1,020km^2 of north Staffordshire and west Derbyshire and includes the Rivers Dove, Churnet, Tean, Manifold and Hamps. There are a number of urban areas in the catchment including Leek, Cheadle, Ashbourne, and Uttoxeter. The River Dove rises on Axe Edge, 5km south of Buxton and meets the Trent at Newton Solney, approximately 3km north of Burton-upon-Trent. The Churnet joins the Dove at Rocester before the lower reaches of the Dove flow through the wide floodplain to its confluence with the Trent. The catchment has two main reservoirs at the headwaters of the River Churnet. Rudyard Reservoir was constructed to support the Caldon Canal whereas Tittesworth Reservoir is used for public water supply. Carsington is another major reservoir within the catchment, at the head of Henmore Brook.

4.51 The Dove CAMS area is of high conservation value with several sites across the catchment nominated by Natural England for protection under the European Habitats and Birds Directives. There are also many Sites of Special Scientific Interest, water-dependent sites including Dove Valley, Biggin Dale, Longdale and Froghall Meadow and Pastures, which is comprised of a range of grasslands and flushed scrub located in the Churnet Valley.

Topography

4.52 As indicated earlier, hydro sites can be divided into low, medium and high head, depending where the height drop is greater. High and medium head hydro sites require steeper slopes to obtain sufficient drop in the water course. The undulating topography within many parts of the Peak Sub-Region and its large network of watercourses provide suitable opportunities for high to medium head sites.

4.53 **Figure 4.4** highlights areas of steep slope (shaded orange to red) in relation to water courses within the Peak Sub-Region.

Key environmental designations

4.54 As outlined earlier in the report, the Peak Sub-Region contains many international and national environmental designations the majority of which are sensitive to changes in the level of the water table as well levels in rivers, streams and small tributaries. The extent of these designations is shown in Figure 3.2**.**

Ease of connection to the grid

4.55 The key constraint to connection to the grid is cost, particularly when a project is small in scale and likely to be some distance from the existing grid network. **Figure 3.5** shows the low voltage network for the Peak District National Park, but not for the High Peak and Derbyshire Dales planning areas where only the higher voltage network is available from the Distribution Network Operators without incurring additional cost to the study. As these areas have many settlements, by implication the low voltage network will have been developed to serve them and will form an extensive network. Most of these low kilovolt lines can accommodate additional loads to the grid network from small/micro scale renewable schemes, but an assessment is required by the network operator before any connection works can be undertaken. The exact location of proposals will ultimately determine suitability and viability.

Landscape sensitivity

4.56 The accompanying Landscape Sensitivity Study provides detailed generic guidance for the siting of this type of technology within the Peak Sub-Region (paragraph 4.38 of Landscape Report). In summary, emphasis should be on using existing structures/locations and local materials; screening with vegetation characteristic of the area, and avoiding adverse impact upon ecological, historic and landscape features.

PEAK DISTRICT NATIONAL PARK

POTENTIAL FOR SMALL/MICRO HYDRO

Local surveys and assessments
Local data from a project run by Friends of the Peak District with support from the Peak District National Park's Sustainable Development Fund identifies eight existing hydro power schemes within the Peak District National Park. These are outlined in the following **Table 4.7**.

Table 4.7: Operating Hydro Power Schemes

LOCATION	RIVER	GRID REF	PLANT	INSTALLED CAPACITY (kW)	GWh/y
Chatsworth House	Emperor Stream/Derwent	SK 260 701	Turbine	100	0.28
Ladybower Reservoir	Derwent	SK 200 854	Turbine	200	0.57
Bottoms Reservoir, Longdendale	Etherow	SK 023 972	Turbine	130	0.37
Rhodeswood Reservoir, Longdendale	Etherow	SK 043 981	Turbine	240	1.47
Torside Reservoir, Longdendale	Etherow	SK 055 983	Turbine	240	1.47
Errwood Reservoir	Goyt	SK 016 759	Turbine	150	0.91
Caudwell's Mill, Rowsley	Wye	SK 255 657	Turbine	15	0.04
Hartington Mill	Dove	SK 120 598	W/wheel	2.5	0.007
Total				1077.5	5.1

Table 4.8: Hydro Sites Under Construction

LOCATION	RIVER	GRID REF	PLANT	INSTALLED CAPACITY (kW)	GWh/y
Bar Brook, Nr Baslow	Derwent	SK 263730	Turbine	88	0.46
Alport Mill, Alport	Derwent	SK 222 646	W/wheel	30	0.15
Total				118	0.61

Source: Friends of the Peak District - 2009

The following section outlines potential sites for new micro hydro within the Peak District National Park as assessed by the Friends of the Peak District. This covers potential non mill schemes as well as old mill sites that could be restored and brought back into use.

Table 4.9: Potential Non-Mill Micro-Hydropower Schemes (Non Water Company)

Location	River	Grid Ref	Ref	Potential Output (kW)	GWh/y
Ilam Church, Ilam	Dove	SK 132 505	Derwent Hydro	10 - 20kW	0.05 – 0.10

Source: Friends of the Peak District 2009

Table 4.10: Potential Old Mill Sites

Mill Name/ Location	River	Grid ref	Potential Output (kW)	GWh/y
Comb Mill, Ashford in the Water	Derwent	SK 190 694	50	0.26
Flewitt's Mill, Ashford in the Water	Derwent	SK 198 695	95	0.49
Lumford Mill, Bakewell	Derwent	SK 213 691	44	0.23
Bamford Mill, Bamford	Derwent	SK 205 833	50	0.26
Blackwell Mill, Wye Dale, Blackwell	Derwent	SK 113 727	20	0.10
Brough Mill, Brough	Derwent	SK 184 826	11	0.05
Calver Mill, Calver	Derwent	SK 247 745	125	0.65
Edensor Mill, Chatsworth	Derwent	SK 260 686	88	0.46
Cressbrook Mill, Cressbrook	Derwent	SK 173 727	94	0.49
Padley Mill, Grindleford	Derwent	SK 251 789	10 - 20	0.05 – 0.10
Lead Mill, Hathersage	Derwent	SK 233 807	17	0.08
Litton Mill, Millers Dale	Derwent	SK 161 729	120	0.63
Caudwell's Mill, Rowsley	Derwent	SK 255 657	15 - 50	0.07 – 0.26
Stoney Middleton Mill	Derwent	SK 230 754	4	0.02
Diggle Mill, nr Saddleworth	Tame	SE 004 078	80	0.42
Gradbach Mill, Gradbach	Dane		15	0.07
Whitelee Mill, Whitelee Farm			20 - 30	0.10 – 0.15
Edale	Grinds Brook		10	0.05
Low Bradfield,	Agden Reservoir		10 - 15	0.05 – 0.07
Total			878 - 938	4.5 – 4.8

Source: Friends of the Peak District - 2009

Severn Trent Water is currently investigating further potential for micro hydro in relation to the three reservoirs in the Upper Derwent Valley, namely Ladybower, Derwent and Howden and will, if not already, be approaching the Peak District National Park Authority with relevant proposals. The potential output is likely to be in the same range as the Ladybower Hydro scheme, ie 200kW producing approximately 0.57 Gwh/y of electrical energy per year. In addition to the local assessment work this study has looked at the following opportunities and constraints to assess the scope for additional hydro schemes within the Peak District National Park.

Water resource

The surface waters of the Peak District National Park fall within four Environment Agency Catchment Area Management plan areas (CAMS). The majority of the Park is covered by the Derwent CAM; the north west flank of the Park by the Tame, Goyt and Etherow CAM; the north east flank by the Don CAM, and the South West Peak area covered by the Dove CAM.

Figure 4.4 shows the water availability status for the Peak District National Park for the Derwent CAM and the Tame, Goyt & Etherow CAM. In the Derwent CAMS area, water availability varies from being ‘over licensed’ to ‘no water available’. The Tame, Goyt & Etherow water resource availability has not been assessed for most of the CAM area, so cannot be illustrated. However, it should be noted that a significant part of the catchment area within the Peak District National Park covers the environmentally sensitive South Pennine Moor Special Area of Conservation and Dark Peak SSSI, where water levels will be carefully monitored by the Agency with abstraction tightly controlled.

The Don CAM is currently out of date and under review, but interim guidance states that there is water availability throughout the catchment. In the Dove CAM which covers the South West Peak the status of water availability throughout the CAM is reported as being 'over abstracted at low flows'.
The indication is that success in obtaining water abstraction licences for new small/micro hydro schemes within the Peak District National Park will be variable according to the specific location of the proposed site and the level of constraint upon the water supply in the area.

Topography

Figure 4.4 also shows water courses in relation to steepness of slope, the orange to red shading denoting greater severity of slope. There are many potential opportunities for high and medium head water sites due to the undulating character of the landscape within the Peak District National Park.

Key environmental designations
Figure 3.2 highlights the large number and areas of both ecological and heritage sites within the Peak District National Park which would be very sensitive to adverse effects from hydro works and infrastructure. These are therefore key constraints to the location of hydro technology within the Park area.

Ease of connection to the grid
The extent of the low voltage grid connection network within the Park is directly related to the location of settlements and significant developments (see **Figure 3.5)**. In the exposed rural areas of the Park structure the network is very sparse, so connection to the grid from a small/micro hydro scheme is likely to be prohibitively expensive. The scope would still exist however for micro hydro off grid systems, particularly useful as an alternative energy source for off grid rural farms and small holdings.

Landscape sensitivity
Generic guidance on the conditions for siting this type of technology within the Park is provided in the accompanying Landscape Sensitivity Study.

HYDRO CONTRIBUTION

The key opportunities for expanding the use of small/micro hydro schemes within the Park are in relation to the restoration of old mill sites and weirs, and in areas of the Park where there is suitable flow or head of water within watercourses. **This study has assessed that potential energy from hydro schemes in the National Park to 2026 could generate between 5.1 and 6.0 GWh of electrical energy per year.**

There are also a number of key constraints however which severely limit the viability of schemes within the Park. These are in relation to water availability, impact on important environmental designations, grid availability, and the need to avoid adverse impact upon the sensitive landscape. This is not to say that there isn't scope within the Park for small/scale hydro as clearly there are, but as future schemes come forward they will need to be carefully considered in terms of conformity with Peak District National Park policy and other legislative requirements.

There is also scope to bring together key stakeholders, including Friends of the Peak District, the Environment Agency and Sub-Regional partners to look for ways to collaboratively facilitate the further development of small/micro hydro within the Peak District National Park.

HIGH PEAK BOROUGH PLANNING AREA

POTENTIAL FOR SMALL/MICRO HYDRO

Local surveys and assessments

There is one operational hydro power scheme within the planning area of the Borough. This is the micro hydro Torrs Hydro plant in New Mills on the River Goyt with a maximum power output of 70kW and an annual electrical output of 0.25 GWh per year. This is shown on **Figure 3.3**.

An assessment by the Friends of the Peak District has also been carried out on the potential for restoration of old mill sites within the area on the fringe of the Peak District National Park, but due to a variety of constraints **none of the old mill sites are considered to have potential for reuse as working hydro schemes**. The sites considered by the Friends of the Peak District are outlined in **Table 4.11** below.

Table 4.11: High Peak Planning Area – Old Mill Sites

Name	Town	Grid Ref	River
Paper Mill	Crowden	SK 079 990	Etherow
Lumbhole Mill	Kettleshulme	SJ 988 804	Goyt
Little Mill Inn	Rowarth	SK 011 890	Goyt

Source: Friends of the Peak District 2009

A feasibility study was also conducted for a hydro power generation at the old Torr Vale Mill; New Mills in 2000 (separate from the Torrs Hydro plant mentioned above). This concluded the potential for 70kW output turbine, with the potential to generate 0.35 GWh/y. The site has not yet been developed, but the potential still exists for future small scale hydro power generation.

No other potential sites were identified from the assessment carried out in 2001 for the East Midlands Region by LUC & IT Power.

In addition to the local assessment work this study has looked at the following opportunities and constraints to assess the scope for additional hydro schemes within the Borough planning area.

Water resource
The surface waters of the High Peak planning area fall within two Environment Agency Catchment Area Management plan areas (CAMS). The majority of the area is covered by the Tame, Goyt and Etherow CAM, with the southern area covered by the Derwent CAM.

Figure 4.4 shows the water availability status for the Borough's planning area to be 'no water available' in the Derwent CAMS area, and the Glossop Brook catchment, with 'water available' in the River Goyt & Etherow catchments.

The indication is that success in obtaining water abstraction licences for new small/micro hydro schemes within High Peak planning area will be variable according to the specific location of the proposed site and the level of constraint upon the water supply in the area.

Topography

Figure 4.4 also shows water courses in relation to steepness of slope, the orange to red shading denoting greater severity of slope. There are very few potential opportunities for high and medium head water sites as the landscape character of the plan area is predominantly, although not entirely, settled valley pasture. The larger reservoirs within the plan area namely Combs, Arnfield, Birch Vale Lodge and Toddbrook may provide future potential but this would need to be investigated in detail in a separate study. The main type of hydro scheme would therefore need to be low head, i.e. artificial low head schemes such as existing weirs and sluices. There are many of these features within the plan area and they may offer the potential for small-scale local energy generation, but would need to be investigated in further detail in a separate study.

This study has assessed that there is the potential for two reservoir schemes potentially generating 0.9 GWh/y each; and five small scale weir sites potentially generating 0.26 GWh/y each, and the Torr Vale Mill site potentially generating 0.35 GWh/y. Collectively, this could potentially generate 3.45 GWh/y.

Key environmental designations
Figure 3.2 shows that the number of ecological and heritage sites within the area compared to its overall size is very small. This would indicate fewer constraints for the location of hydro technology within the area.

Ease of connection to the grid
The low voltage network in the area will be extensive bearing in mind the number of settlements being served. There is also a high voltage national distribution 132kV overhead line connecting a substation at Buxton to a substation at New Mills and a 33kV overhead line connecting Buxton to Hindlow (south) and to Eyam (east). The network will be able to accommodate additional loads to the grid network from small/micro scale renewable schemes, but an assessment is required by the network operator before any connection works can be undertaken. The exact location of proposals and close proximity of suitable grid infrastructure will ultimately determine suitability and viability of future small and micro hydro schemes.

Landscape sensitivity
Generic guidance on the conditions for siting this type of technology within the High Peak planning area is provided in the accompanying Landscape Sensitivity Study.

HYDRO CONTRIBUTION

There are a number of opportunities for the further development of small/micro hydro schemes within the High Peak Borough planning area principally related to the restoration of old mill sites and the use of reservoirs, weirs and sluices.. A more detailed investigation would be required to determine technical and economic feasibility of these potential sites, so it has not been possible to assess at this stage the detailed energy potential from these sources. However, **the study has made an estimate of potential future contribution from small/micro hydro to be 3.45 GWh/y for the High Peak Borough planning area to 2026.**

DERBYSHIRE DALES PLANNING AREA

POTENTIAL FOR SMALL/MICRO HYDRO

Local surveys and assessments
Local data provided by the Friends of the Peak District identifies one existing hydro power scheme within the planning area of the District at Masson Mills on the River Derwent in Matlock Bath. This has a maximum power output of 249kW, and an annual equivalent electrical generating output of 0.85 GWh per year. It is shown on **Figure 3.3**

An assessment by the Friends of the Peak District has also been carried out on the potential for restoration of old mill sites for hydro on sites just over the boundary of the National Park within the Derbyshire Dales District planning area. Two mill sites have been identified, one of which is Bonsall Mill on the River Derwent in Bonsall. This is viewed by Friends of the Peak District as being a 'possible site' for hydro, however, no assumptions have been made for potential power output as this stage.

The other site is at Cromford Corn Mill in Cromford on the River Derwent. This is assessed as a 'good site' with good flow. The Arkwright Society who owns the site has undertaken a feasibility study which suggests that a turbine in the proposed location could accommodate a 70KW capacity turbine, with an annual electrical output of 0.36GWh. The Society was awarded £25K from the Peak District National Park Sustainable Development Fund in December 2008 to develop the scheme on the basis of its immediate benefits to the Park.

An assessment of potential hydro power sites in the East Midlands was carried out in 2001[13] . Seven sites were investigated within the Derbyshire Dales District area but only one was considered to be viable. This is the Oak Hurst Mills site on the River Derwent. A detailed feasibility study was conducted by Derwent Hydro in 2004. It suggested the potential for a 200kW turbine, producing a potential electrical output of 1.38GWh per annum. The scheme has not been progressed further to date, but is clearly a potential site for future hydro generation. The remaining six sites which were assessed but considered not to be economically viable in 2001 are outlined in **Table 4.12** below.

Table 4.12: Hydro Power Sites (Not Economical)

Mill Name/ Location	River	Grid ref	Potential Output GWh/y
Hanging Bridge	Dove	SK159458	0.47
Mayfield Mill weir	Dove	SK159459	0.30
Church Mayfield 1	Dove	SK159449	0.40
Church Mayfield 2	Dove	SK153443	0.22
Snelston	Dove	SK140437	0.23
Norbury Weir	Dove	SK124424	0.49
Total			**2.11**

A local group, Friends of Longford village have recently begun to address the feasibility of hydro power on the Sutton and Longford Brook which flows through Longford village. As yet there is no information available.

Water resource
The surface waters of the Derbyshire Dales planning area fall within two Environment Agency Catchment Area Management plan areas (CAMS). The majority of the area is covered by the Dove CAM, with the eastern and part southern fringes of the area covered by the Derwent CAM.

[13] Viewpoints on sustainable energy in the East Midlands – Land Use Consultants and IT Power - 2001

Figure 4.4 shows the water availability status for the District's planning area to be 'over licensed' in the Derwent CAMS area, and 'over abstracted at low flows' in the River Dove CAMS area.

The indication is that success in obtaining water abstraction licences for new small/micro hydro schemes within District planning area may well be limited and will depend on the specific location of the proposed site.

Topography

Figure 4.4 also shows water courses in relation to steepness of slope, the orange to red shading denoting greater severity of slope. The main opportunities for high and medium head water sites are within the Derwent Valley which is also where a number of key environmental constraints (see below) are concentrated. In the remainder of the District the land is lower lying, so the main type of hydro scheme would be artificial low head schemes such as weirs.

Key environmental designations

Figure 3.2 shows that the number of ecological and heritage sites within the area compared to its overall size is very small. This would indicate fewer constraints for the location of hydro technology within the area, with the exception of Derwent Valley area including the World Heritage Site in the east of the area.

Ease of connection to the grid

The low voltage network in the area will be extensive bearing in mind the number of settlements being served. There is a major substation based in Winster from which radiate a high voltage national distribution 132kV overhead line southwards through the District and a number of lower voltage overhead lines to Ashbourne, Matlock, Cromford and Hopton. The network will be able to accommodate additional loads to the grid network from small/micro scale renewable schemes, but an assessment is required by the network operator before any connection works can be undertaken. The exact location of proposals will ultimately determine suitability and viability.

Landscape sensitivity

Generic guidance on the conditions for siting this type of technology within the Derbyshire Dales District planning area is provided in the accompanying Landscape Sensitivity Study.

HYDRO CONTRIBUTION

The key opportunities for expanding the use of small/micro hydro schemes within the Derbyshire Dales District planning area are in relation to the restoration of old mill sites and in areas of the District where there is suitable flow or head of water within watercourses. Key constraints to the future of hydro development however, are the lack of water availability within the District, highlighted by the severe restrictions imposed on water abstraction by the Environment Agency through the Dove and Derwent Catchment Area Management Plans, and the concentration of key environmental designations in areas of steepest slope. **On the basis of the local studies and assessments carried out to date this study has assessed that potential energy from hydro schemes in the Derbyshire Dales District to 2026 could generate about 1.7GWh of electrical energy per year. This could increase to 3.8 GWh/y if sites considered not to be economically feasible in a 2001 study are included.**

GROUND SOURCE HEAT PUMPS

Opportunities and constraints within the Peak Sub-Region

4.57 To identify the scope for heat pumps within the Peak Sub-Region the study has mapped and assessed a number of opportunities and constraints for each of the three local planning areas, taking particular account of rivers, water bodies and canals; aquifers and soil types. A general overview of these opportunities and constraints is provided for the Peak Sub-Region as a whole, with opportunities discussed in more detail for each of the three local planning authority areas.

Key Environmental Designations

4.58 As a result of the disturbance caused by construction to ground or water habitats when installing GSHP/WSHP, areas of archaeological and ecological importance, protected rocks/soils and sensitive aquifer zones should be avoided.

Geology

4.59 **Figure 4.5** highlights the location of the bedrock geology for aquifers within the Peak Sub-Region where open loop systems could be used.

Water availability

4.60 The Environment Agency Catchment Area Management Plans (CAMS) provide integrated assessments of rivers and ground water, providing a profile of water availability within a whole catchment. The catchment areas that cover the Peak Sub-Region are outlined in detail in the Chapter on Small/Micro Hydro. There are also two canals within the Peak Sub-Region, the Cromford Canal owned by Derbyshire County Council and the Peak Forest canal owned by Pennine Waterways.

PEAK DISTRICT NATIONAL PARK

POTENTIAL FOR HEAT PUMPS

Existing heat pumps

There are currently six GSHP installations within the Peak District National Park, two of which have been installed by the PDNPA at its properties namely the Moorlands Centre at Edale and the Parsley Hay Cycle Hire Centre. GSHPs have also been installed in by home owners (2) and farmers (2).

There are currently no installations of water source or air source heat pumps.

Resources

The Peak District National Park has a wide network of rivers and a number of reservoirs that could provide a potential resource for water source heat pump technology where this coincides with existing or planned development adjacent to the water source.

Ground conditions and slope vary considerably across the Park area raising both opportunities and constraints depending on location.

Figure 4.5 highlights (where data is available) that a large part of the Park is underlain by aquifers. Within the Derwent CAMS area the major aquifers are the Carboniferous Limestone which outcrop to the west of the catchment and the younger Permo-Triassic Sherwood Sandstone in the south of the area. The major aquifers in the Dove CAMS area are the Carboniferous Limestone and younger Permo-Triassic Sherwood Sandstone which outcrops to the north of the catchment.

Key Environmental designations
Figure 3.2 shows that large areas of the Peak District National Park, particularly the Dark Peak and South West Peak moorland areas, are nationally designated Special Protection Areas and Special Areas of Conservation. The collective area of environmentally sensitive areas totals 74,788 ha, which is equal to just over half of the land area of the Peak District National Park. In addition the Park has 109 Conservation Areas, several Scheduled Ancient Monuments, and four areas of historic parks and gardens, the two largest being Chatsworth House and Lyme Hall. These areas are a constraint to the development of GSHPs.

Water availability
As outlined in the preceding Hydro Chapter the availability of water is variable across the Park area ranging from 'no water' to 'water available' depending on location. The use of WSHP and open loop GSHP systems in the Park would need to be authorised in terms of water licensing from the Environment Agency.

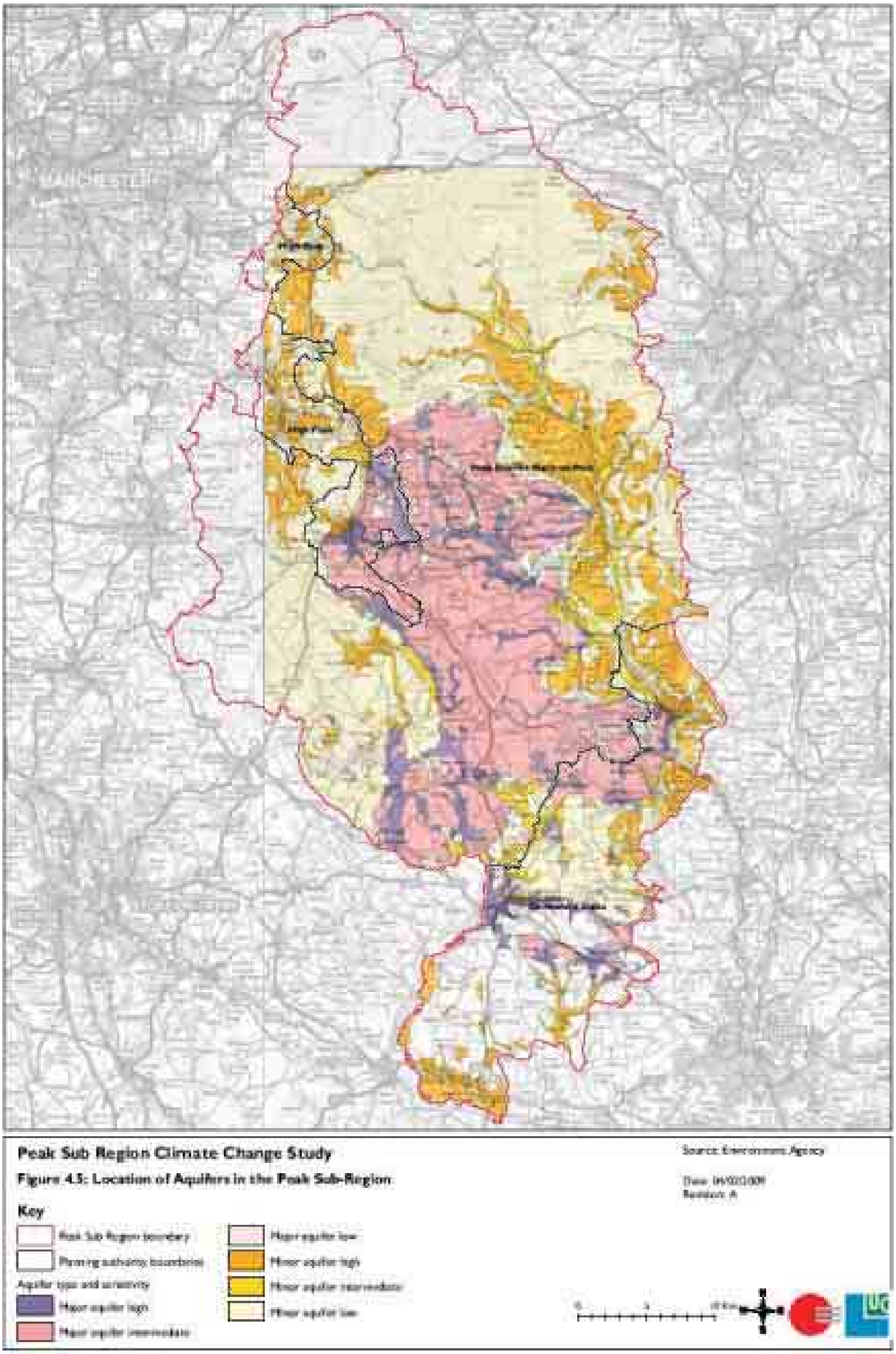
CONCLUSIONS

Overall, there are many opportunities to use heat pump technologies within the Park, which is demonstrated by the six GSHP already installed, but similarly there are many constraints. Suitability of location in terms of conditions and environmental impact will vary for each installation, so feasibility can only be addressed in detail on a case by case basis.

Quantification of potential
The total potential energy generation from heat pumps is calculated on the basis that all new homes and commercial premises forecast to be developed during the plan period up to 2026 have their heat demand supplied by heat pump technology. In the Peak District National Park this is estimated to generate 6 GWh/y of potential energy.

Contribution to 2026
In reality, there will be a mix of technologies used in new build to supply the heat demand in new development. **This study has assessed that ground source heat pumps would provide the heat demand for 40% of planned new development, generating 0.4GWh/y of energy during the period to 2026.**

Figure 4.5: Location of Aquifers in the Peak Sub-Region



NB only partial data could be obtained for the Sub-Region

HIGH PEAK BOROUGH PLANNING AREA

POTENTIAL FOR HEAT PUMPS

Existing heat pumps
There are currently no known heat pump installations within the area.

Resources
The area's main rivers include: River Etherow, Glossop Brook, River Sett, River Goyt, Black Brook and River Wye. There are a number of reservoirs including Combs reservoir, Arnfield Reservoir, Birch Vale Lodge and Toddbrook reservoir. The Peak Forest canal runs for a little under 15 miles from Dukinfield Junction on the Ashton Canal to Bugsworth Basin, with a short spur to Whaley Bridge. The canal could serve as a potential water resource for water source heat pumps, depending on proximity of existing and planned new development.

The area is generally low lying with good soil conditions apart from flood risk areas where top soil will be wet during instances of flooding.

Figure 4.5 highlights (where data is available) that the underlying aquifers in the area are formed by the Millstone Grit Series rocks. There is a limited outcrop of limestone forming the core of the 'Derbyshire Dome' to the East of Chapel-en-le-Frith. Also the sandstone layers within the Millstone Grit tend to act as individual minor aquifer units capable of supporting small to medium sized water supplies.

Key Environmental Designations
Figure 3.2 shows that the number of ecological and heritage sites within the area compared to its overall size is very small. This would indicate fewer constraints for the installation of GS and WS heat pumps.

Water availability
Figure 4.4 shows the water availability status for the Borough's planning area to be 'no water available' in the Derwent CAMS area, and the Glossop Brook catchment, with 'water available' in the River Goyt & Etherow catchments. The use of WSHP and open loop GSHP systems within the area would need to be subject to agreement by the Environment Agency, and for use of canal water, from British Waterways.

CONCLUSIONS

There appear to be good opportunities for the use of heat pump technologies within the area, with limited environmental constraints. Nevertheless, suitability of location in terms of conditions and environmental impact will vary for each installation, so feasibility can only be addressed in detail on a case by case basis.

Quantification of potential
The total potential energy generation from heat pumps is calculated on the basis that all new homes and commercial premises forecast to be developed during the plan period up to 2026 have their heat demand supplied by heat pump technology. In the High Peak Planning Area this is estimated to generate 669 GWh/y of potential energy.

Contribution to 2026
In reality, there will be a mix of technologies used in new build to supply the heat demand in new development. **This study has assessed that ground source heat pumps would provide the heat demand for 40% of planned new development, generating 50GWh/y of energy during the period to 2026.**

DERBYSHIRE DALES PLANNING AREA

POTENTIAL FOR HEAT PUMPS

Existing heat pumps
There are two residential GSHP installations within the District planning area. These are horizontal ground loops. There is no known use of WSHPs or ASHPs.

Resources
The area has two rivers, the Dove and the Derwent, Carsington Water (reservoir) and the Cromford canal which runs for 14 miles south of Cromford to Langley Mill (Nottinghamshire).

The majority of the District is low lying except for the steep valleys and high land associated with the Derwent catchment.

Figure 4.5 - The major aquifers in the Dove CAMS area are the Carboniferous Limestone and younger Permo-Triassic Sherwood Sandstone which outcrops to the north of the catchment.

The major aquifer in the Derbyshire Derwent CAMS is the Permo-Triassic Sherwood Sandstone in the south of the area.

Key Environmental Designations
Figure 3.2 shows that the number of ecological and heritage sites within the area compared to its overall size is very small. This would indicate fewer constraints for the location of WS and GS heat pumps within the area, with the exception of Derwent Valley World Heritage Site in the east of the area.

Water availability
Figure 4.4 shows the water availability status for the District's planning area to be 'over licensed' in the Derwent CAMS area, and 'over abstracted at low flows' in the River Dove CAMS area. The use of WSHP and open loop GSHP systems within the area would need to be subject to agreement by the Environment Agency, and for use of canal water, from British Waterways.

CONCLUSIONS
There appear to be good opportunities for the use of heat pump technologies within the area, with limited environmental constraints. Nevertheless, suitability of location in terms of conditions and environmental impact will vary for each installation, so feasibility can only be addressed in detail on a case by case basis.

Quantification of potential
The total potential energy generation from heat pumps is calculated on the basis that all new homes and commercial premises forecast to be developed during the plan period up to 2026 have their heat demand supplied by heat pump technology. In the Derbyshire Dales Planning Area this is estimated to generate 155 GWh/y of potential energy.

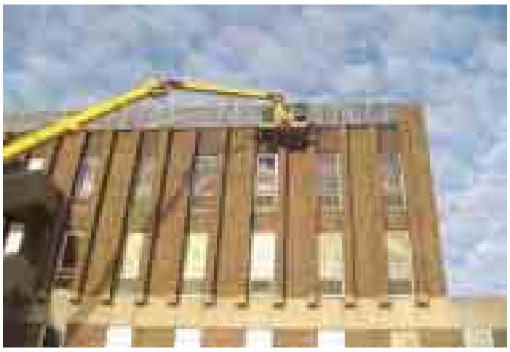
Contribution to 2026
In reality, there will be a mix of technologies used in new build to supply the heat demand in new development. **This study has assessed that ground source heat pumps would provide the heat demand for 40% of planned new development, generating 12GWh/y of energy during the period to 2026.**

SOLAR TECHNOLOGIES

Opportunities and constraints within the Peak Sub-Region

4.61 Overall, there is a significant potential for the further development of solar hot water (SHW) and photovoltaic systems (PV). Solar hot water systems are the cheapest form of renewable energy technology for private, commercial and community buildings, but care is required to minimise the visibility of the units. Specific advice should be sought in the case of Conservation Areas and Listed Buildings.

4.62 PV has the same technical potential, but less overall potential because of cost and relatively low power generation, although power can be sold to the grid at times when generation exceeds use. Development of field-scale PV, or large roof top PV systems (as being developed in continental Europe and in some urban areas in the UK), are also technically feasible, but costly, and would conflict with landscape, heritage and open countryside policy if not appropriately located.

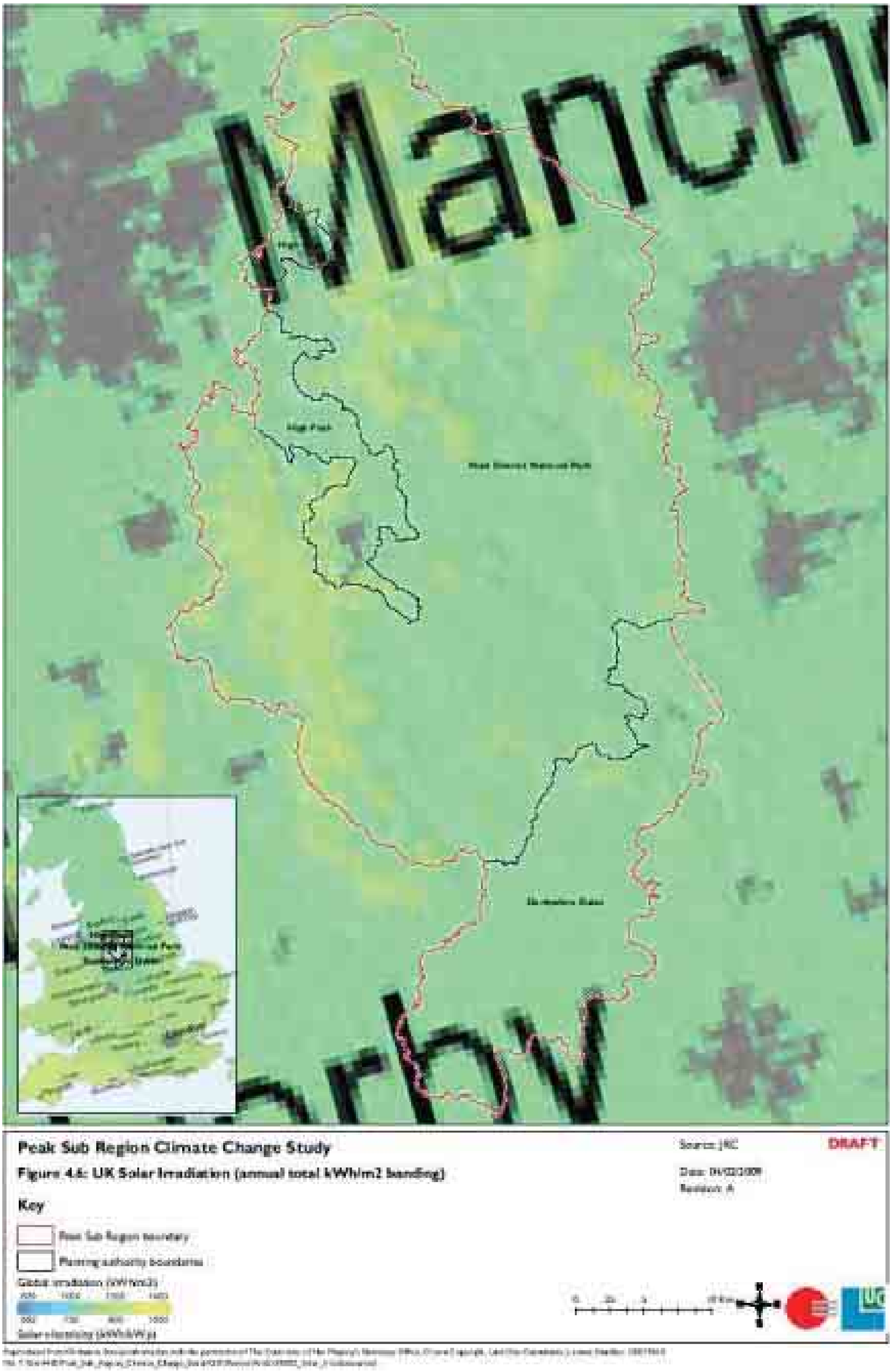


4.63 Standalone and off grid PV systems can also be used successfully with both the urban and rural environment.

Solar resource

4.64 The Peak Sub-Region receives average levels of solar radiation compared to the rest of the UK (**Figure 4.6)**.

Figure 4.6: UK Solar Irradiation (annual total kWh/m^2 banding)



4.65 As a result of this freely available resource, all three planning areas have solar technologies installed, mainly domestic solar thermal systems, but also a few domestic PV units. **Table 4.13** below shows the number and general locations of solar technologies installed within the study area by planning authority area.

Table 4.13: Existing Solar Technologies Installed by Planning Area

Planning Area	Type of solar technology	Numbers
PDNP	Solar thermal	22
	Solar Photovoltaic	0
HPBC	Solar thermal	2
	Solar Photovoltaic	0
DDDC	Solar thermal	17
	Solar Photovoltaic	1

Conclusions

4.66 The scope for further installations of solar thermal technologies within the Peak Sub-Region is expected to increase, particularly with the increasing cost of fossil fuels. The market is also expanding from predominantly domestic installations to other buildings such as commercial and community premises, farms, golf clubs, and tourism facilities such as camping and caravan sites. The technologies are currently used predominantly as retrofit on existing buildings, but are increasingly being incorporated into new developments.

4.67 The extension of General Permitted Development Rights (2008) to domestic microgeneration technologies, including solar thermal and photovoltaic panels will also encourage further installations, although certain restrictions will still apply regarding size, height, protrusion from the roof and in relationship to the curtilage of the dwelling.

4.68 The main constraints to the use of solar technologies however will be in relation to Conservation Areas and World Heritage Sites where microgeneration equipment on buildings will only be permissible if not placed on the principal elevation, or facing onto, or visible from, the highway.

Quantification of potential

4.69 The total potential energy generation from solar technologies is calculated on the assumption that the only properties and assets to benefit from an installed solar system are those with the main facades facing South, South East and South West orientation where optimum systems' solar intake and performance is expected. On this basis only half of all existing homes and half of all new build (housing and commercial) would be able to have solar thermal and PV units, i.e. excluding those facing East and West orientations (by default). Other assumptions made are:

- Number of existing properties in each area authority:
- An annual increase new properties (outlined below)

Area	Expected annual increase of houses
DDDC	180
High Peak	280
PNP	40
Total	**88,349**

4.70 For non domestic, i.e. commercial, an assumption has been made that a gross number of 50 sites are to be developed between 2010 and 2026.

4.71 **Table 4.14** shows the quantification of potential for each planning area by technology is estimated to be as follows:

Table 4.14: Quantification of Potential for Solar Technologies in the Peak Sub-Region

Area	Solar Thermal GWh/y	PV GWh/y
Peak District National Park	93	9
High Peak Planning Area	3	2.84
Derbyshire Dales District Planning Area	49	6.96
Total Peak Sub-Region	**497**	**18.86**

Contribution to 2026

4.72 In reality, this level of installation will not take place. This study has used a bottom up approach and made the following assumptions to assess the level of contribution from these technologies to 2026:

- The annual electricity and heat non domestic demand profile was calculated using a model of an (ideal site, by activity type) taken from mean value of the 10 exemplar sites taken previously.
- Only 10% of the non domestic demand was assumed to benefit from solar technologies, i.e. PV or solar thermal. This is a fair assumption bearing in mind that those installed applications are likely to be of small scale, i.e. bigger than the micro-generation threshold, i.e. up to 5 kW.
- Installation on third sector assets was also calculated using the local plans for the area authorities to roughly estimate the number of, e.g. schools, health centres likely to be built in the coming years.
- Assuming that an even distribution of new developments per sites/yr over 16 years, e.g. between 2010-2026.
- An average performance of a domestic solar thermal system of: 11000 kWh/yr per system was assumed, i.e. lower than the optimum 16800 kWh/yr to allow for drop in performance due to over shading due to urban layout and vegetation cover.
- An average expected delivery of about 1200 kWh/yr for PV domestic system was assumed based on fair, not optimal, performance.

Table 4.15: Contribution from Solar Technologies to 2026

Area	Solar Thermal GWh/y	PV GWh/y
Peak District National Park	0.6	0.57
High Peak Planning Area	0.02	0.18
Derbyshire Dales District Planning Area	2.8	0.44
Total Peak Sub-Region	**3.4**	**1.18**

WIND POWER

Types of technology

4.73 In the context of Peak Sub-Region three sizes of wind turbine have been considered. The size of turbines is normally judged in terms of the amount of energy generated but given the sensitivity of the Peak District National Park and its adjacent landscape this study has also defined size of turbine according to height to blade tip. The three size classes (classified to reflect the landscape sensitivities of the Peak District National Park) that have been considered are:

Size	Height[1]	Energy output[2]	Cost of turbine[3]
Large	65m – 125m	330kW - 3MW	£800k - £1.3m
Medium	15m – 65m	50kW – 330kW	£130k - £800k
Small	up to 15m	6 kW - 50 kW	£10k - £139k

1 Height to blade tip
2 Efficiency and energy output is increasing all the time and therefore these values are likely to increase over time
3 These are the installed cost. A 15kW Proven costs £45k and a 50kW Atlantic Orient costs in the region of £150k (costs could be reduced if an open lattice tower is used). A 200kW turbine might cost around £150k if obtained second hand from within Europe

Opportunities and constraints within the Peak Sub-Region

4.74 To identify the scope for wind energy sources within the Peak Sub-Region the study has mapped and assessed a number of opportunities and constraints for each of the three local planning areas, taking particular account of:

- landscape sensitivity;
- wind resource;
- key environmental designations;
- the ease of connection to the Grid;
- Radar height restrictions;

4.75 A general overview of these opportunities and constraints as listed is provided for the Peak Sub-Region as a whole, and then discussed in detail for each of the three local planning authority areas.

Landscape sensitivity

4.76 The Peak Sub-Region comprises a large proportion of land within the Peak District National Park, designated in 1952 as the first national park in England and Wales. Because the Peak District National Park is recognised as a nationally important landscape, none of the sensitivity assessment scores for wind turbines within its boundary fall below 'moderate', with the majority of landscape types being judged as of either 'moderate-high' or 'high' sensitivity to all sizes of wind turbine developments. The assessment therefore recognises the national importance of this landscape and places it within the UK context – i.e. it uses a sensitivity score applicable to the whole of the UK, with national parks at the top end of this scale. The areas within the Peak Sub-Region bordering the Peak District National Park are also deemed to have a greater degree of sensitivity to development when compared to other landscapes. This is because of their role in providing a setting to the Peak District National Park. Any development that could be visible from the Park, within these bordering areas, is therefore subject to higher constraints than might be the case for other locations.

Wind resource

4.77 Wind speeds across the Peak Sub-Region have been estimated using the NOABL wind speed database (**Figure 4.7 - Figure 4.9**). Currently the BWEA30 suggests that large to medium scale wind turbines requires average wind speeds of more than 7m/s to be viable. Small turbines may be viable with average wind speeds as low as 5m/s.

4.78 The data are an estimate, generated by air flow modelling that estimates the effect of topography on wind speed. The model has been applied with a 1km square resolution and takes no account of small-scale topography or local surface roughness (such as tall crops, stone walls or trees), both of which may have a considerable effect on wind speed. Also no allowance is made for the effect of local thermally driven winds such as mountain/valley breezes. It should also be noted that results from the recent Warwick wind trials indicate that the NOABL wind prediction data was higher than actual measured average wind speeds at the sites trialled. The data therefore only provides a rough guide and should be followed by on-site measurements to obtain an accurate assessment.

Figure 4.7: Peak Sub-Region Wind Resource at 45 metres Height

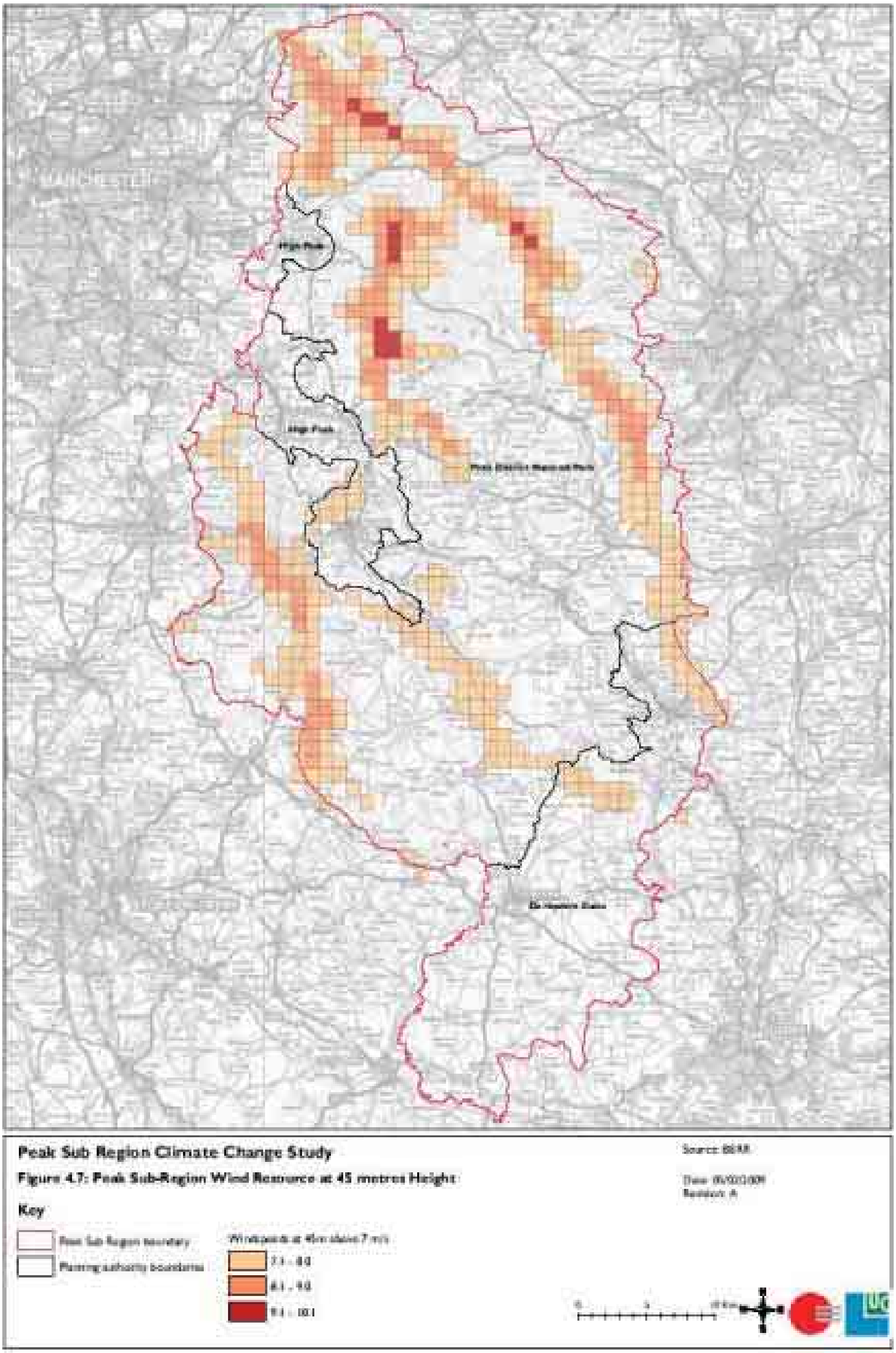


Figure 4.8: Peak Sub-Region Wind Resource at 25 metres Height

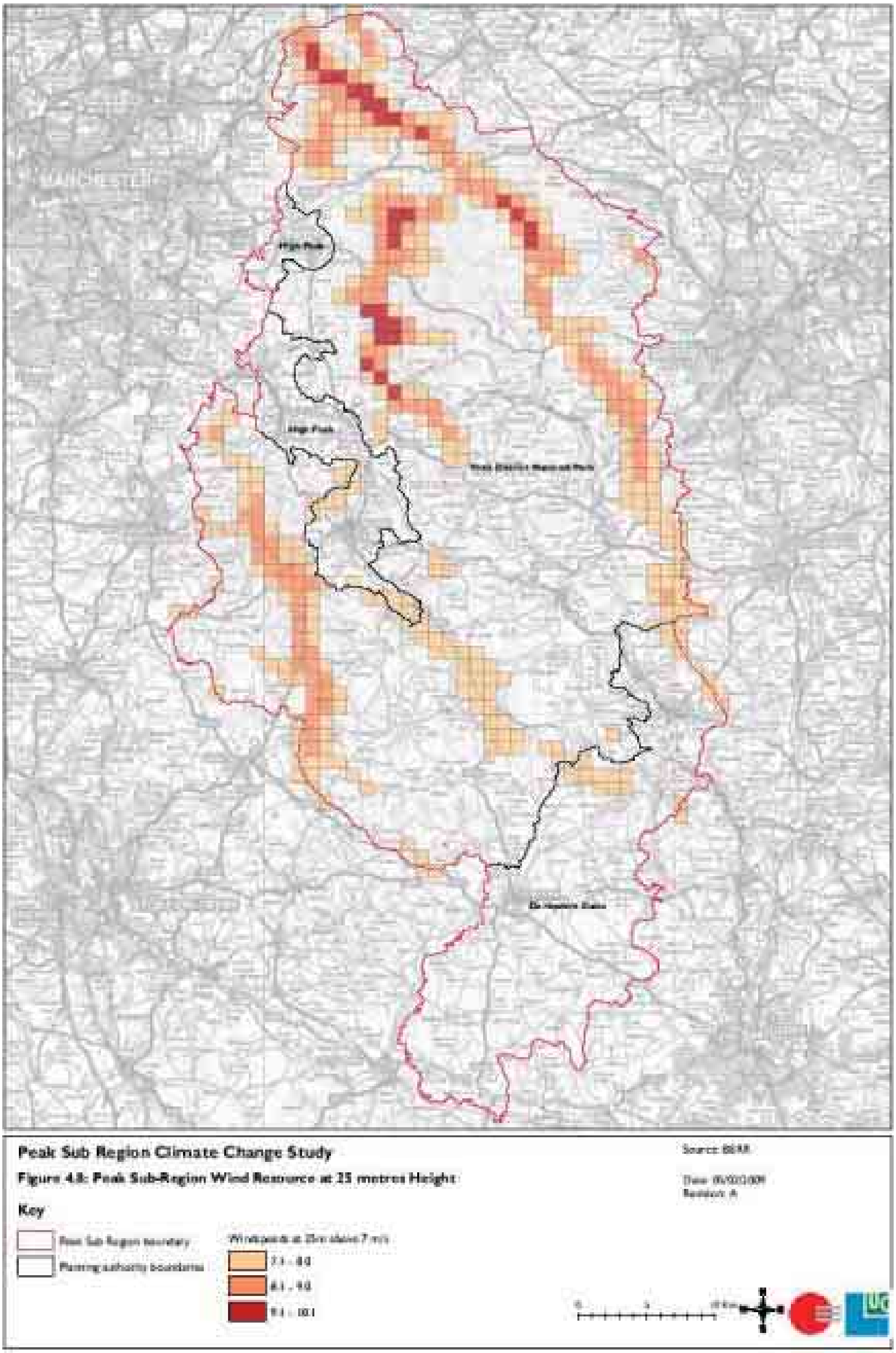
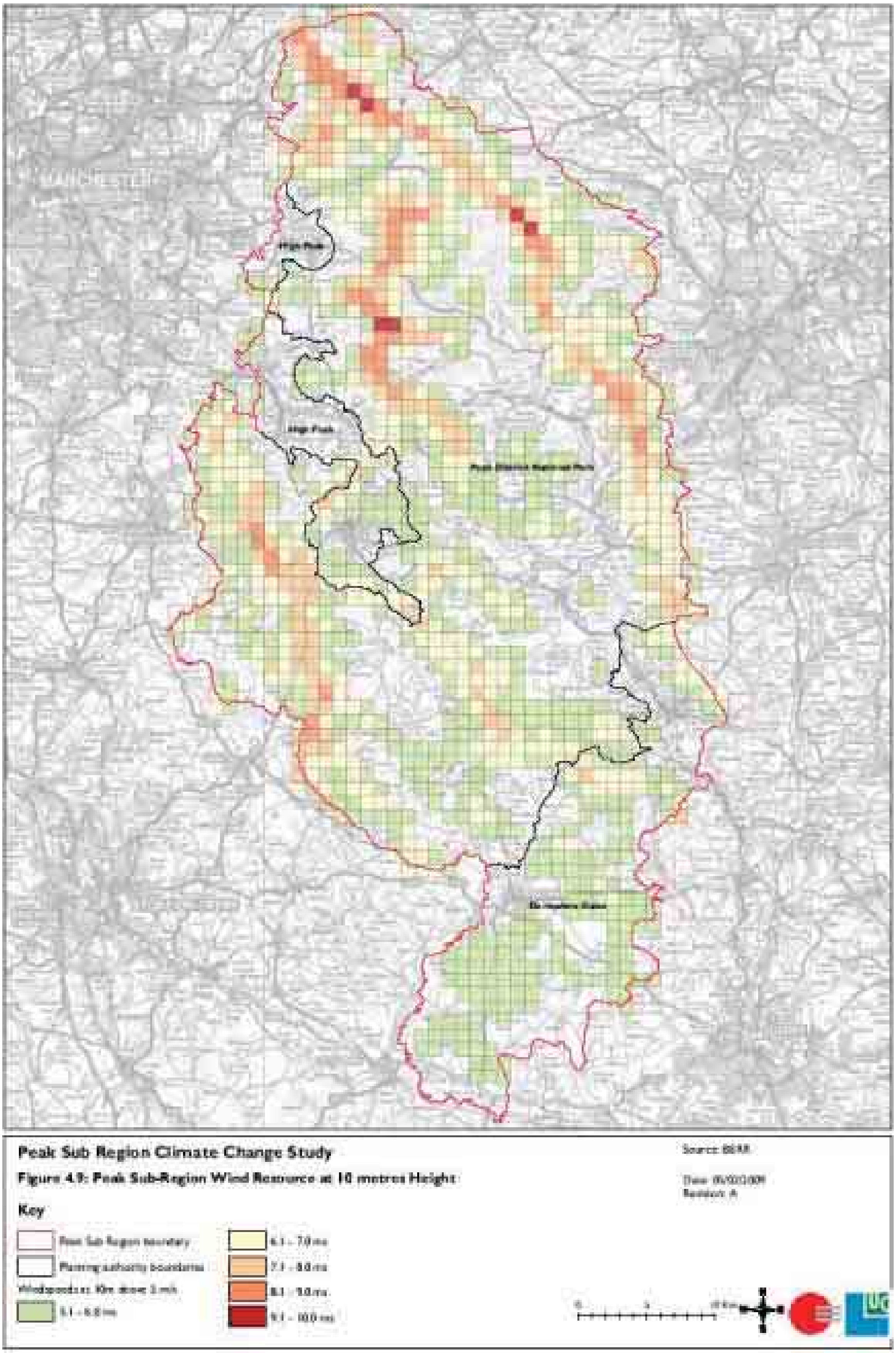


Figure 4.9: Peak Sub-Region Wind Resource at 10 metres Height



Key environmental designations

4.79 As outlined earlier in the report, the Peak Sub-Region contains many international and national environmental designations which are unsuitable locations for siting wind turbine developments and associated infrastructure.

Grid connection

4.80 The Peak Sub-Region falls into three electrical distribution network operator areas (DNO's) (see **Figure 3.4** of this report).

4.81 Applications for renewable technologies within the Sub-Region are unlikely to fail due to grid capacity issues, particularly as the scale of the technologies are likely to be small. A key constraint to connection to the grid however is cost, particularly where a project is small in scale and some distance from the existing grid network i.e. rural in location.

4.82 Stakeholders have also identified this as a key problem. This is the primary reason why some proposals in the Peak Sub-Region have not been taken forward. As a general rule the DNO's do not foresee grid capacity issues precluding the development of medium to small-scale renewable electricity generating technologies within the Peak Sub-Region. It has an extensive low kilovolt (kV) network which can accommodate small to medium scale renewables. However, the exact location of proposals will ultimately determine suitability and viability.

Radar height restrictions

4.83 NATS En Route Plc (NERL) is the air navigation service provider responsible for the safe movement in the en-route phase of flight for all aircraft operating in controlled airspace in the UK. To undertake this responsibility NERL has a comprehensive infrastructure of radar, communication systems and navigational aids throughout the UK. Theory and practical experience has shown that any of these could be compromised by the establishment of a wind farm or turbines in the wrong place. Maps illustrating where NERL consider that structures at specific heights are either 'likely to interfere' or 'remain a potential to interfere' with the operational infrastructure of NERL are provided online for prospective developers to assess potential impact. The height ranges that NERL require developers to consult start from 20 metres up to 140 metres, taking into account the full range of wind turbine tip heights. This study has used the 120m, 60m and 20 m height safeguarding maps provided by NERL to assess potential the impact of the three sizes of wind turbines highlighted in this study. The maps for the Peak Sub-Region are indicated in **Figure 4.11**, **Figure 4.13** and **Figure 4.15**. The implications for each planning area are outlined in detail in the following planning area sections.

Figure 4.10: Landscape Sensitivity to Large Scale Wind Turbine Development

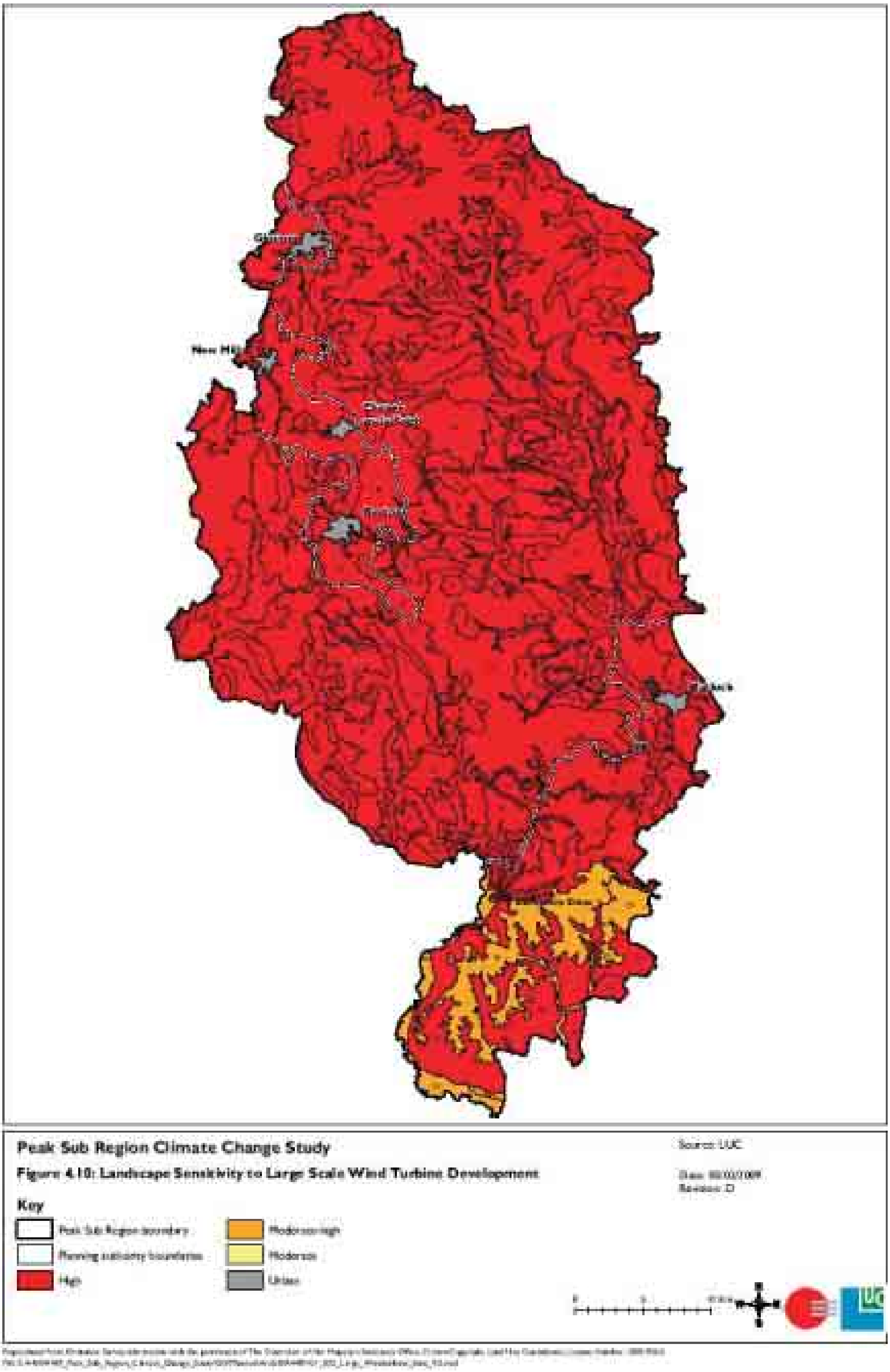


Figure 4.11: Areas of Restriction on New Structures of 120m

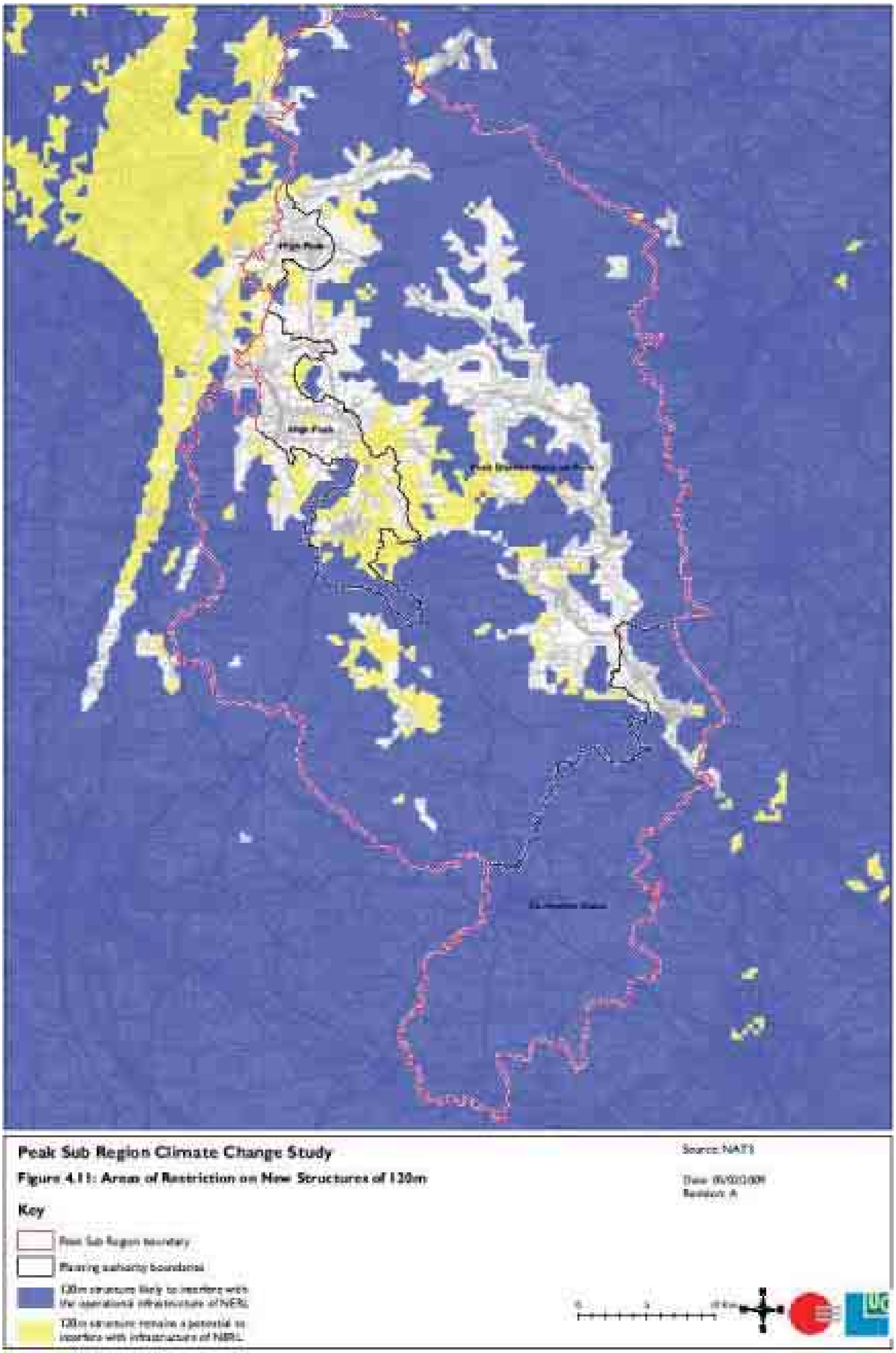


Figure 4.12: Landscape Sensitivity to Medium Scale Wind Turbine Development

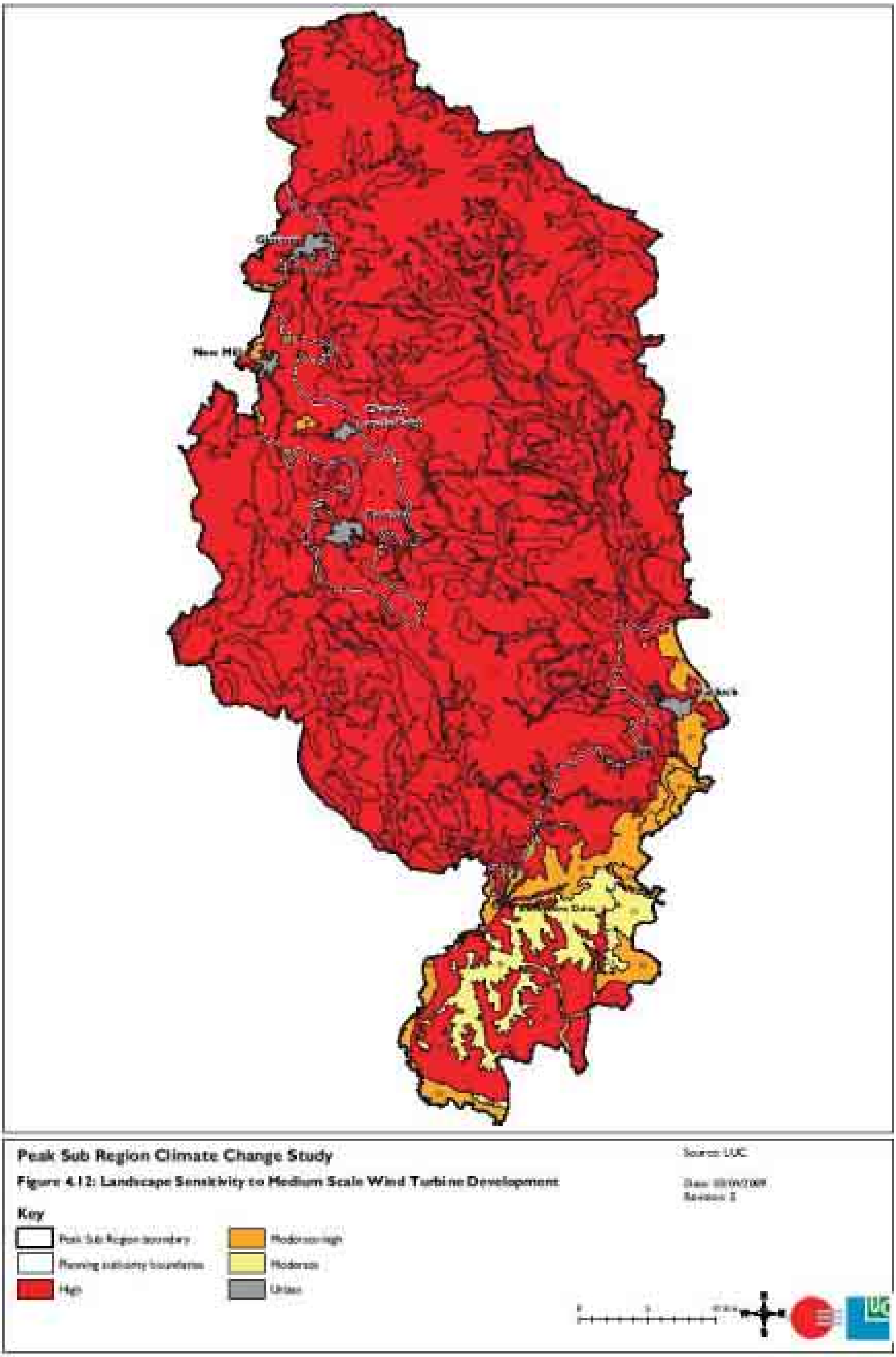


Figure 4.13: Areas of Restriction on New Structures of 60m

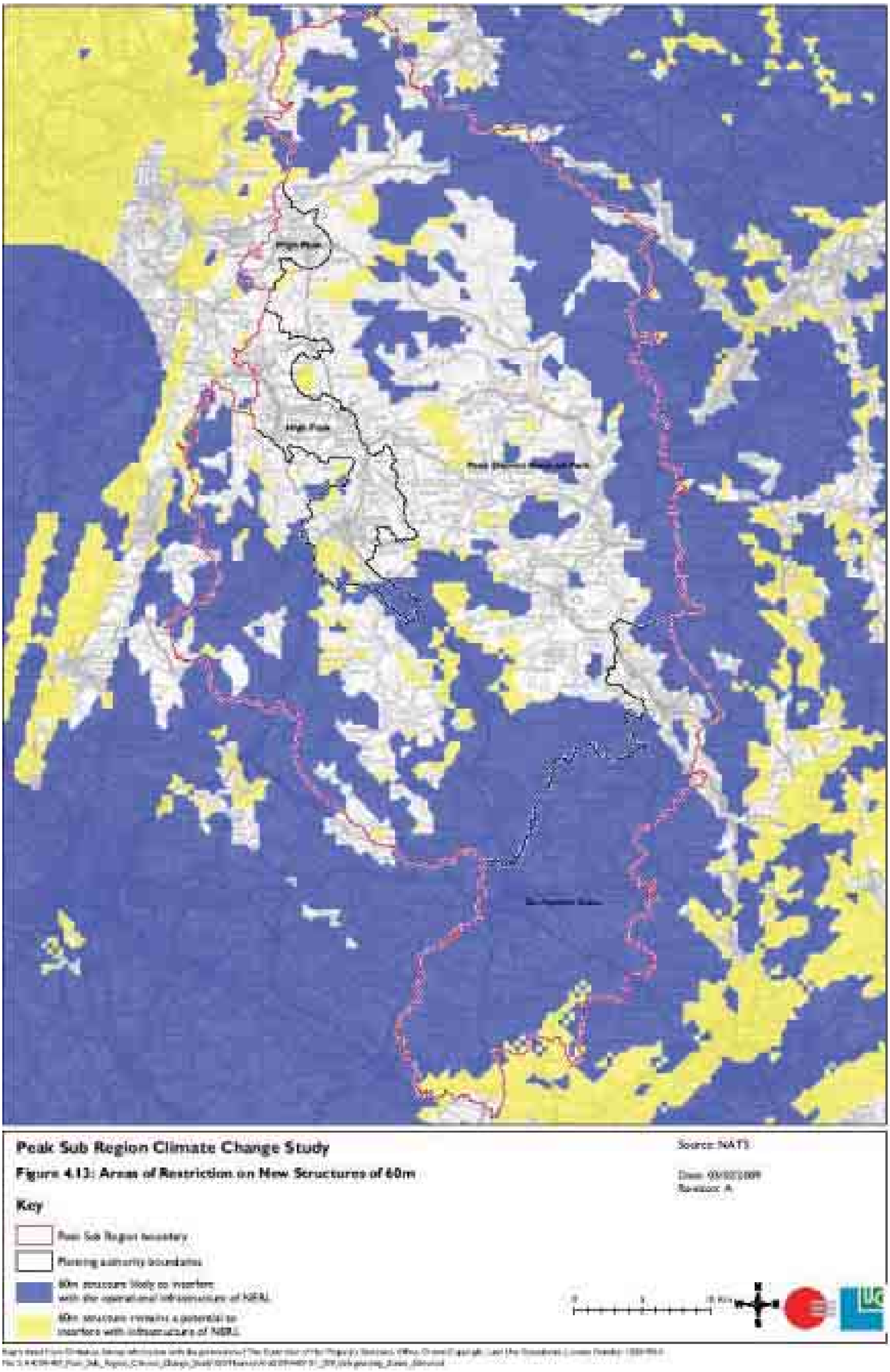


Figure 4.14: Landscape Sensitivity to Small Scale Wind Turbine Development

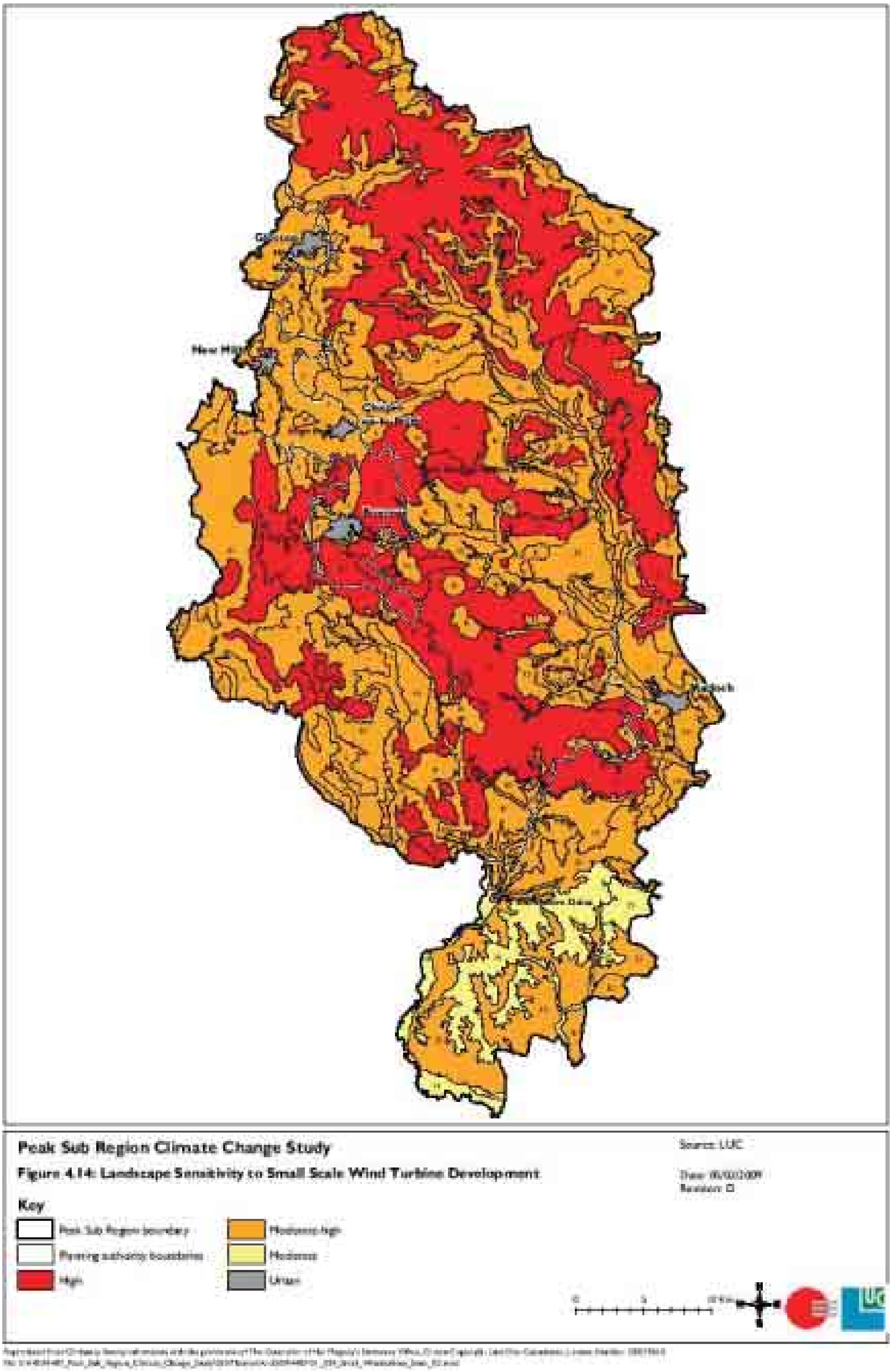
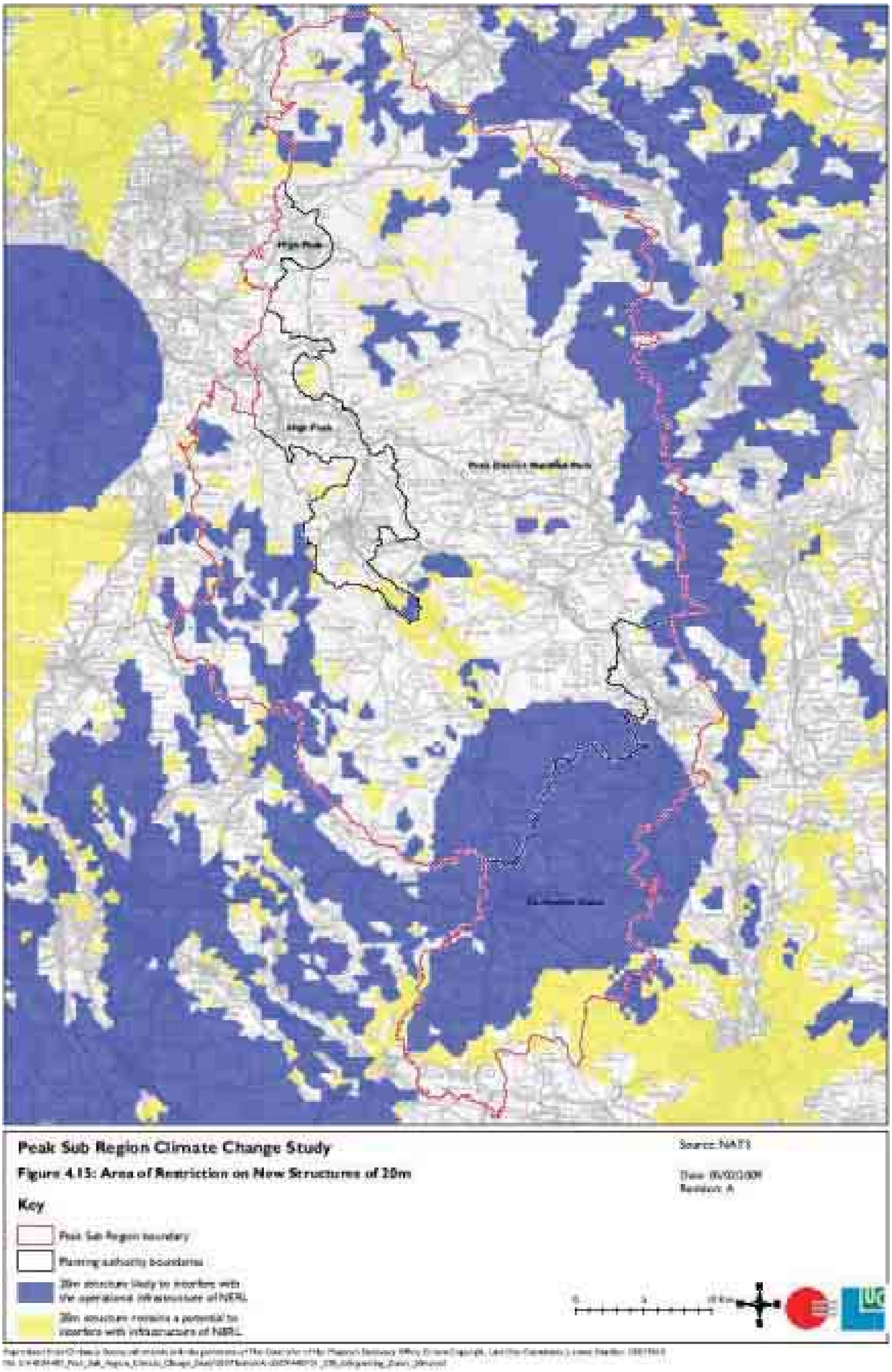


Figure 4.15: Area of Restriction on New Structures of 20m



PEAK DISTRICT NATIONAL PARK

POTENTIAL FOR WIND ENERGY

Existing wind turbines

Since 1996, the Peak District National Park Authority has granted planning permission for a total of 8 small scale/micro wind turbines within the Peak District National Park, either mast mounted or building mounted. Many applications for micro wind turbines have also been refused on the basis that the development is considered contrary to planning policy.

Planning policy

Current policy is outlined in the PDNPA's supplementary planning guidance (SPG) for energy renewables and Conservation (2003) which includes wind turbines. The overriding context of the guidance is that only small-scale schemes appropriate to local need (including those benefiting the wider community) are likely to be compatible with the overall policy of conserving and enhancing the special qualities of the Peak District National Park.

The SPG provides examples where small wind turbines could be suitably located within the Park, for example, where there is an industrial presence that provides a useful backdrop against which to site a turbine or where there is no harm to the traditional features of the settlement. Rural, exposed sites such as remote farms or dwellings are also viewed as having potential to benefit from wind technology. In all cases wind turbine developments are expected to blend in as much as possible within the local environment and to be unobtrusive. The SPG suggests that the impact of a turbine can be lessened if it can be screened, i.e. located near to clumps of trees or power lines, and avoiding standing out on the skyline. Unfortunately these conditions contrast with the technical requirements for locating wind turbines, i.e. locations without obstructions such as local topography, buildings, trees, power lines which can reduce wind speed, or cause turbulence. The SPG guidance is restrictive in order to preserve the special qualities of the landscape and environment of the Peak District National Park, but from a technical point of view, it undoubtedly minimises opportunities for locating small turbines within the Park.

Landscape sensitivity

The Peak District National Park is clearly a very sensitive landscape particularly in terms of its strong relative senses of tranquillity and remoteness when set in the context of the urban areas edging up against its boundary (particularly the Manchester and Sheffield conurbations). All of the Peak District National Park is assessed as being of 'high' sensitivity to large and medium scale turbines (**Figure 4.10** & **Figure 4.12**), whilst still recognising the presence of some existing built structures which already have a visual impact on the Peak District National Park landscape. The Draft Regional Plan (Policy 38) states that **'accommodating large scale renewable generation will always be difficult in the National Park' and that there are 'some opportunities for small wind generation'**.

It is therefore concluded that turbines of the larger scale categories would be unlikely to be able to be sensitively sited within the protected landscape.

The Peak District National Park's open moorland landscapes are recognised as being of 'high' sensitivity to all sizes of wind turbine, recognising their potential contribution to the sense of remoteness. In all cases, single turbines, rather than clusters of 2-5 structures, are deemed most appropriate for all areas within the Peak District National Park.
Small turbines i.e. those less than 15m in height to blade tip, offer the most potential for wind energy generation within the Peak District National Park providing their location and appearance, either individually or cumulatively does not detract from the landscape or the special qualities of the Peak District National Park (**Figure 4.14**).

Wind resource
Unsurprisingly it is the areas of highest altitude and exposed landscapes within the Peak District National Park that experience the highest wind speeds, mostly within the Dark Peak area, but also on the higher ground in the South West Peak (**Figure 4.7** and **Figure 4.8**) with average wind speeds above 7m/s at 45m and 25m respectively.

Areas that experience lower wind speeds are more broadly spread throughout the Peak District National Park (**Figure 4.9** highlighting wind speeds above 5m/s at 10m), but these average wind speeds are still potentially viable for smaller turbines.

Key Environmental Designations
Figure 3.2 shows that large areas of the Peak District National Park, particularly the Dark Peak and South West Peak moorland areas, are nationally designated Special Protection Areas and Special Areas of Conservation. The collective area of environmentally sensitive areas totals 74,788 ha, which is equal to just over half of the land area of the Peak District National Park. In addition the Park has 109 Conservation Areas, several Scheduled Ancient Monuments, and four areas of historic parks and gardens, the two largest being Chatsworth House and Lyme Hall. These areas are a constraint to the development of medium to large wind turbines, where development itself, its associated infrastructure, as well as access for development and maintenance would have an adverse effect on these designations.

Grid connections
The Peak District National Park is covered by the three electrical distribution network operators (DNO's) that cover the whole of the Sub-Region. **Figure 3.5** shows that there is a broad network of overhead electricity cables throughout the Park, but two distinct areas where there is no distribution network, principally the high altitude, exposed and rural areas of the Dark Peak and the South West Peak. This would be a considerable constraint to locating grid connected wind turbines.

NERL height restrictions
Figure 4.11 highlights that large wind turbines with a height to blade tip of 120 metres and above are considered by NERL to be likely to interfere with its operational infrastructure in the majority of the area of the Peak District National Park. The only areas of exception are the lower lying valleys such as around Hathersage to Castleton, the River Ashop Valley, and the Derwent Reservoir area and along part of the Park's boundary with the High Peaks planning area. **Figure 4.13** and **Figure 4.15** show the zones of likely NERL interference from 60m and 20m blade tip height turbines within the Peak District National Park. These zones coincide with areas of high altitude i.e. the Dark Peak, South West Peak, areas south of Buxton and the southern area of the White Peak. In lower lying areas small wind turbines are less likely or unlikely to interfere with NERL infrastructure, roughly equal to half of the Park land area.

CONCLUSIONS

Large to medium scale wind turbines
The constraints of high landscape sensitivity; widespread key environmental designations, lack of grid infrastructure, likely radar interference and the general rural nature and poorer accessibility within the windiest parts of the Park combine to make the Peak District National Park an unsuitable location for large or medium scale wind turbines.

Small scale wind turbines
The study reveals landscape sensitivity to be the overarching constraint with many areas of the Peak District National Park being assessed as of high landscape sensitivity and moderate to high sensitivity. There were no areas of moderate sensitivity. The study concludes that for small wind turbines there may be some limited opportunity to accommodate the technology in areas of moderate to high sensitivity without changing landscape character, but that great care would be needed in locating infrastructure. In terms of locations where small wind turbines could be usefully

used, the Peak District National Park's SPG provides the best source of guidance, but key considerations would also be the need for adequate wind speed, as suitable wind speeds for small scale turbines are not universally spread throughout the Peak District National Park, and the need to avoid areas where the height of a turbine is likely to interfere with NERL radar infrastructure.

Contribution to 2026
Using an assumed annual energy output from a single small 15kW turbine of approximately 25MWh/y, **the study has assessed a conservative figure of 5 additional small wind turbines being accommodated within the Peak District National Park to 2026. This would generate 125MWh/y of electricity, (0.125GWh/y).**

HIGH PEAK BOROUGH PLANNING AREA

POTENTIAL FOR WIND ENERGY

Existing wind turbines
The High Peak Borough Council Planning Authority has granted planning permission for four small/micro wind turbines, two of which are for domestic use and one for use on a farm.

Planning Policy
Current policy is outlined in the High Peak Local Plan Policy CF 10 – Renewables. It provides a general support approach to renewable energy development providing its impact doesn't adversely affect a range of environmental criteria.

Landscape sensitivity
With the exception of the urban areas of Buxton, Chapel-en-le-frith, New Mills and Glossop, the study concludes that the area's landscape sensitivity to large wind turbines is high. (**Figure 4.10**).

For medium scale wind turbines, the majority of the area remains of high landscape sensitivity apart from some localised areas judged to be of moderate to high sensitivity (**Figure 4.12**).

The landscape sensitivity to small wind turbines is markedly less, but still in the moderate to high category. This assessment means that many of the key characteristics of the landscape would be adversely affected by the renewable energy development, and that such development would result in a noticeable change in character. There may be some limited opportunity to accommodate the renewable energy development without changing landscape character, but great care would be needed in locating infrastructure.

Wind resource
The required average wind speeds for large and medium scale wind turbines are only recorded for two small pockets of land, one north of Buxton and south of Chapel-en-le-Frith, the other is an area of land around the southern tip of the planning area bounded by the A515. Elsewhere recorded average wind speeds would be too low, due in the main to the predominantly low lying nature of the area (**Figure 4.7** & **Figure 4.8**). Areas of average wind speed 5m/s and above, suitable for small wind turbines, are located around the Buxton area; in an area north of Chapel-en-Le-Frith, and between New Mills and Hayfield (**Figure 4.9**).

Key environmental designations
Figure 3.2 shows that there are a small number of statutory environmental designations within the area. Buxton Country Park and the Toddbrook and Combs reservoirs are the largest areas which are SSSIs.

Grid connections
The majority of the area is covered by the Electricity North West distribution network operator, with the remaining area around Buxton covered by E-ON Central Networks East. The towns of New

Mills, Chapel-en-Le-Frith and Buxton are served by a double circuit 132kV overhead line, which is the largest of the grid transmission lines. The remaining towns and smaller settlements are supplied with smaller kV transmission lines in line with the size of the electricity demand of the area. (**Figure 3.5**)

NERL Height Restrictions
The low lying nature of the majority of the planning area means that tall structures are unlikely to interfere with radar infrastructure except on higher ground. **Figure 4.11** highlights that large wind turbines with a height to blade tip of 120 metres and above are considered by NERL to be likely to interfere with its operational infrastructure in the hills surrounding the Buxton area and the higher areas south west of Chisworth, and west of Whaley Bridge. **Figure 4.13** and **Figure 4.15** show the zones of likely NERL interference from 60m and 20m blade tip height turbines within the area to be south of Buxton and south west of Chisworth.

CONCLUSIONS

Large – medium scale wind turbines
The study reveals that landscape sensitivity is an overriding constraint for the development of large and medium scale wind turbines in the area. A further constraint is the limited area with average wind speeds above 7m/s. Consequently, the study concludes that the High Peak Borough planning area is unsuitable for the development of large or medium scale wind turbines.

Small scale wind turbines
The study reveals landscape sensitivity to be the overarching constraint with many areas of high landscape sensitivity and moderate to high sensitivity. There are also significant areas where wind speed is below 5m/s. It is concluded that for small wind turbines there may be some limited opportunity to accommodate the technology in areas of moderate to high sensitivity without changing landscape character, but that great care would be needed in locating infrastructure. Furthermore there may be scope for small scale turbines in urban commercial areas where wind speed is above 5 m/s. The areas where they may be scope include limited areas of Buxton and New Mills, but would need detailed on-site assessment before wind speed viability could be established.

Contribution to 2026
Using an assumed annual energy output from a single small 15kW turbine of approximately 25MWh/y, **the study has assessed a conservative figure of 5 additional small wind turbines being accommodated within the High Peak Planning area to 2026. This would generate 125MWh/y of electricity, (0.125GWh/y).**

DERBYSHIRE DALES PLANNING AREA

POTENTIAL FOR WIND ENERGY

Existing wind turbines
The Derbyshire Dales District Planning Authority has granted permission for five small/micro wind turbines in recent years.

Current Proposals
A proposal for four 102 metre high wind turbines on land at Carsington Pastures, Carsington was refused by Derbyshire Dales District Council in July 2007 on the grounds that the proposed development would be visually intrusive and harmful to the character and appearance of the landscape, harmful to the setting of the Peak District National Park and also the settings of both Carsington and Hopton and Brassington Conservation Areas. The proposal was subsequently approved by the Secretary of State for Communities and Local Government following a public

inquiry. The Council is currently appealing the decision through the High Court. Plans by West Coast Energy for five 126 metre high wind turbines on land at Matlock Moor were made public in November 2008.

Planning Policy
Current policy is outlined in the Derbyshire Dales Local Plan Policy CS6 – Wind Turbine Generator Development. It provides a general support approach to renewable energy development providing its impact doesn't adversely affect the landscape; cause unacceptable problems in relation to neighbouring uses, and that safe and satisfactory access is available without damage to the local and wider environment.

Landscape Sensitivity
With the exception of the urban area of Matlock, the study concludes that the area's landscape sensitivity to large wind turbines is predominantly high, with some areas of moderate to high sensitivity in the south of the District (**Figure 4.10**). The presence of the Derwent Valley Mills World Heritage Site, and its accompanying buffer, has been accounted for in the landscape sensitivity assessment. This international designation, which recognises the area's outstanding industrial heritage, places another key sensitivity on areas within the Derbyshire Dales within or buffering this site to wind turbine developments.

There are a few locations however that might be less sensitive to the development of the larger sizes of turbine. These include locations within the 'Lowland Village Farmlands' landscape type in southern Derbyshire which includes extensive urban fringe development and views of nearby power stations; as well as other areas within the southern part of the Sub-Region already experiencing significant development pressure and lying some distance from the Peak District National Park. There may also be some very limited potential for medium-scale turbines to be located in areas of the 'Enclosed Moors and Heaths' landscape type where significant coniferous plantations may provide a screening function (**Figure 4.12**). However, care would need to be taken when looking at the location of any potential wind turbines in terms of their visibility in views from and to the Peak District National Park.

Landscape sensitivity to small wind turbines is predominantly moderate to high, but with significant areas of moderate sensitivity (**Figure 4.14**). In these areas of moderate sensitivity some of the key characteristics of the landscape are vulnerable and may be adversely affected by wind turbine renewable energy development. Although the landscape may have some ability to absorb some development, it is still likely to cause some change in character. Therefore, care would be needed in locating infrastructure.

Wind resource
The required average wind speeds for large and medium scale wind turbines are only recorded for two small pockets of land, one along the northern Planning Area boundary concurrent with the Enclosed Moors and Heaths' landscape area, and an area roughly north east of Brassington and Carsington, an area of high landscape sensitivity (**Figure 4.7** & **Figure 4.8**). Elsewhere, estimated wind speed is too low to be viable for large/medium turbines.

Areas that experience wind speeds suitable for smaller wind turbines (**Figure 4.9** - 5m/s and above) are more broadly spread throughout the Planning area.

Key Environmental Designations
Figure 3.2 shows that the main areas of environmental designations are in the northern part of the District, including the Derwent Valley Mills World Heritage Site.

Grid Connections
The area is covered by E-ON Central Networks East. A high voltage 132kV overhead transmission line runs north/south, passing to the west of Carsington Water, with 33kV lines serving key settlements such as Ashbourne and Matlock. Smaller 25kV and 11kV transmission lines provide a

network connecting smaller settlements, hamlets, farms and other developments within the countryside (**Figure 3.5**).

NERL Height Restrictions
Figure 4.11 highlights that large wind turbines with a height to blade tip of 120 metres and above are considered by NERL to be likely to interfere with its operational infrastructure in the majority of the area with the exception of the Derwent Valley around Matlock. Even at lower heights, see **Figure 4.13** and **Figure 4.15**, a large proportion of the District planning area falls within the NERL zones of likely interference, and is therefore a key constraint.

CONCLUSIONS

Large – medium scale wind turbines
The study reveals that there are three key constraints to the development of large and medium scale wind turbines within the Derbyshire Dales District Planning Area. One is the high sensitivity of the landscape, the second is the limited area with average wind speeds above 7m/s, and the third is the likely interference turbines would make to aviation radar systems in the area.

There are a limited number of locations where there might be slightly lower landscape sensitivity to medium scale turbines as outlined above, however the constraints of low wind speed and likely radar interference would need to be investigated in detail. Consequently, the study concludes that the Derbyshire Dales Planning area is broadly unsuitable for the development of large or medium scale wind turbines, although there are some limited locations that could be considered but only after a thorough investigation of the likely landscape impacts, wind speed and impacts on radar infrastructure has been made.

Quantification of overall potential
The study has identified the 'Enclosed Moors and Heaths' landscape character area as the only location in the District planning area with potential for medium scale wind energy generation. This is by virtue of the area's viable wind speed, and slightly less landscape sensitivity due to opportunities for screening from existing coniferous plantations. A preliminary estimate suggests theoretical potential for a 10MW development generating 20GWh/y of energy by 2026.

Contribution to 2026
The study has assessed that there is potential for a 5MW[14] of wind energy generation in areas defined as the 'Enclosed Moors and Heaths' in the Derbyshire Landscape Character Assessment, generating a potential 10 GWh/y of energy by 2026.

These conclusions are based on a desktop, preliminary assessment, so further detailed expert research would be required to determine actual potential, particularly in relation to wind speed viability, landscape sensitivity, and impact on radar infrastructure.

Small scale wind turbines
The study reveals that there are some opportunities for small scale wind turbines in areas of moderate landscape sensitivity and in urban areas where wind speed is over 5 m/s. Care would be needed in locating infrastructure to avoid any adverse impact on the landscape, as well as areas where turbines are likely to interfere with NERL aviation radar infrastructure.

Contribution to 2026
Using an assumed annual energy output from a single small 15kW turbine of approximately 25MWh/y, **the study has assessed a conservative figure of 30 additional small wind turbines being accommodated within the Derbyshire Dales Planning Area to 2026. This would generate 750MWh/y of electricity, (0.75GWh/y).**

[14] This could be 3 clusters of 5 medium scale turbines, or 5 clusters of 3 medium scale turbines, with a collective capacity of 5 MW.

DISTRICT HEATING

4.84 The East Midland Region Regional Plan encourages an increase in the use of heat networks within the region (see earlier **paragraph 3.50**). **Regional Priorities for Low Carbon Energy - Policy 40** requires local planning authorities to:

- promote the development of CHP and district heating infrastructure; and
- promote the development of distributed energy networks using low carbon and renewable resources

Opportunities and constraints within the Peak Sub-Region

4.85 To identify the scope for district heating within the Peak Sub-Region the study has undertaken a desk top assessment of one key settlement within each planning area, i.e. Bakewell, Buxton and Matlock.

4.86 Working draft of practice guidance to support PPS 1 Planning & Climate Change (Dec 2007) provides a checklist to help assess local potential for decentralised renewable of low carbon energy. The key aspects are:

1) The development of a heat, cooling and power density map for existing building types within the Plan area. **This has not been included in this study**, although the public industrial heat map for the East Midlands region, published by AEA and BERR, shows no major (above 1MWth) heat source in the three planning authority areas.
2) Whether there is any public sector housing stock in line for major refurbishment and under local authority management as this could provide a heat load for a new heating network. **This has been investigated.**
3) Whether there are any existing ‘anchor heat loads such as leisure centres, hospitals, prisons, hotels, which could be linked into a district heating network or already supplied by CHP. **This has been investigated.**
4) The location, performance and capacity of existing heating schemes both in the public and private sectors, so this can be used to establish any energy sources which could be tapped into by new development. **This has been investigated.**
5) The location, performance and capacity of existing sources of waste heat from power generation or industrial processes. **This has been investigated.**

4.87 A summary of the outcomes from this assessment for three towns (one town per local authority planning area) is outlined as follows:

PEAK DISTRICT NATIONAL PARK
DISTRICT HEATING ASSESSMENT The principal town of Bakewell has been reviewed with regard to criteria 2-4 above. **Criteria 2 – social housing refurbishment potential -** Social housing is provided in the Peak District National Park through Dales Housing Ltd and High Peak Community Housing and a number of Housing Associations. There are no known plans for new or retrofit district heating schemes for social housing in the town. **Criteria 3 – existing anchor heat loads** Newholme Community Hospital – Baslow Road Bakewell Pool/Leisure centre **Criteria 4 – existing heating networks -** None known **Criteria 5 – existing sources of waste heat -** No significant power generation or industrial processes in the town area. Bakewell thermal spring water – 15 degrees centigrade

CONCLUSIONS
There are two existing heat anchors in the town which could provide potential in the future for possible linkage to a small scale district heating system if potential for redevelopment in the vicinity comes forward in the planning period to 2026. There is also scope for new development within the plan period to investigate the potential for district heating as part of its proposals for carbon reduction.

HIGH PEAK BOROUGH PLANNING AREA

DISTRICT HEATING ASSESSMENT

The town of Buxton has been reviewed with regard to criteria 2-4 above.

Criteria 2 – social housing refurbishment potential
Social housing is provided in the Borough through an Arms Length Management Organisation ALMO called High Peak Community Housing and a number of Housing Associations. The ALMO took over responsibility for Council housing stock in 2004. There are no known plans for new or retrofit district heating schemes for social housing areas in the town.

Criteria 3 – existing anchor heat loads
Buxton Hospital, London Road – proposed for redevelopment by PCT (see below)
Cavendish Hospital, Manchester Rd – proposed for redevelopment by PCT (see below)
Buxton Spa Swimming Pool – uses thermal spring water for pool
Buxton Derby University Campus – former Devonshire Royal Hospital, Manchester Rd.
Buxton Crescent Hotel and Thermal Spa - Investigation works for the Buxton Crescent Hotel and Thermal Spa project started in September 2008. The development will provide: a 79 bedroom five-star spa hotel - one of only two genuine spa hotels to be developed in the UK in more than 100 years; a state of the art natural thermal mineral water spa; eight specialist shops; refurbishment of the Pump Room as a high quality café, giving free access for the public to "take the waters"; and a new visitor interpretation centre, with integrated tourist information facilities for visitors to the Peak District.

Criteria 4 – existing heating networks
None known

Criteria 5 – existing sources of waste heat
No significant power generation or industrial processes in the town area
Buxton Spring – thermal source fed by at least two fissures which emerge in a pool complex in the town centre. Temperature of water is 28 degrees centigrade. High Peak Borough Council are owners of the source and abstraction licence – potential to use for heat networks would require a feasibility study.

The Derbyshire County PCT is planning a new multi agency medical campus in the town replacing existing dispersed premises. A key part of any development will include energy efficiency. Potential scope for district heating linkages depending on location of new proposal.

Other opportunities

Buxton town centre redevelopment proposals – supermarket, retail units, six storey hotel and multi-story car park.

CONCLUSIONS
Future redevelopment proposals within the town, such as the two mentioned above should consider the potential for district heating, as well as links to existing adjacent development if appropriate/feasible.

DERBYSHIRE DALES PLANNING AREA

DISTRICT HEATING ASSESSMENT

The principal town of Matlock has been reviewed with regard to criteria 2-4 above.

Criteria 2 – social housing refurbishment potential
Social housing is provided by Dales Housing Ltd and a number of Housing Associations. There are two main areas of social housing in the town but no known plans for new or retrofit district heating schemes for these areas.

Criteria 3 – existing anchor heat loads
Matlock swimming pool in the centre of town
Matlock Hospital north west of the town on the A6 Bakewell Road.
Derbyshire County Council office complex near in centre of Town in Matlock Bank
Derbyshire Dales District Council Offices and adjacent Matlock Parish Council offices near town centre

Criteria 4 – existing heating networks
None known

Criteria 5 – existing sources of waste heat
No significant power generation or industrial processes in the town area
Thermal springs in town area – 20 degrees centigrade - potential for use in heating network

Other development opportunities
Matlock Town Centre SPD 2008 – key development proposals such as library, new offices and residential and retail/superstore could all investigate potential for district heating for the development zones identified in the town.

CONCLUSIONS
Future redevelopment proposals within the town, as mentioned above should consider the potential for district heating, as well as links to existing adjacent development if appropriate/feasible.

CONTRIBUTIONS SUMMARY

4.88 This part of the report summarises the outcome of each of the technology assessments in terms of their potential energy production and carbon saving potential during the period to 2026.

4.89 To set the scene, an estimate of the **current contribution from renewable technology installations** within the Peak Sub-Region is shown in **Table 4.16** and summarised below.

4.90 **The Peak District National Park** accounts for almost sixty percent (60%) of the total current renewable energy capacity for the Peak Sub-Region, the majority of which is generated from hydro installations.

4.91 **Derbyshire Dales District Planning Area** is the second largest contributor with around thirty eight percent (38%) of total capacity within the Peak Sub-Region, generated mainly from biomass heating installations and hydro installations.

4.92 **The High Peak Borough Planning Area** is the smallest contributor within the Peak Sub-Region responsible for two percent of current capacity of which the majority is from hydro installations.

Table 4.16: Estimate of Current Energy Generation from Existing Renewable Technologies

Technology	**Current Capacity 2008 GWh/y**			
	PDNP	HPBC	DDDC	Sub Region
Biomass	0.216	0	2.59	**2.8**
Energy Crops	0	0	0✪	**0**
Anaeorobic Digestion	0	0	0	**0**
Hydro	5.1	0.26	0.85	**6.2**
Heat Pumps	*	*	*	*
Micro Solar Thermal	0.021	0.0018	0.022	**0.0448**
Micro PV	0	0	0.003	**0.003**
Onshore wind				
Large	0	0	0	**0**
Medium	0	0	0	**0**
Small	0.068	0.002	0.015	**0.085**
Total Wind				
Micro wind	0.0075	0.0009	0.003	**0.0114**
TOTAL	**5.4125**	**0.2647**	**3.483**	**9.1442**

✪1 miscanthus farm - production data unknown

* Output of GSHPs unknown

Quantification of potential for Anaerobic digestion unknown

4.93 A key purpose of the study is to assess the likely energy capacity from a range of renewable energy technologies within the Peak Sub-Region by 2026. **Table 4.17** shows the results of the assessments estimating a total capacity for the Peak Sub-Region to 2026 of 128 GWh/y. This represents one and a half percent (1.5%) of the East Midland target to 2026. This low percentage of contribution is primarily due to the constraints within the Sub-Region from the nationally designated Peak District National Park. This constraint is recognised and acknowledged within the East Midlands Plan as a significant constraint upon large scale renewable energy generation within the Peak Sub-Region, but that there are many opportunities for small scale renewable energy generation.

4.94 **Derbyshire Dales District Planning Area** – Approximately fifty percent (50%) of the total renewable energy capacity of the Peak Sub-Region to 2026 is from the Derbyshire Dales District Planning Area, an estimated target of 65 GWh/y by 2026. The main contributors are energy crops, heat pumps and medium scale wind.

4.95 **The High Peak Borough Planning Area** – The contribution of approximately 50 GWh/y by 2026 constitutes about forty percent (40%) of the Peak Sub-Region renewable energy capacity, the main technology contribution being from heat pumps.

4.96 **The Peak District National Park** – The National Park area contribution is approximately 12 GWh/y by 2026, constituting the remaining ten percent (10%) of the Peak Sub-Region total capacity. The main technology contributors are small scale hydro and biomass.

Table 4.17: Estimate of Energy Production from Renewables to 2026

Technology	Quantification of potential GWh/y				Target to 2026 GWh/y				East Midlands Targets to 2026 GWh/y	% of EM targets
	PDNP	HPBC	DDDC	Sub Region	PDNP	HPBC	DDDC	Sub Region		
Biomass	92.9	5.9	23.2	**122**	4.64	0.29	1.16	**6**	77	8
Energy Crops	0	0	735	**735**	0	0	37	**37**	1114	3
Anaeorobic Digestion				#	0	0	0	**0**	72	0
Hydro	6	3.4	3.8	**13.2**	6	3.4	3.8	**13.2**	73	18
Heat Pumps	6	669	155	**830**	0.4	50	12	**62**	na	na
Micro Solar Thermal	93	3	49	**145**	0.6	0.02	2.8	**3.4**	na	na
Micro PV	9	2.84	6.96	**18.86**	0.57	0.18	0.44	**1.19**	1018	1
Onshore wind										
Large	0	0	0	**0**	0	0	0	**0**	–	
Medium	0	0	20	**20**	0	0	10	**10**	–	
Small	0.125	0.125	0.75	**1**	0.125	0.125	0.75	**1**	–	
Total Wind	0.125	0.125	20.75	**21**	0.125	0.125	10.75	**11**	460	2.3
Micro wind	11.61	25.85	21	**58.46**		*		**0.5**	1832	0.03
TOTAL	**218**	**710**	**1014**	**1943**	**12.21**	**50.49**	**65.85**	**128.79**	**8339**	**1.5**

Footnotes: * **Contribution estimated for Peak Sub-Region only**
– **East Midlands targets not sub-divided by wind turbine size**

4.97 **Table 4.18** shows the estimated carbon savings resulting from the estimated renewable energy capacity figures (**Table 4.17**) for the Peak Sub-Region to 2026.

4.98 Presenting the contribution to CO_2 saving from potential renewables as a proportion of the current energy use (and resultant CO_2 emissions) in the Peak Sub-Region gives a more localised picture of the role that renewables could play in replacing conventional fossil fuel energy consumption in the future.

4.99 The study has used 2006 energy use data from the UK National Atmospheric Emissions Inventory[15] which shows CO_2 emissions by local authority area. The Peak Sub-Region consists of the two local authority administrative areas of the High Peak Borough Council and the Derbyshire Dales District Council. The 2006 CO_2 emission figures for the two local authorities are 3,038,000 tonnes and 779,000 tonnes of CO_2 respectively, (the figure for the High Peak Borough includes very high solid fuel demand principally associated with lime and cement production). If energy use and equivalent CO_2 in the two areas was to stay constant until 2026, renewable energy generation within the Peak Sub-Region would constitute approximately one percent (1%) of CO_2 savings.

[15] UK National Atmospheric Emissions Inventory (www.naei.org.uk)

Table 4.18: Estimated Carbon Savings from Renewable Energy Production to 2026

Technology	**Carbon Dioxide Savings to 2026 (tonnes)**			
	PDNP	HPBC	DDDC	Sub Region
Biomass	1136.8	71	284.2	**1492**
Energy Crops	0	0	9065	**9065**
AD	0	0	0	**0**
Hydro	2580	1462	1634	**5676**
Heat Pumps	98	12250	2940	**15288**
Solar thermal	142.1	4.9	686	**833**
PV	245.1	77.4	189.2	**511.7**
Onshore wind				
Large	0	0	0	**0**
Medium	0	0	4300	**4300**
Small	53.75	53.75	322.5	**430**
Micro wind				**215**
TOTAL	**4353.75**	**13919.05**	**19420.9**	**37908.7**

SPATIAL CONCLUSIONS

4.100 This part of the report draws together the spatial implications from the findings of the technology assessments. It then goes on to provide recommendations for additional planning policies to support the provision of renewable energy technologies. This is outlined for the respective three planning areas below:

PEAK DISTRICT NATIONAL PARK

SPATIAL IMPLICATIONS

Note. [It should be taken into consideration that all development within the National park will need to have regard to the statutory purposes and duty of the National Park as set out in the Environment Act 1995].

Biomass

Medium/small scale biomass plants are already being developed within the settlements throughout the Peak District National Park where the plant house and storage facilities can either be accommodated within existing development or appropriately planned new development. The current limited supply of locally produced biomass material may improve in future years as the market demand for supply expands. It is unlikely however to influence the location of medium/small scale biomass plans in the future as materials can be easily delivered in sufficient quantities by road throughout the Park.

Anaerobic digestion

There may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites providing appropriate criteria is applied to prevent adverse impacts upon the sensitive nature of the environment and landscape.

Larger biomass or digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. It is recognised that such facilities are limited within the Peak District National Park. Appropriate criteria will need to be applied to prevent adverse impacts to the environment and landscape of the Peak District National Park. Where facilities would not have a significant adverse effect on the environment and local communities, a positive planning approach should be adopted. This should be considered through the policies in the Derbyshire Waste Development Framework, the Peak District National Park Local Development Framework and through the development control process.

Currently, the Derbyshire Waste Strategy, 'Looking after Derbyshire's Waste' July 2006 states that that any processing of residual waste either by energy recovery or by anaerobic digestion, or a combination of the two will not be located within the Peak District National Park..

Hydro
The hydro assessment undertaken by the Friends of the Peak District highlights that future development potential for small scale and micro hydro plants is predominantly in relation to the restoration of old mill sites within the Park. Elsewhere potential sites identified appear likely to be in rural river/stream locations.

Heat pumps
Potential locations are likely to include both urban and rural locations in conjunction with either existing or new development.

Solar
Potential locations are likely to include residential and commercial areas and community buildings in existing settlements, as well more rural locations such farms, golf clubs and tourism facilities such as camping and caravan sites.

Wind
There are no suitable locations for large and medium scale turbines. Potential locations for small scale turbines are limited to areas of moderate to high landscape sensitivity where these correlate with wind speeds of 5m/s and above. These could be in either rural or edge of urban settings provided that their appearance doesn't detract from the landscape or the special qualities of the Peak District National Park.

District Heating
The study examined the potential for district heating within Bakewell, the largest town in the Park area. There are two existing heat anchors in the town which could provide potential in the future for possible linkage to a small scale district heating system if potential for redevelopment in the vicinity comes forward in the planning period to 2026. There is also scope for new development within the plan period to investigate the potential for district heating as part of its proposals for carbon reduction.

NEW PLANNING POLICY
The Peak District National Park Authority should consider the following policy areas for incorporation into the Core Strategy as a means of addressing national and regional planning policy guidance and the outcome of this study in regard to renewable energy.

Anaerobic Digestion
The Regional Plan requires a positive planning approach to be adopted by the Peak District National Park Authority and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

Energy Statement
The requirement for an energy statement for proposed new developments will support the East Midlands Energy Strategy and its objectives of improving energy efficiency and increasing the proportion of energy used generated from renewable sources.

The statement should demonstrate the expected energy and carbon dioxide savings from the energy efficiency and renewable energy measures incorporated in the development, and where relevant include the feasibility of connecting to, or the provision of, community heating systems. Its purpose is to show the project's compliance to statutory regulation and/or regional or planning authority guidelines. Requiring an energy statement would assist in fulfilling part of the policy requirement of Regional Plan Policy 40.

A detailed description of the elements to be included in an energy statement, and guidelines on how they can be implemented by local planning authorities, is included in Section 6 of the Appendices accompanying this report.

It is recommended that the detailed process of an energy statement procedure should be displayed on the relevant websites of the three planning authorities in the Peak Sub-Region. The flow chart outlined in **Appendix 5** outlines the steps applicants should follow.

It is also beneficial for each planning authority to implement a template wording that should be used in the planning application as "compliance statement", i.e. a pledge by the applicant to implement the target guideline of the Energy statement.

Provision of heating networks
In line with Regional Plan Policy 40, the DPD should include policies to secure a reduction in the need for energy through the location of developments, site layout and building design. As a planning authority, the Peak District National Park should create a framework for energy to be considered early in the development process, potentially taking some of the burden away from the developer. By identifying potential areas for district heating or CHP schemes, it should reduce the risk of developments not being designed to connect to decentralised energy, and may also encourage the development of Energy Service Companies (ESCos) that could supply heat and/or power to new developments. Decentralised energy can also provide a path to carbon neutral development, with initial fossil-fuelled heating-only schemes potentially being upgradeable to biomass fuel and/or CHP.
SPG for Energy Renewables and Conservation
An update of this SPG is now required and could include more recent exemplar renewable energy developments to demonstrate best practice.

HIGH PEAK BOROUGH PLANNING AREA

SPATIAL IMPLICATIONS

Biomass
Medium/small scale biomass plants have potential to be developed within settlements throughout the Borough planning area where the plant house and storage facilities can either be accommodated within existing development or appropriately planned new development. The current limited supply of locally produced biomass material may improve in future years as the market demand for supply expands. It is unlikely however to influence the location of medium/small scale biomass plans in the future as materials can be easily delivered in sufficient quantities by road throughout the area.

Anaerobic digestion
There may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites providing appropriate criteria is applied to prevent adverse impacts upon the environment and sensitive nature of the landscape.

Larger biomass or digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. Appropriate criteria will need to be applied to prevent adverse impacts to the environment and landscape of the High Peak Planning Area.

Hydro
There are a number of opportunities for the further development of small/micro hydro schemes within the High Peak Borough planning area principally related to the restoration of old mill sites and the use of reservoirs, weirs and sluices.. A more detailed investigation would be required to determine technical and economic feasibility of these potential sites.

Heat pumps
Potential locations are likely to include both urban and rural locations in conjunction with either existing or new development. In particular, waterside/canalside regeneration areas within the Borough provide potential locations for the use of WSHP technology.

Solar
Potential locations are likely to include residential and commercial areas and community buildings in existing settlements, as well more rural locations such farms, golf clubs and tourism facilities such as camping and caravan sites.

Wind
There are no suitable locations for large and medium scale turbines. Potential locations for small scale turbines are limited to areas of moderate to high landscape sensitivity where these correlate with wind speeds of 5m/s and above. These could be in either rural or edge of urban settings provided that their appearance doesn't detract from the qualities of the landscape.

District Heating
The study examined the potential for district heating within the principal town of Buxton. Future redevelopment proposals within the town could provide potential for district heating, and may be appropriate to extend links to existing adjacent development if appropriate/feasible

NEW PLANNING POLICY
The High Peak Borough Planning Authority should consider the following policy areas for incorporation into the Core Strategy as a means of addressing national and regional planning policy guidance and the outcome of this study in regard to renewable energy

Anaerobic Digestion
The Regional Plan requires a positive planning approach to be adopted by the Peak Sub-Region Planning Authorities and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

Energy Statement
The requirement for an energy statement for proposed new developments will support the East Midlands Energy Strategy and its objectives of improving energy efficiency and increasing the proportion of energy used generated from renewable sources.
The statement should demonstrate the expected energy and carbon dioxide savings from the energy efficiency and renewable energy measures incorporated in the development, and where relevant include the feasibility of connecting to, or the provision of, community heating systems. Its purpose is to show the project's compliance to statutory regulation and/or regional or planning authority guidelines. Requiring an energy statement would assist in fulfilling part of the policy requirement of Regional Plan Policy 40.

A detailed description of the elements to be included in an energy statement, and guidelines on how they can be implemented by local planning authorities, is included in Section 6 of the Appendices accompanying this report.

It is recommended that the detailed process of an energy statement procedure should be displayed on the relevant websites of the three planning authorities in the Peak Sub-Region. The flow chart outlined

in **Appendix 5** outlines the steps applicants should follow.
It is also beneficial for each planning authority to implement a template wording that should be used in the planning application as "compliance statement", i.e. a pledge by the applicant to implement the target guideline of the Energy statement.

Provision of heating networks
In line with Regional Plan Policy 40, the DPD should include policies to secure a reduction in the need for energy through the location of developments, site layout and building design. As a planning authority, High Peak should create a framework for energy to be considered early in the development process, potentially taking some of the burden away from the developer. By identifying potential areas for district heating or CHP schemes, it should reduce the risk of developments not being designed to connect to decentralised energy, and may also encourage the development of Energy Service Companies (ESCos) that could supply heat and/or power to new developments. Decentralised energy can also provide a path to carbon neutral development, with initial fossil-fuelled heating-only schemes potentially being upgradeable to biomass fuel and/or CHP.

Decentralised energy: heating and power
Again, in line with Regional Plan Policy 40, the DPD should require all developments to demonstrate that their heating and power systems have been selected to minimise carbon emissions. Proposals for major developments should evaluate combined heat and power systems and where a new system is installed as part of a new development, examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

Stand alone renewables
A policy should be added to deal with cases of stand alone renewable facilities that could be used to export energy to the grid, or to empower private wire and/or district heating schemes. A policy similar to Derbyshire Dales Adopted Plan Policy CS5 would be a consistent and appropriate policy approach for the area.

DERBYSHIRE DALES PLANNING AREA

SPATIAL IMPLICATIONS

Biomass
Medium/small scale biomass plants are already being developed within the settlements within the District planning area where the plant house and storage facilities can either be accommodated within existing development or appropriately planned new development. The current limited supply of locally produced biomass material may improve in future years as the market demand for supply increases, and if the farming community within the south of the District explore opportunities for energy crop planting in place of traditional arable and pastoral farming. Supply is unlikely however to influence the location of medium/small scale biomass plans in the future as materials can be easily delivered in sufficient quantities by road throughout the area.

Anaerobic digestion
There may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites providing appropriate criteria is applied to prevent adverse impacts upon the environment and sensitive nature of the landscape.

Larger biomass or digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. Appropriate criteria will need to be applied to prevent adverse impacts to the environment and landscape of the Derbyshire Dales Planning Area.

Hydro
The key opportunities for expanding the use of small/micro hydro schemes within the Derbyshire

Dales District planning area are in relation to the restoration of old mill sites and in areas of the District where there is suitable flow or head of water within watercourses. The hydro assessment undertaken by the Friends of the Peak District highlights that future development potential for small scale and micro hydro plants relates to the restoration of two old mill sites, one in Bonsall, the other in Cromford.

An assessment of potential hydro power sites in the East Midlands carried out in 2001[16] identified seven potential sites within the Derbyshire Dales District area but only one was considered to be viable. This is the Oak Hurst Mills site on the River Derwent. The scheme has not been progressed further to date, but is clearly a potential site for future hydro generation. The remaining six sites which were assessed for potential but considered not to be economically viable are located along the River Dove.

Key constraints to the future of hydro development however, are the lack of water availability within the District, highlighted by the severe restrictions imposed on water abstraction by the Environment Agency through the Dove and Derwent Catchment Area Management Plans, and the concentration of key environmental designations in the Derwent area which coincide with areas of steep slope potentially suitable for high head hydro sites.

Solar
Potential locations are likely to include residential and commercial areas and community buildings in existing settlements, as well more rural locations such farms, golf clubs and tourism facilities such as camping and caravan sites.

Heat pumps
Potential locations are likely to include both urban and rural locations in conjunction with either existing or new development.

Wind
The Derbyshire Dales Planning area is broadly unsuitable for the development of large or medium scale wind turbines, although there are some limited locations that could be considered for medium turbines but only after a thorough investigation of the likely landscape impacts, wind speed and impacts on radar infrastructure has been made.

Potential locations for small scale turbines are limited to areas of moderate to high landscape sensitivity where these correlate with wind speeds of 5m/s and above. These could be in either rural or edge of urban settings provided that their appearance doesn’t detract from the landscape quality of the area.

District Heating
The study examined the potential for district heating within the principal town of Matlock. Future redevelopment proposals within the town, as mentioned above should consider the potential for district heating, as well as links to existing adjacent development if appropriate/feasible.

NEW POLICY AREAS
The Derbyshire Dales LPA should consider the following policy areas for incorporation into the Core Strategy as a means of addressing national and regional planning policy and the outcome of this study in regard to renewable energy.

Anaerobic Digestion
The Regional Plan requires a positive planning approach to be adopted by the Peak Sub-Region Planning Authorities and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

[16] Viewpoints on sustainable energy in the East Midlands – Land Use Consultants and IT Power - 2001

Energy Statement

The requirement for an energy statement for proposed new developments will support the East Midlands Energy Strategy and its objectives of improving energy efficiency and increasing the proportion of energy used generated from renewable sources. The statement should demonstrate the expected energy and carbon dioxide savings from the energy efficiency and renewable energy measures incorporated in the development, and where relevant include the feasibility of connecting to, or the provision of, community heating systems. Its purpose is to show the project's compliance to statutory regulation and/or regional or planning authority guidelines. Requiring an energy statement would assist in fulfilling part of the policy requirement of Regional Plan Policy 40.

A detailed description of the elements to be included in an energy statement, and guidelines on how they can be implemented by local planning authorities, is included in **Section 6** of the Appendices accompanying this report. It is recommended that the detailed process of an energy statement procedure should be displayed on the relevant websites of the three planning authorities in the Peak Sub-Region. The flow chart outlined in **Appendix 5** outlines the steps applicants should follow. It is also beneficial for each planning authority to implement a template wording that should be used in the planning application as "compliance statement", i.e. a pledge by the applicant to implement the target guideline of the Energy statement.

Provision of heating networks

In line with Regional Plan Policy 40, the DPD should include policies to secure a reduction in the need for energy through the location of developments, site layout and building design. As a planning authority, High Peak should create a framework for energy to be considered early in the development process, potentially taking some of the burden away from the developer. By identifying potential areas for district heating or CHP schemes, it should reduce the risk of developments not being designed to connect to decentralised energy, and may also encourage the development of Energy Service Companies (ESCos) that could supply heat and/or power to new developments. Decentralised energy can also provide a path to carbon neutral development, with initial fossil-fuelled heating-only schemes potentially being upgradeable to biomass fuel and/or CHP.

5 CARBON CAPTURE

5.1 This study has also assessed the potential for carbon savings from the restoration of peat moorlands within the Peak Sub-Region. Moorlands and peat covered areas are usually considered as a natural carbon sink as they can actively sequester (or fix) carbon. As the peat forms it locks in carbon, contained in plant matter and prevents it from being released into the atmosphere, thus could have a direct and positive effect through reducing and capturing CO_2 and storing it. Conversely, it has been estimated that drying peat releases as much carbon into the atmosphere each year as the entire transportation system of the UK.

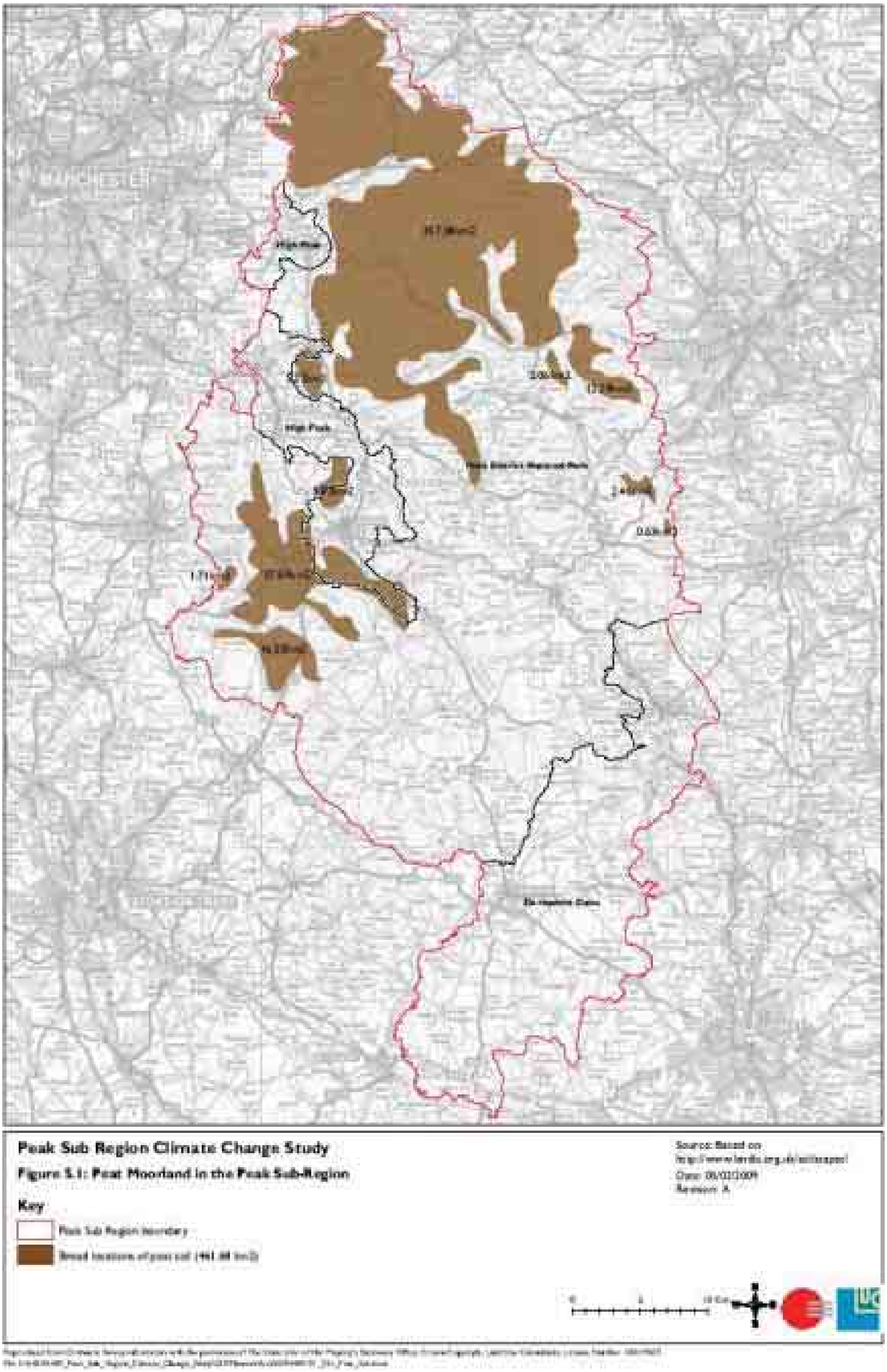
5.2 The location and extent of peat moorland in the Peak Sub-Region is shown on **Figure 5.1**. The map is drawn from data taken from the interactive website of Cranfield University/ Silsoe.

5.3 The assessment addressed the impact of this issue on the Peak Sub-Region and considered a scenario of complete restoration of the moorland for carbon capture (see **Appendix 3** for details).

5.4 The study examined the carbon savings resulting from restoring and expanding peat moorland in the Peak Sub Region to double its current area of **462** km^2. The calculation was forecasted for up to 10 years to see the effect that the restoration process would have on minimising the level of carbon dioxide emissions in the atmosphere. The total carbon saving of 1 km^2 of restored peat moorland would be **-609 to -1128** tonnes of equivalent CO_2/km^2/yr. This figure is equivalent to taking 240 cars off the roads or generating renewable energy from a 1MW wind turbine.
If the current area of 462 km^2 of peat moorland is doubled, this could effectively result in massive carbon savings of between 160,167 tonnes – 296,664 tonnes, far in excess of the savings that can be achieved from the contribution from renewables during the period up to 2026.

5.5 An added benefit for the three planning authorities would be to use the process to claim Carbon Credits, as part of the Carbon Reduction Commitment CRC, which currently equals to £25/tonne of equivalent CO_2 compared to £10/tonne of equivalent CO_2 from woodland restoration.

Figure 5.1: Peat Moorland in the Peak Sub-Region



6 SETTING TARGETS

6.1 The Peak Sub-Region, as defined in the East Midlands Regional Plan, consists of the area covered by the Derbyshire Dales District, the High Peak Borough and the Peak District National Park. However, the East Midland region's renewable electricity targets are not sub-divided geographically, so there are currently no targets for renewable energy generation for the Peak Sub-Region, or for the local or planning authorities within the sub-region.

6.2 The three authorities in the Peak sub-region have indicated their intention to set targets for sustainable energy within their respective areas. Targets for total renewable energy consumption may be set in two ways:

- in absolute terms, expressed as a set figure of energy production from renewables or other low carbon sources. This approach allows the sub-regional contribution towards the East Midlands regional targets to be seen clearly in percentage terms, as a fraction of energy demand in the sub-region. Targets in this form should help the sub-region contribute to the national targets for climate change, which include milestone targets for reducing carbon dioxide (CO_2) emissions such as:
    - a total reduction in emissions of 80% by 2050 (Climate Change Act, 2008);
    - a 12.5% reduction in CO_2 emissions over the 2008-12 period (Kyoto) enhanced to a 20% cut by 2010;
    - 15% of energy demand to come from renewable energy by 2020 (EU Renewables Directive, as part of an EU-wide 20% target);
    - a 9% improvement in energy efficiency by 2016 (EU End-Use Directive).

6.3 Percentage targets may also be set for new developments within the sub-region (using the "Merton Rule"), where the planning authorities have a much greater influence over whether and how they may be achieved and a set of targets are given in **Table 6.7**.

Absolute Sub-Regional Targets

6.4 The regional renewables targets, which focused on electricity, were first set out in the 2001 document Viewpoints on Sustainable Energy in the East Midlands. They were subsequently reviewed by Best Foot Forward in 2006, as it was apparent that most were likely to be missed, although others – notably offshore wind – had already been exceeded.

6.5 In the 2006 review, the following targets in GWh/year were identified on a Business as Usual (BAU) scenario for the entire East Midlands.[17]

Table 6.1: East Midlands BAU Renewable Energy Targets in GWh/annum (2006 data)

BAU scenario	2001	2003	2005	2010	2015	2020	2025	2030	2050
Offshore wind	0	0	473	1315	2158	3000	3483	3967	5900
Onshore wind (large scale)	0	3	16	126	183	240	277	313	460
Biomass – wet agricultural wastes	0	0	0	14	28	42	77	112	254
Biomass – poultry litter	0	0	0	118	118	210	210	210	210
Biomass – energy crops/co-firing	0	0	2085	2085	2085	1012	1114	1217	1626
Hydropower	12	14	14	39	51	62	73	84	129
Microgeneration - Wind	0	0	0	0	0	145	426	707	1832
Microgeneration - PV	0	0	0	0	1	1	1	1	1018
MSW Waste (incineration & gasificatio	55	55	55	55	118	118	118	118	118
Landfill gas	232	345	438	438	438	438	358	278	117
Anaerobic digestion	0	0	11	39	50	64	72	78	100
TOTAL (renewables %)	1%	2%	13%	18%	21%	21%	24%	26%	39%

6.6 Although Best Foot Forward went on to consider seven further scenarios, based on inclusion or exclusion of microgeneration and offshore wind, as well as the impact of a more rigorous implementation of the national 20% target, the component parts most relevant to the sub-region did not vary in order of magnitude. Looking specifically at how 2010 interim targets were seen in

[17] East Midlands Regional Targets and Scenarios for Renewable Energy, Best Foot Forward, 2006: http://www.emra.gov.uk/files/file724.pdf, p23.

the light of experience to date, the conclusions drawn[18] – excluding municipal and industrial solid wastes (MSW) and Landfill gas – were as follows:

Table 6.2: Summary of East Midlands 2010 Renewable Energy Targets in GWh/annum (2006 data)

BAU scenario	2010 GWh/yr	capacity MWe	Comments
Offshore wind	330	1250	Could reach 3,000 GWh/yr
Onshore wind	319	122	Will miss for 2010, but could make in 2020
Biomass – wet agricultural wastes	41.7	5.1	Will miss for 2010, but could make in 2020
Biomass – poultry litter	118.3	15	
Biomass – energy crops	343	46	Excludes biomass co-firing (Drax)
Hydropower		10.6	Likely to reach 8.5MWe installed by 2010
Microgeneration - Wind	13.8	15.9	Assumed to be mainly wind as PV not cost effective until 2025 (EST)
Microgeneration - PV	0	0	PV may be most appropriate in sub-region
Anaerobic digestion	64.1	8.1	Will miss for 2010, but could make in 2020
Energy Efficiency - Industrial	1120		20% reduction from 2001 energy use
Energy Efficiency - Services	254		9.5% reduction from 2001 energy use
Energy Efficiency - Domestic	600		8% reduction from 2001 energy use

6.7 These may then be viewed as to how targets can be attributed to the sub-region. Data in the table below is drawn from the 2006 Best Foot Forward (BFF) report on target for the East Midlands Regional Assembly on a Business as Usual (BAU) scenario for 2001-2010, with the 2026 figures taken from Appendix 5 of the East Midlands Plan[19], published in 2009, which in turn is based upon modified scenario 4d of the BFF report.

Table 6.3: Attribution of EM 2026 Renewable Energy Targets to Sub-Region

BAU scenario	East Midlands Targets[20] (BFF) 2001 GWh/yr	2010 GWh/yr	2020 GWh/yr	EM RSS 2026 GWh/yr	**Sub-Region 2026** GWh/yr	Notes
Offshore wind	0	1,315	3,000	3,483	**0**	1
Onshore wind	0	126	240	460	**10**	2
Biomass – wet agricultural wastes	0	14	42	77	**15**	3
Biomass – poultry litter	0	118	210	210	**0**	4
Biomass – energy crops	0	2,085	1,012	1,114	**37**	5
Hydropower	12	39	62	73	**8**	6
Microgeneration – Wind	0	0	145	1,832	**2**	7
Microgeneration – PV	0	0	1	1,018	**1**	8
Anaerobic digestion (non-farm)	0	39	64	72	**0**	9
TOTAL	12	3,732	4,776	8,339	**73**	
TOTAL (renewables %)	1%	18%	21%	20%	**2%**	10

*Notes to **Table 6.3** above, indicating basis for 2026*

1. Offshore wind is not applicable in the sub-region, but is included in this table for completeness and for comparison with the renewables percentage contribution to regional demand.
2. No large wind developments are likely to be operational by 2020, although there is a current project in planning which may be on stream. By 2026, the assumption is that the will be 5MW of capacity, representing either one very large turbine, two large turbines, or up to 12 medium sized turbines.

[18] Conclusions drawn from the East Midlands Regional Targets and Scenarios for Renewable Energy, Best Foot Forward, 2006: http://www.emra.gov.uk/files/file724.pdf
[19] East Midlands Regional Plan published by Communities and Local Government, March 2009 (RSS 2009). The 2026 column in the table is taken from the indicative target for 2026 in GWh/yr in Appendix 5: Renewable Energy Targets (Policy 40), p179.
[20] East Midlands Regional Targets and Scenarios for Renewable Energy, Best Foot Forward, June 2006

3. Reflecting less intensive agriculture in the sub-region, there will be only a limited number of AD plants on farms
4. Few poultry farms in area (compared to Lincolnshire, for example); any chicken litter available for use will probably be exported outside the sub-region.
5. Sub-region has a reasonable proportion excluding co-firing, which will mainly be supplied from local sources.
6. Although East Midlands' hydro resource is mainly in the sub-region, there appears to be a disconnect between the RSS indicative target, which is based on a top-down approach assuming that all the technical capacity will be brought on stream by 2050, and that much of it will be operational by 2026. In contrast, the sub-regional review takes a bottom up approach looking at what is likely to be able to be brought into production economically.
7. Limited in sub-region except at the smallest scale. Recent evidence from field trials by Encraft, the BRE and the Carbon Trust suggest output from micro wind turbines (under 5kWp capacity) does not generally meet expectations, so a lower – but achievable – sub-regional target has been retained. The estimates used in the RSS for 2020 leapt from 145GWh/yr (in the 2006 review of targets) to 1,832GWh/yr (for both 2020 and 2026).
8. As with micro-wind, PV estimates have swung from very low (in BFF's 2006 review of targets) to significantly higher (in the indicative 2026 target). The initial PV targets were unambitious if mandatory renewables targets are imposed on all new developments, as in many areas PV will be the easiest to achieve, even though it will not be cheap. However, based on installed capacity, the indicative 2026 target would be equivalent to around 1 million domestic installations in the East Midlands (ignoring commercial roofs). This will be equivalent to substantially all South facing roofs in the region having been fitted with PV between 2010 and 2026. The same assumption has not been adopted for the sub-region in this study, but if it were to be, would lead to a target output of around 33GWh/yr. This has not been incorporated into the above table as it is unlikely to occur without new legislation.
9. Mainly sewage sludge, as it excludes wet agricultural wastes. There may be a small contribution (under 1GWh/yr) contributions from within the sub-region, but any significant plants are likely to be built nearer to Derby or other large population centres).
10. Total includes co-firing, MSW, and landfill gas.

6.8 The sub-regional targets above should be seen as purely indicative of the level of output that might enable the Peak area to contribute its "fair share" to the Best Foot Forward estimates on a BAU scenario. Based on the latest data available from Defra[21], the sub-region is responsible for around 3.8Mt of CO_2 emissions, compared to 40.8Mt in the East Midlands as a whole. If these estimates are restricted to exclude transport (including off-road use by tractors) and non-fuel emissions, the respective figures become 1.95 and 25.0Mt respectively. These figures, which are broken down by main fuels, can be converted back into energy, indicating a sub-regional demand of 6.2GWh/yr, or around 7.4% of the East Midlands demand. With vigorous energy efficiency measures this may be assumed to fall by 20% to just under 5.0GWh by 2026. However this includes very high solid fuel demand within High Peak Borough (where it has the 6th highest reported emissions in the UK, principally associated with lime and cement production)[22]. Excluding the four largest plants, demand may fall to 3.7GWh by 2026. Annual renewable production of 73GWh would meet just 2.0% of this demand.

6.9 If the lime and cement production plants are eliminated from the calculation, the sub-region has around 5.6% of regional energy use, based on the Defra 2006 data. For comparison, the sub-regional renewable energy contribution by 2026 is 1.5% of the East Midlands target excluding offshore wind.

6.10 The East Midlands targets above also exclude heat. In both the whole region and the Peak sub-region, it is likely on grounds of cost-effectiveness and ease of installation that solar thermal and ground source heat pumps will be the principal contributors, alongside biomass. Due to difficulties in estimating thermal output from these technologies when installations are small and widely distributed, and the fact that most domestic installations are permitted development and

[21] The Defra data is only available by local authority district, so the figures are for the sum of the High Peak plus Derbyshire Dales districts. See http://www.defra.gov.uk/environment/statistics/globatmos/galocalghg.htm for sources. Information restricted to the National Park area is not readily available. It could in theory, be approximated by summing up the 1km grid square data that is also available, but this would actually introduce a significant new level of error.
[22] The National Atmospheric Emissions inventory identifies four "point sources" for CO_2 emissions from energy use within High Peak. These are (in descending order of emissions) Hope and Tunstead Cement works, and Hindlow and Buxton Lime Works. This excludes CO_2 emitted from the processing of limestone.

are therefore not recorded by local authority planning departments, it is not possible to set any sub-regional targets, but instead it is necessary to rely on site specific targets. As data becomes available over time, it may be practicable to revisit this, and use other data sources (such as gas or fuel oil deliveries, combined with Carbon Emissions Reduction Target - CERT energy efficiency installations) or packaged wood fuel sales to derive a likely heat figure.

6.11 Finally, any renewable energy from geothermal sources (as may be available in Buxton, Matlock Bath or nearby areas) has also been excluded from national and regional target setting.

Sub Regional Percentage Targets

6.12 The regional targets referred to above are expressed in absolute terms of energy generated (in GWh/yr) and not as a percentage of energy demand (or supplied) within the region. However many of the Government's national targets are expressed in percentage terms (e.g. to reduce CO_2 emissions by 32% by 2020.) Percentage savings targets are also commonly applied to energy efficiency measures.

6.13 In considering the sub-regional targets, it is therefore logical to look first at energy efficiency in percentage terms and then to focus on absolute targets for renewable energy. It is outside the scope of this document to make recommendations on individual energy efficiency targets, as many are delivered through programmes that are outside the control of planning authorities, such as the Carbon Emissions Reduction Target (imposed on fuel utilities), the Carbon Reduction Commitment (for non-domestic energy users above a threshold level) and minimum standards (and labelling) on appliances agreed at an EU level. Of course, it is possible for local authorities, in their role as energy conservation authorities (under the Home Energy Conservation Act) to encourage residents to take action (as they can, indeed, promote renewable energy installations).

Local Target Setting: Renewable Energy Targets

6.14 Existing policy approaches to setting renewable energy targets for development have, in most cases, derived from a ‘one size fits all’ approach which is typified by councils pioneering policies requiring at least a 10% contribution from on-site renewables, the most well known of which is the Merton Rule. Planning authorities are now building on their experience of renewables targets, tightening definitions, reviewing the site size thresholds and, in some cases, setting differential targets for residential and commercial development. To date, almost all targets have been defined in terms of a percentage of the energy used, or CO_2 emitted, to be provided from on-site renewable sources. [The use of CO_2 as a baseline has recently emerged as a way of accounting for the different CO_2 emission intensities between a kWh of grid electricity and a kWh of gas].

6.15 In order to create robust targets, which are set at a level that reflects local opportunities and constraints, are underpinned by sufficient evidence, and are viable, planning authorities are urged to assess the scope for area-wide and site specific target setting. The levels at which these targets can be set will vary depending on the range of local circumstances. The latest Planning Advisory Service guidance[23] on the type of situations where higher percentage (**site specific**) targets could be set include:

- where there is an existing or proposed district heating main supplied by a renewable or low carbon source close to a site;
- larger sites where new biomass district heating schemes are appropriate
- where there are existing or potential waste resources available
- mixed use sites containing buildings with complementary energy demands, which make CHP a more cost effective option
- where free standing wind turbines are feasible
- where hydro resources are available close by
- substantial growth/regeneration area where the scale of development may permit district wide strategies using a mix of sources.

6.16 Having investigated the scope for a range of renewable technologies and examined the potential for district heating for three towns within the Peak Sub-Region, this study reveals that the situations outlined above appear to be limited.

[23] Planning Advisory Service – Setting targets for decentralised energy (http://www.pas.gov.uk/pas/core/page.do?pageId=94401)

6.17 In addition to looking at **area-wide targets** for the three planning authority areas, a small number of representative sites from each were assessed for their potential renewable energy options as a reality check on how targets might be delivered. The sites due to be, or currently being developed for domestic and non domestic end-uses were selected to collectively represent the range of developments likely to occur in each of the three planning authority areas. A summary of the methodology and conclusions are included here, with further details outlined in **Appendix 2**.

6.18 Typical energy demands were quantified for each site through assessment of the likely energy intensity and size of each given development according to its end use.

6.19 Having ascertained the attributable energy demands and CO_2 emissions, the feasibility and viability of each of the applicable low- and zero-carbon technologies was examined to determine the extent to which CO_2 emissions could be reduced without negatively impacting on the character and sensitivity of the landscape in which they would be situated. Contributions of each of the appropriate technologies and the volume of CO_2 emissions displaced through their operation were then quantified with the assumption that natural gas and grid electricity were as the comparable conventional fuels in each of the case studies.

6.20 The following tables present a summary of the outcomes of the case studies. Table 6.4 presents an index of the sites assessed. The next two tables present a summary of the range of feasible and viable contributions from the appropriate low- and zero-carbon technologies (domestic new-build developments - Table 6.5, and non-domestic new-build developments - **Table 6.6**) and the related CO_2 emissions reductions that the installation of these technologies could provide[24] .

Table 6.4: Index of Case Studies for Potential of Renewable Energy in Domestic and Non-domestic Development Sites

Case Studies	Site	Site Reference	Area	No Units
Non-Domestic				
Case Study 1	Tongue Lane Industrial Estate, Buxton	NLP 142, 143 and 144	4 ha	3 developments
Case Study 2	Ashbourne Industrial Estate, Ashbourne	NLP 016	5.5 ha	mixed end-use
Case Study3	Hall Farm, Hathersage	NLP 063	0.26 ha	Office
Domestic				
Case Study 1	Bakewell Road, Matlock	W2396	0.95 ha	58 social housing
Case Study 2	Chequer's Farm, Millers Green	DD 713	0.25 ha	5 apartments, 5 houses
Case Study 3	Main Street, Kniveton	DD 694	0.14 ha	1 house
Case Study 4	St Georges Road, New Mills	HP 179	200 m^2	1 house
Case Study 5	Glossop Road, Charlesworth	HP 844	120 m^2	1 house
Case Study 6	Brown Edge Road, Buxton	HP 160	15 @ 120 m^2 and 15 @ 150 m^2	30 houses
Case Study 7	Highfield Road, Bakewell	NP/DDD/0401/163 15th July 2002	23 @ 66 m^2 and 13 @ 76 m^2	36 houses

6.21 The landscape sensitivity assessment and site-specific case studies have confirmed that wind energy generation would be inappropriate in much (but not all) of the Peak Sub-Region and that where acceptable on landscape grounds, there is a risk that wind speeds may be too low for wind to be economically viable. Furthermore, other forms of renewable electricity generation such as hydro and energy from waste (CHP) are unlikely to be suitable as on-site energy sources for both domestic and non-domestic developments throughout the region. As a result, the most likely low- and zero-carbon technologies to be used and considered in these case studies are biomass boilers, GSHP, solar thermal and PV.

[24] The results are not based on life cycle analysis. For example, the PV figure does not take into account the energy embodied in the panels themselves. However in the case of biomass it does include a factor for the energy used in the production of the fuel, including distribution energy. To be as consistent as possible, it excludes the energy embodied in the actual stove or boiler system.

Table 6.5: Summary of Case Studies: Potential of Low- and Zero-Carbon Technologies for Domestic New-Build Developments

Technology	Application	Renewable Energy Contribution (% of total demand)	Annual CO_2 emission reduction (% of total emissions)	Assumptions
Biomass Boiler	Central Heating	up to 60%	25-30%	Installation of a Biomass Boiler instead of a natural gas fired boiler for central heating.
Biomass Stove (room-heater)	Secondary Heating	10%	3%	Installation of a Biomass Stove (room-heater) to supplement a natural gas central heating system.
GSHP	Central Heating	up to 60%	10%	Installation of a GSHP running on grid electricity instead of a natural gas boiler for central heating. CO_2 emission reduction depends on COP.
Solar Thermal	Domestic Hot Water	< 10%	4%	Installation of a Solar Thermal Hot Water system (2m^2 for typical 3 bed semi) for DHW. All other space and water heated with natural gas.
Solar PV	Electricity Generation	Up to 5% potentially more but expensive	<20%	Installation of Solar Photovoltaics (1 kW$_p$ typical for domestic installations) to offset some use of grid electricity.
Biomass CHP/District Heating	Heat and Electricity Generation	up to 100%	up to 100%	Entirely dependant on magnitude and degree of heat demand, system size and development size. .

Table 6.6: Summary of Case Studies: Potential of Low- and Zero-Carbon Technologies for Non-Domestic New-Build Developments

Technology	Application	Renewable Energy Contribution (% of total demand)	Annual CO_2 emission reduction (% of total emissions)	Assumptions
Biomass Boiler	Central Heating and Industrial Processes (where relevant)	20% to 60%	15% to 25%	Dependant on energy intensity and heat: electricity ratio of industry.
Biomass Stove (room-heater)	Secondary Heating	n/a	Potential for small contribution	Small contribution possible in hospitality and some offices.
GSHP	Primary Central Heating and pre-heating water for industrial processes (where relevant)	20% to 60%	5% to 10%	Dependant on energy intensity and heat: electricity ratio of industry.
Solar Thermal	Domestic Hot Water (also small potential for preheating water for industrial processes)	less than 5%	less than 5%	Dependant on energy intensity, heat: electricity ratio of industry and demand for low temperature water.
Solar PV	Electricity Generation	<6%; limited only by roof-space and available budget	<6% potentially but expensive	Installation of Solar Photovoltaics (1 kW_p typical for domestic installations) to offset some use of grid electricity.
Biomass CHP/District Heating	Heat and Electricity Generation	Up to 100%	up to 100%	Entirely dependant on magnitude and degree of heat demand, system size and development size.

6.22 The site assessments reveal that while it is relatively easy to achieve large contributions to total energy demand from low- and zero-carbon technologies in domestic developments (e.g. 66% from 12 kW Biomass Boiler in Case study 5), it is more difficult for industrial or commercial applications (especially where there is demand for process energy e.g. **Case study 1**). Consequently, setting a blanket target for low- and zero-carbon technology energy generation across all development sites irrespective of end-use would be inappropriate.

6.23 Furthermore, with the exception of PV, all of these technologies generate heat energy, so the fossil fuel source they are most likely to displace is natural gas - the primary heat energy source in the UK for both domestic and non-domestic development. (It is acknowledged however that there are areas within the Peak Sub Region that have not yet been connected to the gas grid). Consequently, it is more difficult for non domestic developments (especially those using electricity as the primary energy source) to achieve large renewable energy contributions when the range of electricity generating low- and zero-carbon technology types is constrained.

6.24 To reflect these local constraints (i.e. the relative ease of installation of low/zero carbon technologies in domestic new-build developments and the limited possibilities of generating electricity from renewables in non-domestic development), we recommend that differential targets for domestic and non domestic properties be set. We suggest introducing a tiered target based on planning use:

Table 6.7: Recommended Differential Targets for Renewable Energy Generation in New Developments by End Use

End Use	Renewable Energy Target (% of gross demand)
Domestic	14
Non-domestic (Offices, hotels, leisure)	10
Non-domestic (Other non-dwellings)	6

6.25 In each case, the percentage figures are set at levels that could typically be achieved by using:

- Biomass for primary heating;
- Biomass CHP/District Heating;
- GSHP;
- Solar PV (Non-domestic, other non dwellings);
- Biomass Secondary Heating and Solar PV; and/or
- Biomass Secondary Heating and Solar Thermal.

6.26 This approach will allow for maximum choice of approach for developers to achieve the targets and does not lead to a reliance on any one technology. Setting differential targets for domestic and non-domestic properties has been adopted by a minority of local authorities who have adopted Merton-type rules[25] but is appropriate for the sub-region given the constraints identified in the detailed assessment work.

6.27 Non-domestic energy intensity and therefore renewable energy contribution varies according to the end-use. In general the offices/hotels/leisure are more likely to avail of larger contributions for biomass secondary heating and solar thermal. This means that more options are available to them and that they should therefore achieve at least 10% contribution from low- and zero- carbon technologies as demonstrated in the case studies.

6.28 Due in part to the uncertainty of the energy-intensity of non-domestic end-uses, a target of less than 10% should be used for non-domestic end uses other than offices, hotels and leisure. This ensures that there are a variety of generation mixes available for the target to be reached and does not force developers to rely on biomass which could in turn, impose short-term strains on local supply, given the previously identified constraints in the sub-region. Based on the case studies, NEF believe that 6% is an appropriate target for non domestic developments other than offices hotels and leisure. A lower level for non-domestic properties is also in keeping with the published timeline for national Building Regulations, where homes are expected to achieve Code Level 6 (net zero carbon) by 2016, but DCLG do not expect non-domestic properties to achieve equivalent carbon neutrality until 2019.

6.29 As demonstrated in the domestic case studies, a renewable energy contribution of over 14% is readily achievable through a number of viable combinations of low- and zero-carbon technologies.

[25] Lancaster City Council is reported by the TCPA to also use differential rates, and most local authorities set different thresholds.

6.30 We suggest that, in line with the Merton rule, planning authorities include a minimum size threshold below which compliance with renewable energy targets will be encouraged but not mandatory. Typically, targets will not need to apply for developments of fewer than 5 dwellings (or a total of 16 bedrooms) or non-domestic floor-space of below 1,000 m2.

CO_2 Targets

6.31 The carbon dioxide savings that will result from the renewable energy targets will vary greatly depending on the primary energy being displaced. For example, displacing electricity as opposed to gas will double the CO_2 savings (as shown **Table 6.8** below).

Table 6.8: Summary of DEFRA's Guidelines of Greenhouse Gas Conversion Factors (2008)[26]

Fuel	Kg CO_2 per KWh
Gas	0.19
Electricity	0.537
Oil	0.258

6.32 As a result, a number of local authorities use CO_2 emissions reduction targets as the measurement when adopting Merton-type rules instead of a percentage of renewable energy generation.

6.33 The equivalent CO_2 emissions reduction from the renewable energy generation target recommended in Table 6.9 would therefore be as follows:

Table 6.9: Recommended Differential Targets Expressed as Percentage of Renewable Energy Generation and Related CO_2 Emissions Reductions in New Developments

	Renewable Energy Target (% of gross demand)	Percentage reduction in predicted carbon emissions (% of gross emissions)
Domestic	14	8
Non-domestic (Offices, hotels, leisure)	10	6
Non-domestic (Other non-dwellings)	6	3.5

6.34 In order to define those CO_2 targets, we used standard conversion factors (as in **Table 6.8**) and included the key parameters identified in the case studies.

6.35 The relationship between the contribution of renewable energy to the total energy demand and the CO_2 emissions reduction is largely dependant on the heat: electricity ratio of the proposed development and the low- and zero-carbon technology employed.

6.36 In the case studies, we already established that the implementation of renewable energy systems to provide electricity (such as PV and wind) is very limited; therefore the most likely low- and zero-technologies to be implemented will provide heat energy and therefore most likely displace gas.

6.37 A 50:50 heat: electricity ratio would produce 0.364kg CO_2 per unit of energy used (using DEFRA's guidelines for gas and electricity as in table 6.6). Assuming 10% of the total energy demand is generated from renewable heat (biomass for example), the actual CO_2 saved would be 0.019kg CO_2, which would be about 5% of the total CO_2 emissions. Applying this logic to any type of ratio heat: electricity gives the chart as shown in **Appendix 6**.

[26] All the standard conversion factors are taken from the Defra Environmental Reporting Guidelines (annexes updated April 2008) which can be downloaded at http://www.defra.gov.uk/environment/business/reporting/pdf/ghg-cf-guidelines-annexes2008.pdf. At the time of this report (July 2009) Defra released the new 2009 figures onto its website: http://www.defra.gov.uk/environment/business/reporting/pdf20090701-guidelines-ghg-conversion-factors.pdf. A review of the 2009 data shows that almost all factors have changed but by very small amount hences making no difference to the results of this report.

6.38 For domestic properties, the heat: electricity ratio typically ranges from around 50:50 to 65:35. By supplying 14, 10 and 6% of the total energy with low/zero-carbon energy, the related CO_2 savings would be in the range of 8, 6 and 3.5% respectively.

6.39 Site-specific renewable energy targets will only need to apply to developments approved under the current or next building regulations (2010). Subsequent regulations (2013 and 2016) will almost certainly require carbon reductions that can only be met by technological solutions equivalent to those listed above.

6.40 As an alternative approach, the authorities in the sub-region could instead impose standards based on achieving set levels of the Code for Sustainable Homes, or BREEAM in the non-domestic sector. This has added benefits in drawing in wider environmental issues, but may impose significant additional on-costs for developers in order to meet the non-energy elements, especially at higher than mandated levels. There are also concerns about which levels can be achieved at all using current mass-market technologies. **Table 6.10** (at the end of this section) extracts the additional costs relating to scenarios 1 and 3 (small developments of around 9 houses and market town developments of 100 homes, principally houses rather than flats) from the July 2008 DCLG report "*Cost Analysis of The Code for Sustainable Homes*". This updated earlier information prepared for them by Cyril Sweett in late 2006 and excludes any potential compliance by use of small or micro wind turbines.

6.41 We recommend that planning authorities also need to consider procedures for developers to show that they are meeting any targets set. In general this can be achieved through a combination of planning and building control. At the planning stage, developers need to submit a calculation of expected energy use and the strategy for meeting the renewables target. A procedure will need to be put into place to refer approved planning permissions within the PDNP to the relevant local authority so that they can be tracked by the appropriate building control department. In the domestic sector, once the building is completed, or being marketed, a registered On Construction Domestic Energy Assessor (OCDEA) has to issue an Energy Performance Certificate (EPC), indicating compliance; the method below is applicable mainly to non-domestic buildings. The Government's Standard Assessment Procedure (SAP) is used as the basis for calculating both EPCs and the baseline energy demand baseline for calculating the percentage renewable energy supply for the Merton Rule. Developers will be able to provide renewables output figures based on manufacturers' data.

6.42 There are various toolkits that have been produced to assist developers in meeting renewable energy target requirements; the best known is probably the London Renewables toolkit which can be freely downloaded from the GLA website[27]. The Town and Country Planning Association also produce a number of useful reports that may be freely downloaded from its website, including Sustainable Energy by Design[28].

6.43 Some domestic developers may oppose differential targets for domestic and non-domestic, as they will have to make higher percentage savings. However this structure creates a more level playing field by taking into account the most likely split between heating (including hot water), lighting and other energy uses of the varying types of building.

6.44 The use of renewable energy targets has sometimes come under attack due to an increase in construction costs, and in particular, how this may affect the provision of affordable homes. More work would be needed to ensure that the domestic targets did not conflict with the authorities' desire to see appropriate provision of affordable housing, but the suggested figure of 14% for homes is still lower than that being required by the GLA in London, for example, where there are fewer small scale renewable options.

6.45 In addition, the Homes and Communities Agency (formerly the Housing Corporation) has announced its intention that new homes funded under the National Affordable Housing Programme[29] should meet zero carbon and level 6 of the Code for Sustainable Homes by 2015 if the technology needed to achieve this cost-effectively is available and – through the Homes & Communities Agency – is working to facilitate this through advice and support for social housing providers[30]. There is also an acceptance that some of the additional costs may have to be borne

[27] Available from http://www.london.gov.uk/mayor/environment/energy/renew_resources.jsp
[28] Available from http://www.tcpa.org.uk/downloads/TCPA_SustEnergy.pdf
[29] Design and Quality Strategy: www.housingcorp.gov.uk/upload/pdf/Design_and_quality_strategy.pdf
[30] There may still be a cost issue for affordable homes built by individuals (such as self-builders), although these usually fall outside the scope of the rule due to being on developments of less than 5 dwellings.

through lower land values, and potentially funded by S106 agreements from associated commercial developments.

6.46 Adoption of a renewable energy target will not generate significant additional work for the three authorities. At the planning and building control level, there would need to be limited additional checking work to ensure compliance. There is no need for any authority adopting such a rule to aggregate statistics for reporting purposes, although some choose to do so to demonstrate its effectiveness. Any statutory requirements would be caught already by the Home Energy Conservation Act or in the reporting targets for national indicator NI186 on CO_2 emissions.

6.47 As an alternative approach, some local authorities, such as Milton Keynes, have established a route for local offsetting of carbon emissions where developers find the requirements too onerous. Under these arrangements, often known as a Carbon Offset Fund, developers have to pay a fixed amount per tonne of residual annual CO_2 emissions (£200 in the case of Milton Keynes). The money is then used to support energy efficiency improvements in existing housing stock in the same local authority district, resulting in at least equivalent savings. The figure has been set on the broad assumption that an investment of £200 should enable an annual reduction of at least one tonne in existing properties.

Table 6.10: Cost of Achieving Minimum Energy Requirements for Code Levels 1 to 6[31]

Code level	Carbon Saving (%)	Development scenario					
		Small (9 dwellings)			Market town (100 dwellings)		
		Technology	Capital cost	Code credits	Technology	Capital cost	Code credits
Detached House							
1	10	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,648	4
3	25	4m2 flat panel SHW	£3,916	7	4m2 flat panel SHW	£3,916	7
4	44	Best practice energy efficiency and PV	£10,914	11	Biomass heating	£9,868	10
5	100	Biomass heating and PV	£22,367	17	Biomass CHP	£17,132	16
6	Zero Carbon	Advance practice energy efficiency, PV and biomass heating	£40,228	19	Advance practice energy efficiency, PV and biomass CHP	£32,752	19
End Terraced							
1	10	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,648	4
3	25	4m2 flat panel SHW	£3,916	7	4m2 flat panel SHW	£3,692	7
4	44	Biomass heating	£5,880	11	Biomass heating	£7,115	10
5	100	Biomass heating and PV	£13,292	17	Biomass CHP	£12,353	16
6	Zero Carbon	Advance practice energy efficiency, PV and biomass heating	£29,393	19	Advance practice energy efficiency, PV and biomass CHP	£24,822	19
Mid Terraced							
1	10	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,648	4
3	25	4m2 flat panel SHW	£3,916	7	4m2 flat panel SHW	£3,692	7
4	44	Biomass heating	£5,133	11	Biomass heating	£6,187	10
5	100	Biomass heating and PV	£11,933	17	Biomass CHP	£10,742	16
6	Zero Carbon	Advance practice energy efficiency, PV and biomass heating	£29,172	19	Advance practice energy efficiency, PV and biomass CHP	£24,696	19
Flat							
1	10	N/A	N/A	N/A	Improved controls	£275	1
2	18	N/A	N/A	N/A	Improved air tightness and insulation levels	£1,648	4
3	25	N/A	N/A	N/A	PV and Best Practice energy efficiency	£2,622	8
4	44	N/A	N/A	N/A	Biomass heating	£5,054	10
5	100	N/A	N/A	N/A	Biomass CHP	£9,962	16
6	Zero Carbon	N/A	N/A	N/A	Advance practice energy efficiency, PV and biomass CHP	£18,996	19

31 Source: Cost Analysis of The Code for Sustainable Homes, DCLG July 2008 (Table 2.3: assuming that no wind power can be used)

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 This Chapter bring together a summary of the conclusions and recommendations for the three respective planning authorities by technology and planning policy themes.

PEAK DISTRICT NATIONAL PARK

BIOMASS

Biomass feedstocks - The National Park can play an increasing, but limited role, in improving biomass resource from existing and expanded woodlands in terms of production of logs and other useful forest residues.

The contribution from forestry biomass is estimated to be about 1,300 tonnes of waste wood a year, potentially generating 4.64 GWh of energy per year, and saving 1,136 tonnes of carbon dioxide. In terms of energy crops, the landscape of the Peak District National Park is considered to be very sensitive and predominantly unsuitable for energy crops. The study has assessed no contribution from energy crops within the National Park.

Recommendation

The scope for harnessing the products of conservation management from within the National Park and using them as a biomass source should be reviewed by the National Park Authority. Appropriate funding sources should be investigated.

Biomass infrastructure - Medium/small scale biomass plants are already being developed within the settlements throughout the Peak District National Park where the plant house and storage facilities can either be accommodated within existing development or appropriately planned new development. The current limited supply of locally produced biomass material may improve in future years as the market demand for supply expands. It is unlikely however to influence the location of medium/small scale biomass plans in the future as materials are currently easily delivered by road throughout the Park from the surrounding region and beyond.

Recommendation for the expansion of feedstocks

As part of a sustained commitment to tackling climate change, the Peak District National Park Authority and its local partners and stakeholders should continue to assist wherever possible in promoting the expansion of the local biomass resource within their areas, and to promote the use of biomass systems for heating/power generation locally. This will help in the longer term to overcome some of the obstacles outlined above, as will advances in heating technologies by improving flexibility of use compared to gas or oil systems.

ANAEROBIC DIGESTION (AD)

There may be opportunities for accommodating small scale anaerobic digester plants dealing with farm manure or slurry on or adjacent to existing farm buildings providing appropriate criteria is applied to prevent adverse impacts upon the sensitive nature of the environment and landscape.

Currently, the Derbyshire Waste Strategy, 'Looking after Derbyshire's Waste' July 2006 states that any processing of residual waste either by energy recovery or by anaerobic digestion, or a combination of the two will not be located within the Peak District National Park.

Due to the current limited information regarding the quantity of various feed stocks for AD within the Peak District National Park it is not possible to make a meaningful assessment of the likely contribution the AD could make towards the Regional target.

Recommendation

The Regional Plan requires a positive planning approach to be adopted by the Peak District National Park Authority and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

To assist in the Government's shared goals for AD, the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

SMALL AND MICRO SCALE HYDRO

Within the Peak District National Park the key opportunities for expanding the use of small/micro hydro schemes are in relation to the restoration of old mill sites and weirs, and in areas of the Park where there is suitable flow or head of water within watercourses.

There are also a number of key constraints however which severely limit the viability of schemes within the Park. These are in relation to water availability, impact on important environmental designations, grid availability, and the need to avoid adverse impact upon the sensitive landscape. This is not to say that there isn't scope within the Park for small/scale hydro, but as schemes come forward they will need to be carefully considered in terms of conformity with Peak District National Park policy and other stakeholder legislative requirements. The study has assessed that the potential energy from hydro schemes in the National Park could generate up to 6GWh/y or energy, a carbon dioxide saving of 2580 tonnes.

Recommendation

There is scope for the National Park Authority to bring together key stakeholders, including Friends of the Peak District, the Environment Agency and Sub-Regional partners to look for ways to collaboratively facilitate the future development of small/micro hydro within the Peak Sub-Region.

HEAT PUMP TECHNOLOGIES

Overall, there are many opportunities within the Peak District National Park to use heat pump technologies within the Park, which is demonstrated by the six GSHP already installed, but similarly there are many constraints. Suitability of location in terms of conditions and environmental impact will vary for each installation, so feasibility can only be addressed in detail on a case by case basis. The study has assessed that ground source heat pumps could provide the heat demand for 40% of planned new development up to 2026, generating 0.4GWh/y of energy, a carbon dioxide saving of 98 tonnes.

SOLAR TECHNOLOGIES

The scope for further installations of solar thermal technologies within the Peak Sub-Region is expected to increase, particularly with the increasing cost of fossil fuels. The market is also expanding from predominantly domestic installations to other buildings such as commercial and community premises, farms, golf clubs, and tourism facilities such as camping and caravan sites. The technologies are currently used predominantly as retrofit on existing buildings, but are increasingly being incorporated into new developments. The study has assessed the energy contribution from solar technologies within the National Park to 2026 to be 0.6GWh/y from solar thermal and 0.57GWh/y from photovoltaics, a carbon dioxide saving of 142, and 245 tonnes respectively.

WIND

Large – medium scale wind turbines

The constraints of high landscape sensitivity; widespread key environmental designations, lack of grid infrastructure, likely radar interference and the general rural nature and poorer accessibility within the windiest parts of the Park combine to make the Peak District National Park an unsuitable location for large or medium scale wind turbines.

Small scale wind turbines

The study reveals landscape sensitivity to be the overarching constraint with many areas of the Peak District National Park being assessed as of high landscape sensitivity and moderate to high sensitivity. There were no areas of moderate sensitivity.

The study concludes that for small wind turbines there may be some limited opportunity to accommodate the technology in areas of moderate to high sensitivity without changing landscape character, but that great care would be needed in locating infrastructure. In terms of locations where small wind turbines could be usefully used, the Peak District National Park's SPG provides the best source of guidance, but key considerations would also be the need for adequate wind speed, as suitable wind speeds for small scale turbines are not universally spread throughout the Peak District National Park, and the need to avoid areas where the height of a turbine is likely to interfere with NERL radar infrastructure.

The study has assessed a conservative estimate of five additional small wind turbines being accommodated within the National Park to 2026. This would generate 0.125GWh/y of energy, a CO_2 saving of 53 tonnes.

TOTAL RENEWABLE ENERGY CONTRIBUTION

The Peak District National Park contribution in total is approximately 12 GWh/y by 2026, constituting ten percent (10%) of the Peak Sub-Region total capacity and generating a CO_2 saving of 4,353 tonnes. The main technology contributors are small scale hydro and biomass.

DISTRICT HEATING

Principal town - Bakewell

There are two existing heat anchors in the town which could provide potential in the future for possible linkage to a small scale district heating system if potential for redevelopment in the vicinity comes forward in the planning period to 2026. There is also scope for new development within the plan period to investigate the potential for district heating as part of its proposals for carbon reduction.

CARBON CAPTURE

The study has examined the potential for carbon savings resulting from restoring and expanding peat moorland within the National Park. The carbon saving of 1 km^2 of restored peat moorland would be -609 to -1128 tonnes of equivalent $CO_2/km^2/yr$. This figure is equivalent to taking 240 cars off the roads or generating energy from a 1 MW wind turbine.

If the current area of 462 km^2 of peat moorland is doubled in size this could effectively result in massive carbon dioxide savings of between 160,167 tonnes – 296,664 tonnes, far in excess of the savings that can be achieved from the contribution from renewables.

An added benefit for the three planning authorities would be to use the process to claim Carbon Credits, as part of the Carbon Reduction Commitment CRC, which currently equals to £25/tonne of equivalent CO_2. Compared to £10/tonne of equivalent CO_2 from woodland restoration.

PLANNING POLICY & TARGET SETTING

Anaerobic Digestion

Provision of appropriately worded policy to support the development of anaerobic digestion within the Peak District National Park, to include suitable criteria to safeguard the environment and sensitive landscape of the Park.

Energy Statement
The study recommends the requirement of an energy statement from developers for new development proposals as means of ensuring a proposal's compliance to statutory regulation and planning policy.

Heating Networks
In line with Regional Plan Policy 39, the DPD should include policies to secure a reduction in the need for energy through the location of developments, site layout and building design. As a planning authority, the Peak District National Park should create a framework for energy to be considered early in the development process, potentially taking some of the burden away from the developer. By identifying potential areas for district heating or CHP schemes, it should reduce the risk of developments not being designed to connect to decentralised energy, and may also encourage the development of Energy Service Companies (ESCos) that could supply heat and/or power to new developments. Decentralised energy can also provide a path to carbon neutral development, with initial fossil-fuelled heating-only schemes potentially being upgradeable to biomass fuel and/or CHP.

Decentralised energy: heating and power
Again, in line with Regional Plan Policy 39, the DPD should require all developments to demonstrate that their heating and power systems have been selected to minimise carbon emissions. Proposals for major developments should evaluate combined heat and power systems and where a new system is installed as part of a new development; examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

SPG for Energy Renewables and Conservation
An update of this SPG is now required and could include more recent exemplar renewable energy developments to demonstrate best practice

Targets for Total Renewable Energy Consumption
These may be set in two ways: In absolute terms - expressed as a set figure of energy production from renewables or other low carbon sources. This approach allows the Sub-Regional contribution towards the East Midlands regional targets to be seen clearly.

In percentage terms, as a fraction of energy demand in the Sub-Region. Targets in this form should help the Sub-Region contribute to the national targets for climate change

Site Specific Targets
Percentage targets may also be set for new developments within the planning area, where the planning authority has a much greater influence over whether and how they may be achieved. The study has suggested using differential targets for domestic and non-domestic properties and set a tiered target based on planning use:

Use	Renewable Energy Target (% of gross demand)
Domestic (>5 dwellings, or >16 bedrooms in total)	14%
Offices, hotels, leisure (>1,000m^2)	10%
Other non-dwellings (>1,000m^2)	6%

As an alternative approach, some local authorities have established a route for local offsetting of carbon emissions where developers find the requirements too onerous. Under these arrangements, often known as a Carbon Offset Fund, developers have to pay a fixed amount per tonne of residual annual CO_2 emissions. The money is then used to support energy efficiency improvements in existing housing stock in the same local authority district, resulting in at least equivalent savings.

HIGH PEAK BOROUGH PLANNING AREA

BIOMASS

Biomass feedstocks - The area can play an increasing, but limited role, in improving biomass resource from existing and expanded woodlands in terms of production of logs and other useful forest residues. The contribution from forestry biomass is estimated to be about 84 tonnes of waste wood a year, potentially generating 0.29 GWh of energy per year, and saving 71 tonnes of CO_2. In terms of energy crops, the landscape of the High Peak planning area is considered to be very sensitive and predominantly unsuitable for energy crops. The study has assessed no contribution from energy crops within the High Peak planning area.

Recommendation

The scope for harnessing the products of conservation management from within the High Peak planning area, and using them as a biomass source should be reviewed by the High Peak Borough Council. Appropriate funding sources should be investigated.

Biomass infrastructure - Medium/small scale biomass plants have potential to be developed within settlements throughout the Borough planning area where the plant house and storage facilities can either be accommodated within existing development or appropriately planned new development. The current limited supply of locally produced biomass material may improve in future years as the market demand for supply expands. It is unlikely however to influence the location of medium/small scale biomass plans in the future as materials can be easily delivered in sufficient quantities by road throughout the area.

Recommendation for the expansion of feedstocks

As part of a sustained commitment to tackling climate change, the High Peak Borough Council and its local partners and stakeholders should continue to assist wherever possible in promoting the expansion of the local biomass resource within their areas, and to promote the use of biomass systems for heating/power generation locally. This will help in the longer term to overcome some of the obstacles outlined above, as will advances in heating technologies by improving flexibility of use compared to gas or oil systems.

ANAEROBIC DIGESTION (AD)

There may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites providing appropriate criteria is applied to prevent adverse impacts upon the environment and sensitive nature of the landscape.

Larger digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. Appropriate criteria will need to be applied to prevent adverse impacts to the environment and landscape of the High Peak Planning Area. Due to the current limited information regarding the quantity of various feed stocks for AD within the High Peak Planning Area it is not possible to make a meaningful assessment of the likely contribution the AD could make towards the Regional target.

Recommendation

The Regional Plan requires a positive planning approach to be adopted by the Peak Sub-Region Planning Authorities and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

To assist in the Government's shared goals for AD, the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into

the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

SMALL AND MICRO SCALE HYDRO

There are a number of opportunities for the further development of small/micro hydro schemes within the High Peak Borough planning area principally related to the restoration of old mill sites and the use of reservoirs, weirs and sluices. A more detailed investigation would be required to determine technical and economic feasibility of these potential sites, so it has not been possible to assess at this stage the detailed energy potential from these sources. However, the study has made an estimate of potential future contribution from small/micro hydro to be 3.4 GWh/y for the High Peak Borough planning area to 2026, a carbon dioxide saving of 1,462 tonnes.

Recommendation

To assist in the realisation of additional potential, the Borough Council should bring together key stakeholders, including Friends of the Peak District, the Environment Agency and Sub-Regional partners to look for ways to collaboratively assess the potential and facilitate the future development of small/micro hydro schemes within the area.

HEAT PUMP TECHNOLOGIES

There appear to be good opportunities for the use of heat pump technologies within the area, with limited environmental constraints. Nevertheless, suitability of location in terms of conditions and environmental impact will vary for each installation, so feasibility can only be addressed in detail on a case by case basis.

The study has assessed that ground source heat pumps would provide the heat demand for 40% of planned new development up to 2026, generating 50GWh/y of energy, a carbon dioxide saving of 12250 tonnes.

SOLAR TECHNOLOGIES

The scope for further installations of solar thermal technologies within the area is expected to increase, particularly with the increasing cost of fossil fuels. The market is also expanding from predominantly domestic installations to other buildings such as commercial and community premises, farms, golf clubs, and tourism facilities such as camping and caravan sites. The technologies are currently used predominantly as retrofit on existing buildings, but are increasingly being incorporated into new developments.

The study has assessed the energy contribution from solar technologies within the High Peak planning area to 2026 to be 0.02GWh/y from solar thermal and 0.18GWh/y from photovoltaics, a carbon dioxide saving of 5, and 77 tonnes respectively.

WIND

Large – medium scale wind turbines

The study reveals that landscape sensitivity is an overriding constraint for the development of large and medium scale wind turbines in the area. A further constraint is the limited area with average wind speeds above 7m/s. Consequently, the study concludes that the High Peak Borough planning area is unsuitable for the development of large or medium scale wind turbines.

Small scale wind turbines

The study reveals landscape sensitivity to be the overarching constraint with many areas of high landscape sensitivity and moderate to high sensitivity. There are also significant areas where wind speed is below 5m/s. It is concluded that for small wind turbines there may be some limited opportunity to accommodate the technology in areas of moderate to high sensitivity without changing landscape character, but that great care would be needed in locating infrastructure. Furthermore there may be scope for small scale turbines in urban commercial areas where wind speed is above 5 m/s. The areas where they may be scope include limited areas of Buxton and New Mills, but would need detailed on-site assessment before wind speed viability could be established. The study has assessed a conservative estimate of five additional small wind turbines being accommodated within the High Peak Borough planning area to 2026. This would generate 0.125GWh/y of energy, a carbon dioxide saving of 53 tonnes.

TOTAL RENEWABLE ENERGY CONTRIBUTION
The High Peak Borough Planning Area contribution in total is approximately 50 GWh/y by 2026, constituting forty percent (40%) of the Peak Sub-Region renewable energy capacity, generating a carbon dioxide saving of 13,919 tonnes. The main contribution is from heat pump technologies.

DISTRICT HEATING
Buxton
Future redevelopment proposals within the town should consider the potential for district heating, as well as links to existing adjacent development if appropriate/feasible.

PLANNING POLICY & TARGET SETTING
Stand-alone renewables
Consider including a policy to deal with cases of stand alone renewable facilities that could be used to export energy to the grid, or to empower private wire and/or district heating schemes. A policy similar to Derbyshire Dales Adopted Plan Policy CS5 would be a consistent and appropriate policy approach for the area.

Anaerobic Digestion
Provision of appropriately worded policy to support the development of anaerobic digestion within the High Peak Borough Planning Area, to include suitable criteria to safeguard the environment and sensitive landscape of the area.

Energy Statement
The study recommends the requirement of an energy statement from developers for new development proposals as means of ensuring a proposal's compliance to statutory regulation and planning policy.

Heating Networks
In line with Regional Plan Policy 39, the DPD should include policies to secure a reduction in the need for energy through the location of developments, site layout and building design. As a planning authority, the High Peak Borough Council should create a framework for energy to be considered early in the development process, potentially taking some of the burden away from the developer. By identifying potential areas for district heating or CHP schemes, it should reduce the risk of developments not being designed to connect to decentralised energy, and may also encourage the development of Energy Service Companies (ESCos) that could supply heat and/or power to new developments. Decentralised energy can also provide a path to carbon neutral development, with initial fossil-fuelled heating-only schemes potentially being upgradeable to biomass fuel and/or CHP.

Decentralised energy: heating and power
Again, in line with Regional Plan Policy 39, the DPD should require all developments to demonstrate that their heating and power systems have been selected to minimise carbon emissions. Proposals for major developments should evaluate combined heat and power systems and where a new system is installed as part of a new development; examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

Targets for Total Renewable Energy Consumption
These may be set in two ways: In absolute terms - expressed as a set figure of energy production from renewables or other low carbon sources. This approach allows the Sub-Regional contribution towards the East Midlands regional targets to be seen clearly.
In percentage terms, as a fraction of energy demand in the Sub-Region. Targets in this form should help the Sub-Region contribute to the national targets for climate change

Site Specific Targets
Percentage targets may also be set for new developments within the planning area, where the planning authority has a much greater influence over whether and how they may be achieved.

The study has suggested using differential targets for domestic and non-domestic properties and set a tiered target based on planning use:

Use	Renewable Energy Target (% of gross demand)
Domestic (>5 dwellings, or >16 bedrooms in total)	14%
Offices, hotels, leisure (>1,000m^2)	10%
Other non-dwellings (>1,000m^2)	6%

As an alternative approach, some local authorities have established a route for local offsetting of carbon emissions where developers find the requirements too onerous. Under these arrangements, often known as a Carbon Offset Fund, developers have to pay a fixed amount per tonne of residual annual CO_2 emissions. The money is then used to support energy efficiency improvements in existing housing stock in the same local authority district, resulting in at least equivalent savings.

DERBYSHIRE DALES PLANNING AREA

BIOMASS
Biomass feedstocks - The area can play an increasing, but limited role, in improving biomass resource from existing and expanded woodlands in terms of production of logs and other useful forest residues. The contribution from forestry biomass is estimated to be about 326 tonnes of waste wood a year, potentially generating 1.16GWh of energy per year, and saving 284 tonnes of CO_2.

In terms of energy crops, the landscape of the south of the district is considered to provide opportunities for both SRC and miscanthus planting which could contribute in the future to an increase in local biomass production and supply. The study has assessed that production could generate 37GWh of energy per year, a CO_2 saving of 9065 tonnes.

Recommendation
The scope for harnessing the products of conservation management from within the Derbyshire Dales planning area, and using them as a biomass source should be reviewed by the Derbyshire Dales District Council. Appropriate funding sources should be investigated.

Biomass infrastructure - Medium/small scale biomass plants are already being developed within the settlements within the District planning area where the plant house and storage facilities can either be accommodated within existing development or appropriately planned new development. The current limited supply of locally produced biomass material may improve in future years as the market demand for supply increases, and if the farming community within the south of the District explore opportunities for energy crop planting in place of traditional arable and pastoral farming. Supply is unlikely however to influence the location of medium/small scale biomass plans in the future as materials can be easily delivered in sufficient quantities by road throughout the area.

Recommendation for the expansion of feedstocks
As part of a sustained commitment to tackling climate change, the Derbyshire Dales District Council and its local partners and stakeholders should continue to assist wherever possible in promoting the expansion of the local biomass resource within their areas, and to promote

the use of biomass systems for heating/power generation locally. This will help in the longer term to overcome some of the obstacles outlined above, as will advances in heating technologies by improving flexibility of use compared to gas or oil systems.

ANAEROBIC DIGESTION (AD)

There may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites providing appropriate criteria is applied to prevent adverse impacts upon the environment and sensitive nature of the landscape.

Larger digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites. Appropriate criteria will need to be applied to prevent adverse impacts to the environment and landscape of the Derbyshire Dales Planning Area.

Due to the current limited information regarding the quantity of various feed stocks for AD within the Derbyshire Dales Planning Area it is not possible to make a meaningful assessment of the likely contribution the AD could make towards the Regional target.

Recommendation

The Regional Plan requires a positive planning approach to be adopted by the Peak Sub-Region Planning Authorities and the Derbyshire Waste Authority to ensure that opportunities for appropriately scaled and located AD facilities are not stifled. This could be achieved through the inclusion of a policy to promote the development of AD, but with appropriate safeguarding criteria such as that generic guidance for AD provided in the accompanying Landscape Sensitivity Study to this report.

To assist in the Government's shared goals for AD, the waste and planning authorities of the Peak Sub-Region may wish to consider carrying out a more detailed investigation into the future potential for AD within the Peak Sub-Region, as well as focus on shared stakeholder interests for developing this emerging renewable energy technology.

SMALL AND MICRO SCALE HYDRO

The key opportunities for expanding the use of small/micro hydro schemes within the Derbyshire Dales District planning area are in relation to the restoration of old mill sites and in areas of the District where there is suitable flow or head of water within watercourses. Key constraints to the future of hydro development however, are the lack of water availability within the District, highlighted by the severe restrictions imposed on water abstraction by the Environment Agency through the Dove and Derwent Catchment Area Management Plans, and the concentration of key environmental designations in areas of steepest slope.

On the basis of the local studies and assessments carried out to date this study has assessed that potential energy from hydro schemes in the Derbyshire Dales District to 2026 could generate about 1.7GWh of electrical energy per year. This could increase to 3.8 GWh/y if sites considered not to be economically feasible in a 2001 study are included. This could generate a carbon dioxide saving of 1634 tonnes.

Recommendation

To assist the realisation of this potential, the District Council should bring together key stakeholders, including Friends of the Peak District, the Environment Agency and Sub-Regional partners to look for ways to collaboratively facilitate the future development of small/micro hydro within the District.

HEAT PUMP TECHNOLOGIES

Within the area there appear to be good opportunities for the use of heat pump technologies within the area, with limited environmental constraints. Nevertheless, suitability of location in terms of conditions and environmental impact will vary for each installation, so feasibility can only be

addressed in detail on a case by case basis.
The study has assessed that ground source heat pumps would provide the heat demand for 40% of planned new development up to 2026, generating 12GWh/y of energy, a CO_2 saving of 2940 tonnes.

SOLAR TECHNOLOGIES
The scope for further installations of solar thermal technologies within the Derbyshire Dales District planning area is expected to increase, particularly with the increasing cost of fossil fuels. The market is also expanding from predominantly domestic installations to other buildings such as commercial and community premises, farms, golf clubs, and tourism facilities such as camping and caravan sites. The technologies are currently used predominantly as retrofit on existing buildings, but are increasingly being incorporated into new developments.
The study has assessed the energy contribution from solar technologies within the Derbyshire Dales planning area to 2026 to be 2.8GWh/y from solar thermal and 0.44GWh/y from photovoltaics, a carbon dioxide saving of 686 and 189 tonnes respectively.

WIND
Large – medium scale wind turbines
The study reveals that there are three key constraints to the development of large and medium scale wind turbines within the Derbyshire Dales District Planning Area. One is the high sensitivity of the landscape, the second is the limited area with average wind speeds above 7m/s, and the third is the likely interference turbines would make to aviation radar systems in the area.

The study concludes that the Derbyshire Dales Planning area is broadly unsuitable for the development of large or medium scale wind turbines, although there are some limited locations that could be considered for medium scale turbines but only after a thorough investigation of the likely landscape impacts, wind speed and impacts on radar infrastructure has been made.

The study has identified that there is potential for 5MW[32] of wind generated energy in the area known in landscape terms as the 'Enclosed Moors and Heaths' area. This could generate 10 GWh/y by 2026, a carbon dioxide saving of 4300 tonnes.

Small scale wind turbines
The study reveals that there are some opportunities for small scale wind turbines in areas of moderate landscape sensitivity and in urban areas where wind speed is over 5 m/s. Care would be needed in locating infrastructure to avoid any adverse impact on the landscape, as well as areas where turbines are likely to interfere with NERL aviation radar infrastructure.

The study has assessed a conservative estimate of five additional small wind turbines being accommodated within the High Peak Borough planning area to 2026. This would generate 0.75GWh/y of energy, a carbon dioxide saving of 322 tonnes.

TOTAL RENEWABLE ENERGY CONTRIBUTION
The Derbyshire Dales District Planning Area contribution in total is approximately 65 GWh/y by 2026, constituting fifty percent (50%) of the Peak Sub-Region total capacity. The main contributors are energy crops, heat pumps and medium scale wind.

DISTRICT HEATING
Principal town - Matlock
Future redevelopment proposals within the town should consider the potential for district heating, as well as links to existing adjacent development if appropriate/feasible.

PLANNING POLICY & TARGET SETTING
Anaerobic Digestion

[32] This could be 3 clusters of 5 medium scale turbines, or 5 clusters of 3 medium scale turbines, with a collective capacity of 5MW.

Provision of appropriately worded policy to support the development of anaerobic digestion within the Derbyshire Dales District Planning Area, to include suitable criteria to safeguard the environment and sensitive landscape of the area.

Energy Statement

The study recommends the requirement of an energy statement from developers for new development proposals as means of ensuring a proposal's compliance to statutory regulation and planning policy.

Heating Networks

In line with Regional Plan Policy 39, the DPD should include policies to secure a reduction in the need for energy through the location of developments, site layout and building design. As a planning authority, the Derbyshire Dales District Council should create a framework for energy to be considered early in the development process, potentially taking some of the burden away from the developer. By identifying potential areas for district heating or CHP schemes, it should reduce the risk of developments not being designed to connect to decentralised energy, and may also encourage the development of Energy Service Companies (ESCos) that could supply heat and/or power to new developments. Decentralised energy can also provide a path to carbon neutral development, with initial fossil-fuelled heating-only schemes potentially being upgradeable to biomass fuel and/or CHP.

Decentralised energy: heating and power

Again, in line with Regional Plan Policy 39, the DPD should require all developments to demonstrate that their heating and power systems have been selected to minimise carbon emissions. Proposals for major developments should evaluate combined heat and power systems and where a new system is installed as part of a new development, examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

Targets for Total Renewable Energy Consumption - These may be set in two ways:

In absolute terms - expressed as a set figure of energy production from renewables or other low carbon sources. This approach allows the Sub-Regional contribution towards the East Midlands regional targets to be seen clearly.

In percentage terms, as a fraction of energy demand in the Sub-Region. Targets in this form should help the Sub-Region contribute to the national targets for climate change

Site Specific Targets

Percentage targets may also be set for new developments within the planning area, where the planning authority has a much greater influence over whether and how they may be achieved. The study has suggested using differential targets for domestic and non-domestic properties and set a tiered target based on planning use:

Use	Renewable Energy Target (% of gross demand)
Domestic (>5 dwellings, or >16 bedrooms in total)	14%
Offices, hotels, leisure (>1,000m^2)	10%
Other non-dwellings (>1,000m^2)	6%

As an alternative approach, some local authorities have established a route for local offsetting of carbon emissions where developers find the requirements too onerous. Under these arrangements, often known as a Carbon Offset Fund, developers have to pay a fixed amount per tonne of residual annual CO_2 emissions. The money is then used to support energy efficiency improvements in existing housing stock in the same local authority district, resulting in at least equivalent savings.

8 FUNDING OPPORTUNITIES

8.1 This chapter provides a summary of the main funding sources available for the renewable and low carbon technologies identified in this report. It is divided into three parts:

- Funding for **all types of renewable technologies**
- Funding for **specific technologies**
- **Income** from the Renewable Obligation Scheme.

FUNDING FOR ALL TYPES OF RENEWABLE TECHNOLOGIES

8.2 The funding sources identified below are those available to privately owned homes and businesses; they do not include funding streams that may be available to registered social landlords. The key funding programmes available include:

- UK Low Carbon Buildings Programme
- Carbon Emission Reduction Target
- Green Energy Fund (by EDF Energy)
- E.on SOURCE
- Ashden Awards for Sustainable Energy
- Salix (Carbon Trust)
- Carbon Trust Enterprises Limited
- Funding from Charitable Trusts
- Community Ownership
- Community Energy Saving Programme/Community Sustainable Energy Programme
- Sustainable Development Fund.

UK Low Carbon Building Programme

8.3 The UK Government's Low Carbon Buildings Programme provides funding throughout the UK for community and public sector organisations via two grant phases.

Phase 1 is open for domestic schemes and grants are available towards the costs of: solar photovoltaics, solar thermal, wind turbines, ground source heat pumps, air source heat pumps, biomass boilers and CHP plant and micro CHP.

Phase 2 is open for public sector and charitable organisations. It offers larger grants to 'community' schemes which are owned and operated by a non-profit organisation for the benefit of the local community. Such organisations include councils, schools and housing associations. Grant of up to 50% of project costs can be obtained. An essential element of these schemes is their ability to raise awareness within the community and improve the national profile of renewable energy schemes.

- Both Phase 1 and 2 grants are awarded on a first come, first served basis (if they meet the pre-determined criteria) see www.lowcarbonbuildings.org.uk/about/;

Carbon Emission Reduction Target

8.4 This is the replacement grant scheme to the Energy Efficiency Commitment (EEC) placed upon UK domestic energy suppliers (with at least 50,000 UK customers). Under CERT, suppliers have to make a certain level of savings through approved measures which are usually based around domestic energy efficiency, including loft insulation, cavity wall insulation and the provision of subsidised compact fluorescent lamps (CFLs). Work is generally undertaken by approved contractors acting on behalf of the energy companies. Clients either receive a subsidy (if they are in an "able to pay" client group) or the work free of charge if they are in the priority group of low-income consumers.

8.5 The Climate Change and Sustainable Energy Act (2006) allows the Government to expand the range of measures that can be used by energy suppliers to deliver their commitments. CERT was originally expected to include an expanded range of measures including micro-generation and behavioural measures, but the utility companies' focus on providing high carbon-saving measures at the least possible cost has tended to restrict it mainly to basic insulation measures (cavity walls and lofts) and CFLs. CERT has also increased the carbon target on energy suppliers, effectively requiring them to double their previous effort, significantly increasing activity in proven activities like insulation, and encouraging new markets like micro-generation.

Although it is too early to be certain about the longer-term measures supported by CERT, the following ones are also likely:

- Cavity Wall Insulation.
- External Solid Wall Insulation.
- Loft insulation (including top-ups from under 100mm).
- Solar Water Heating.
- Air Source & Ground Source Heat Pumps.

Green energy fund (by EDF energy)

8.6 This fund is open to local authorities, housing associations, public sector and community groups. It provides funding for the installation of small-scale renewable technology (up to £5K for feasibility studies, and £30K for installation).

e.on source

8.7 This fund is also open to local authorities, housing associations, public sector and community groups. It provides funding to assist the implementation of sustainable energy projects for buildings, including energy efficiency and micro-generation. The maximum award is £30K. www.eon-uk.com/source.aspx

Ashden awards for sustainable energy (renewable energy award)

8.8 This award is open to non-government organisations, not-for-profit organisations, schools and local authorities which have carried out projects or programmes to increase the supply of renewable electricity and/or heat at a local level. The maximum award is £30K. The annual round of awards opens in autumn of each year. www.ashdenawards.org

Salix (Carbon Trust)

8.9 Salix is an independent, publicly funded company that provides interest-free match funding to the public sector to invest in energy efficiency measures and technologies that will reduce carbon emissions. www.salixfinance.co.uk/home.html

Carbon trust enterprises limited

8.10 The Carbon Trust has also established a number of commercial organizations which collectively, under the Carbon Trust Enterprises Ltd banner, provide a variety of carbon reducing services. Connective Energy, a partnership between Doosan Babcock (energy services) and Triodos Renewables (ethical bank) provides the development, investment, financing, construction and operation of the infrastructure for sharing heat energy between neighbouring businesses. Source-in Energy design, build and operate systems including anaerobic digesters, biogas and CHP for the food and drink sector. Partnerships for Renewables work with the public sector to develop community-based schemes using renewable energy technologies based on public sector land (including planning, design, construction and operation). Funding is provided for the development stages.

Funding from charitable trusts

8.11 There are a small number of charitable trusts within the UK that will occasionally support innovative or demonstration projects in the field of sustainable energy. These include the

Rowntree Foundation, Eaga Charitable Trust, Pilkington Energy Efficiency Trust (PEET) and the Gatsby Foundation. These Trusts provide support for innovative work rather than core funding.

Community ownership schemes

8.12 Community ownership provides an alternative means of financing medium to large scale renewable energy projects. There are a small number of community ownership specialists (most notably Energy4All, which developed out of the pioneering Baywind Community wind turbines in Cumbria) that specialise in setting up co-operatives. Traditionally these been around medium scale wind developments (of perhaps 1-10MW capacity), but the model could also be used for biomass or medium-sized hydro schemes. Community renewables schemes also often work on the demand side through promoting energy efficiency measures and an educational forum to promote changing current consumption habits. Communities may be strictly geographic or could also include those who share certain common values.

The benefits of community schemes for their members identified by Energy4All include:

- A direct stake in a local project
- Attractive financial return to members
- Extended economic benefits for the local area
- Delivery of local energy conservation projects
- Educational support on environmental issues
- Individual commitment to low carbon initiatives
- Membership of a nationwide network

They also note that for policymakers it helps the public feel more involved, consulted and supportive of the transition away from centralised fossil fuel or nuclear power. This helps local communities overcome some of the resultant evolution that occurs to the landscape.
The Sub-Region already has one excellent example of a community owned small hydro scheme at Torrs Hydro (detailed earlier).

Community Energy Saving Programme:

8.13 This is a forthcoming initiative where Energy Companies are to be directed to put £350M into community based energy saving measures. It is to be implemented from October 2009 and is currently being drafted into the Climate Change Bill proceeding through Parliament. http://www.number10.gov.uk/Page16807

The Community Sustainable Energy Programme

8.14 Provides £8 million to community based organisations for the installation of microgeneration technologies and energy efficiency measures. It will also provide £1 million for project development grants that will help community organisations establish a microgeneration and energy efficiency installation will work for them. www.communitysustainable.org.uk

Sustainable Development Fund

8.15 National Park initiatives to develop innovative sustainable projects that help improve the quality of life for current and future generations within National Parks. It is administered in the Peak District by the Peak District National Park Authority. Projects are suitable for the fund include, those involving the main sustainability themes:

- Effective protection of the environment
- careful use of natural resources
- Social progress recognizing the needs of all people
- maintaining sustainable levels of economic growth

Projects can range from the locally-based to those applying across the Peak District National Park. Partnership working and community support is desirable.

FUNDING FOR SPECIFIC TECHNOLOGIES

Biomass and Energy Crops

8.16 **The Royal Forestry Society** has produced a guide called Grants for Trees that lists over 50 funding sources and is a useful initial reference point http://www.rfs.org.uk/grantsfortrees.asp

8.17 **Bio-energy Capital Grants Scheme**: promotes the efficient use of biomass for energy, by stimulating the early deployment of biomass fuelled heat and biomass combined heat and power projects. It will do this by awarding capital grants towards the cost of equipment in complete installations.

It is aimed at businesses, organisations and charities in the commercial, industrial and community sectors that are considering investing in biomass-fuelled heat and/or combined heat and power projects, including anaerobic digestion. It is not aimed at householders or individuals. There is no minimum grant aid in any one application and the maximum is £500,000 per installation. An application form and Guidance notes can be found on the website: www.bioenergycapitalgrants.org.uk. The next deadline for the receipt of applications is 30 April 2009.

8.18 **Bio-Energy Infrastructure Scheme**: provides grants to help the development of the supply chain required to harvest, process, and store and supply biomass to heat, combined heat and power, and electricity end-users. The scheme is open to farmers, foresters, businesses, local authorities and charities. Each project can claim grant of up to £200,000.

Grants are available for:

- Growers to set up producer groups to supply biomass to energy end-users. Eligible costs include legal and administrative work in setting up the group, rental of office accommodation, purchase or rental of IT and office equipment.
- Producer groups and businesses to: Purchase or rent specialist capital equipment for use in harvesting, pre-use processing, quality assurance and handling,
- Purchase or rent storage and hard-standing. Receive training in issues directly relevant to the successful operation of the supply chain.

8.19 Eligible biomass:

- Short rotation coppice (willow, poplar, alder, ash, hazel, lime, silver birch, sweet chestnut and sycamore)
- Miscanthus
- Switchgrass, reed canary grass, prairie cord grass, rye grass
- Straw
- Wood fuel from forestry, arboriculture tree management and primary processing
- Other energy crops at DEFRA's discretion

Defra hope to run an application round in winter 2008/spring 2009.
www.defra.gov.uk/farm/crops/industrial/energy/infrastructure.htm

8.20 **Energy Crops Scheme** – Grants to farmers in England for the establishment of miscanthus and short rotation coppice. It is part of the Rural Development Plan for England coordinated by Natural England and funded by the EU. http://www.naturalengland.org.uk/planning/grants-funding/energy-crops/default.htm

8.21 **Energy Aid Payments:** scheme to enable aid to be claimed in respect of crops which are grown to be used for the production of energy (for heat, electricity or transport fuels) on land which has not been set aside. Operated by the Rural Payments Agency. http://www.rpa.gov.uk/rpa/index.nsf/293a8949ec0ba26d80256f65003bc4f7/ef8e92da5664ed0680256fcd0054202b

8.22 **The English Woodland Grant Scheme (EWGS)** is the Forestry Commission's suite of grants designed to develop the co-ordinated delivery of public benefits from England's woodlands. http://www.forestry.gov.uk/ewgs

- Woodland Planning Grant - Preparation of plans that both assist with management of the woodland and meet the UK Woodland Assurance Standard.
- Woodland Assessment Grant - Gathering of information to improve management decisions.
- Woodland regeneration Grant - Supporting desirable change in woodland composition through natural regeneration and restocking after felling.
- Woodland Creation Grant - Encouraging the creation of new woodlands where they deliver the greatest public benefits, including annual Farm Woodland Payments to compensate for agricultural income forgone.

Anaerobic digestion

8.23 **Environmental Transformation fund (AD**): Administered by WRAP funding 3 – 6 projects to meet the criteria of the programme which is developed from the main themes which are:

- maximising the cost effective production of biogas;
- maximising the environmental benefits from the use of anaerobic digestion and its products;
- maximising the potential of anaerobic digestion to reduce the carbon footprint of the food supply chain;
- maximising the opportunity for the injection of bio-methane into the gas grid; and
- Maximising the potential of anaerobic digestion to reduce the carbon footprint of water treatment infrastructure. http://www.wrap.org.uk/composting/environmental.html

Small scale/micro hydro

8.24 The government's Low Carbon Buildings Programme offers grants to domestic owners of mini-hydro plant equal to £1000 per kW installed, up to a maximum of £5000. The equipment must be chosen from an approved product list, and installed by a registered installer. Further details on www.lowcarbonbuildings.org.uk.

8.25 The Programme also offers larger grants to "community" schemes which are owned and operated by a non-profit organisation to the benefit of the local community. Such organisations can include councils, schools, housing associations, etc. Grant of up to 50% of project costs can be obtained. An essential element of these schemes is their ability to raise awareness within the community and improve the national profile of renewable energy schemes. In addition, under Stream 2A of the Programme, businesses can also apply for up to 40% funding. Application deadlines occur quarterly.

Tax Breaks

8.26 For domestic developers and other non-commercial owners, the government has reduced the VAT payable on hydro-electric plant to 5% for systems supplying buildings which are either residential or used for charitable purposes.

Wind

8.27 Grants available for small scale wind turbines from the Low Carbon Buildings Programme (see previous section)

Advice for Communities

8.28 Good Practice & Community Involvement in Wind Energy Developments

8.29 The Renewables Advisory Board (RAB) and DTI commissioned several reports on community involvement in wind energy developments which are relevant to this study:

- Delivering Community Benefits from Wind Energy Development: A Toolkit (May 07)
- Bankable Models which Enable Local Community Wind Farm Ownership (May 07)
- The Protocol for Public Engagement with Proposed Wind Energy Developments in Wales (May 07).

Net metering

8.30 This represents another potential source of income, and may be enshrined in law following the implementation of the Climate Change Act 2008.

In the meantime, some "green" electricity companies will pay a premium rate, up to the rate for units of electricity delivered for renewably generated electricity, usually accompanied by a requirement to surrender ant Renewable Obligation Certificates. This helps fund small scale (usually building mounted) schemes, typically from PV or micro-wind.

Income from renewable obligation

8.31 The Renewable Obligation (RO) is a Government initiative to encourage more renewable electricity generation. A certificate, known as a Renewable Obligation Certificate (ROC), is issued for each megawatt hour of renewable electricity generated. Electricity suppliers need these certificates as they have an obligation to source a specific and annually increasing percentage of the electricity they supply from renewable sources. The current level is 9.1% for 2008/09 rising to 15.4% by 2015/16.

8.32 ROCs can be issued on a monthly or yearly basis. The threshold for claiming 1 ROC is 0.5MWh. The renewables obligation is primarily aimed at large scale generation although micro-generators can participate. For example, a 1kW wind turbine may only generate enough electricity to claim 1 or 2 ROCs a year which could be valued as much as £40 or as little £15 per ROC depending on market price. The Government allows micro-generators to participate through an agent who can amalgamate the output of several micro-generators making it more worthwhile for micro-generators to get involved.

Eligibility of energy derived from waste

8.33 Electricity generating stations that use biomass, energy crops, agricultural waste and forestry material to generate electricity are eligible to claim ROCs. Source: Department for Business Enterprise & Regulatory Reform (BERR) 2008

8.34 **Table 8.1** details the renewable energy sources eligible under the Obligation.

Table 8.1: Renewable Energy Sources

Sources	Eligibility
Landfill gas	Yes
Sewage gas	Yes
Hydro exceeding 20 MW declared net capacity (dnc)	Only stations commissioned after 1 April 2002
Hydro 20 megawatts or less dnc	Yes
Onshore wind	Yes
Offshore wind	Yes
Co-firing of biomass	Yes. (There are no restrictions on the amount of co-firing a generator can undertake. However, suppliers can only meet 10% of their obligation from co-fired ROCs.)
Other biomass	Yes
Geothermal power	Yes
Tidal and tidal stream power	Yes
Wave power	Yes
Photovoltaics	Yes
Energy crops	Yes

Source: http://www.berr.gov.uk/whatwedo/energy/sources/renewables/policy/renewables-obligation/what-is-renewables-obligation/page15633.html

LANDSCAPE SENSITIVITY ASSESSMENT FOR RENEWABLES IN THE PEAK SUB-REGION

This section of the report was prepared by LUC Consultants. The associated electronic maps are available on 2 CDs referenced as below:

Appendix 7 - MapInfo (GIS) Data

Appendix 8 - Published Map

SCOPE OF THE METHODOLOGY

1. This landscape sensitivity study for renewable developments forms part of the wider Climate Change Study within the Peak Sub-Region, undertaken by the National Energy Foundation (NEF) and Land Use Consultants (LUC).

2. This landscape sensitivity assessment was undertaken by LUC for those renewables that, if developed, could have landscape-scale impacts, namely, Bioenergy crops (Short Rotation Coppice and Miscanthus), and wind turbine developments at the three different size scales:

- Small (up to 15m to blade tip)
- Medium (15m – 65m to blade tip)
- Large (over 65m to blade tip)

3. For these technologies / plantings the landscape sensitivity study has resulted in two outputs:

- Maps showing the landscape sensitivities of the Landscape Types within the Sub-Region to each technology / planting type.
- Guidance contained in this report that describes these sensitivities in greater detail to inform planning decisions.

4. For the other main renewable technologies resulting in the development of specific plants (anaerobic digestion, biomass, biogas and hydrogen) and for small scale hydro schemes, generic guidance has been prepared to be applied on a site by site basis. For other domestic-scale technologies, including building-mounted wind turbines, photovoltaics and ground/air source heat pumps, landscape guidance has not been prepared as the impact of these technologies, where relevant, will be dealt with through building conservation policies.

5. This guidance, with assessment criteria that could be used by the local planning authorities and developers, is included from paragraph 29. Please note that the assessments and guidance in this document relates only to the sensitivity of the landscape to the different technologies concerned. It therefore does not take account of the *technical* capabilities or otherwise of the landscape. It should be read in conjunction with the main report prepared by NEF which specifically considers the wider constraints and opportunities of renewables in the Sub-Region.

Approach to landscape sensitivity assessment

6. Landscape attributes/characteristics may indicate the suitability of a landscape to accommodate renewable energy development. In devising the criteria for judging sensitivity, suggestions and guidance in the Landscape Character Assessment Guidance[33] promoted by the Countryside Agency and Scottish Natural Heritage have been followed, as well as that in Topic Paper 6 that accompanies the Guidance[34]. Definitions of landscape character and sensitivity used in this study have also been drawn from this guidance.

Landscape character is defined in the landscape character assessment guidance as:

[33] Countryside Agency and Scottish Natural Heritage (2002) Landscape Character Assessment: Guidance for England and Scotland CAX 84

[34] 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.

'…the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how these are perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement'.

7. 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'

Para 4.2 goes on to say:

'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'

8. This landscape sensitivity assessment is unrelated to any Government targets and is based on an assessment of landscape character using carefully defined criteria.

Landscape character baseline

9. Since landscape character forms the basis of the approach to the landscape sensitivity assessment, this work is based on the two Landscape Character Assessments that cover the sub-region – the Peak District Landscape Character Assessment (2008) for areas within the National Park; and the Derbyshire county-wide assessment from 2003 ('The Landscape Character of Derbyshire') for the areas of the Derbyshire Dales District and High Peak Borough falling outside of the National Park boundary. These assessments both use Landscape Character Areas and Landscape Types as their characterisation units, the latter of which can be found across one or more Landscape Character Areas. In all, the number of landscape types falling within the Peak Sub-Region totals 36 across 16 Character Areas. For ease of undertaking the sensitivity assessments in a logical manner, those landscape types found in the two different assessments which clearly displayed the same key characteristics, were assessed as one. This resulted in an assessment of 25 combined landscape types, each of which has been numbered for ease of reference. Please see **Figure 1** for a map of the combined landscape types and **Table 1** for a breakdown by Local Planning Authority.

CRITERIA FOR DETERMINING SENSITIVITY

10. Criteria for determining landscape sensitivity to wind turbines and Bioenergy crop planting are based on attributes of the landscape most likely to be affected by their development. These are detailed below for both wind energy and Bioenergy crops.

Wind energy

11. Landscape attributes that may indicate the sensitivity of a landscape to wind turbine development include:

Landform and scale - the scale and form of the landscape may indicate whether a landscape could accommodate large structures such as wind turbines and how these structures would relate to the overall `shape' and form of the physical landscape. It can also indicate what scale of wind turbine cluster may be appropriate.

Figure 1: Combined landscape types within the Peak Sub-Region

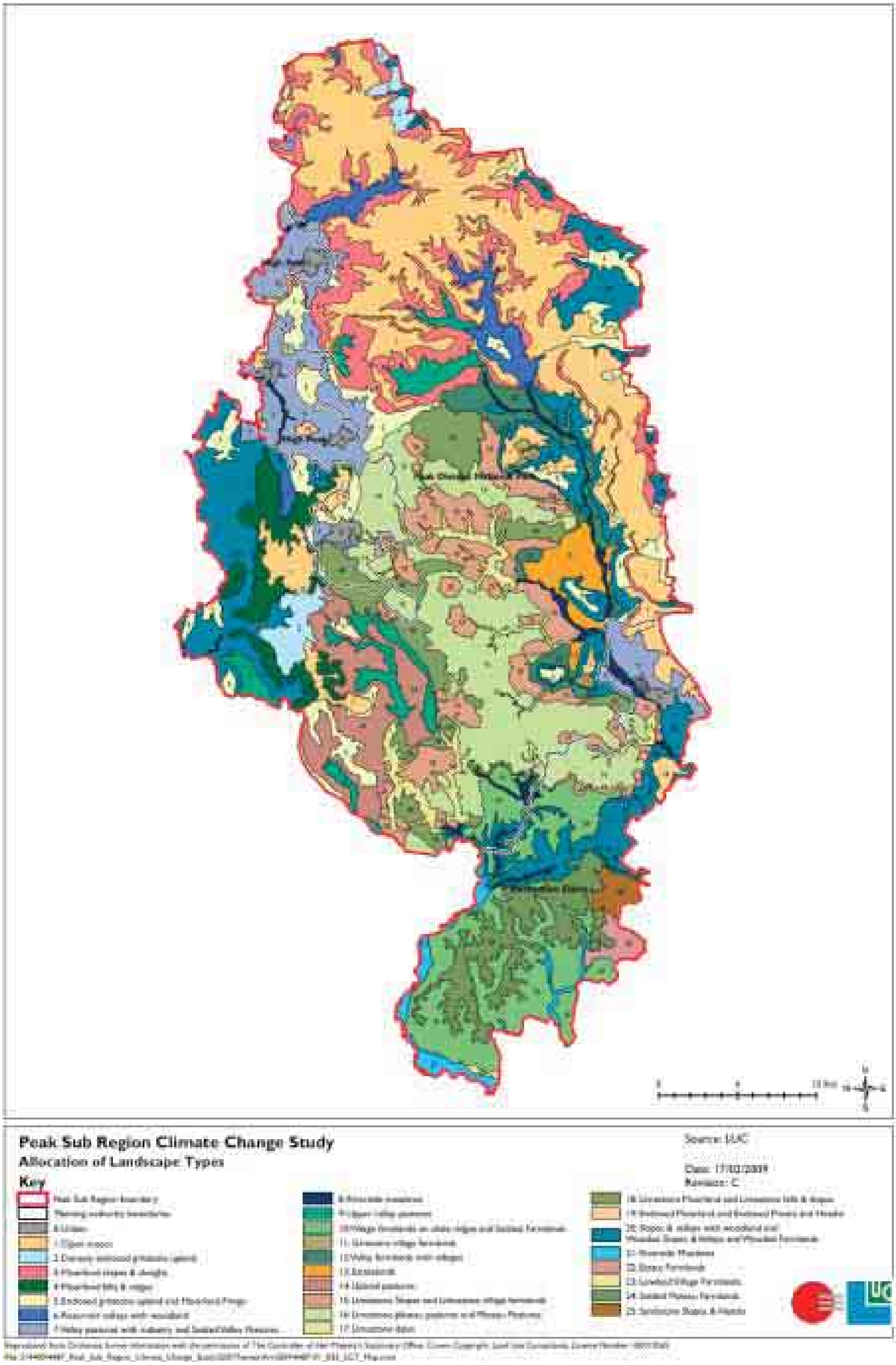


Table 1: Landscape Types by Local Planning Authority area

	Landscape types for the sensitivity assessment	Relevant local planning authority / authorities
1	Open Moors	ALL
2	Densely Enclosed Gritstone Upland	Peak District National Park
3	Moorland Slopes & Cloughs	High Peak Borough Peak District National Park
4	Moorland Hills & Ridges	High Peak Borough Peak District National Park
5	Enclosed Gritstone Upland & Moorland Fringe	High Peak Borough Peak District National Park
6	Reservoir Valleys with Woodland	Peak District National Park
7	Valley Pastures with Industry & Settled Valley Pastures	ALL
8	Riverside Meadows	ALL
9	Upper Valley Pastures	Peak District National Park High Peak Borough (very small area)
10	Village Farmlands on Shale Ridges & Settled Farmlands	Derbyshire Dales District Peak District National Park
11	Gritstone Village Farmlands	Peak District National Park
12	Valley Farmlands with Villages	Derbyshire Dales District (very small area) Peak District National Park
13	Estatelands	Peak District National Park
14	Upland Pastures	Peak District National Park
15	Limestone Slopes & Limestone Village Farmlands	Derbyshire Dales District
16	Limestone Plateau Pastures & Plateau Pastures	Peak District National Park Derbyshire Dales District
17	Limestone Dales	ALL
18	Limestone Moorland & Limestone Hills and Slopes	ALL
19	Enclosed Moorland & Enclosed Moors and Heaths	Peak District National Park (very small area) Derbyshire Dales District
20	Slopes and Valleys with Woodland & Wooded Slopes and Valleys & Wooded Farmlands	ALL
21	Riverside Meadows	Derbyshire Dales District Peak District National Park (very small area)
22	Estate Farmlands	Derbyshire Dales District
23	Lowland Village Farmlands	Derbyshire Dales District
24	Settled Plateau Farmlands	Derbyshire Dales District
25	Sandstone Slopes and Heaths	Derbyshire Dales District

Landscape pattern – the scale of the landscape pattern overlying the landform may inform sensitivity to large scale structures. It may also inform guidance for accommodating wind turbines into the landscape in the most suitable configuration.

Sense of enclosure – the sense of enclosure provided by topography or vegetation may indicate the ability of the landscape to accommodate the low level features associated with wind developments.

Senses of tranquillity/remoteness – turbines introduce a strong human element to the landscape and this can have an impact upon experiential qualities such as sense of remoteness and 'stillness'. It is important therefore that these elements are considered in order to inform landscape sensitivity.

Settlement /transport network – this will help to indicate the extent of human impact on the landscape and therefore sensitivity to additional man-made elements.

Skyline – the character of the skyline will indicate where new elements could provide new interest, where they might threaten existing interest or where they may result in visual clutter. For example, a landscape with prominent, undeveloped skylines is likely to be more sensitive to wind turbine development than a landscape with non-prominent skylines (e.g. flat lowland) that is already affected by built development.

Inter-visibility – the location of a turbine on the edge of one landscape type may adversely affect the perceptual character of an adjacent landscape. It is therefore essential to consider views into and from adjacent landscapes to understand the sensitivity of a landscape to wind turbine development.

Sensitive/rare landscape features – the density of sensitive and/or rare landscape features, such as important archaeological sites, can provide an insight into the potential sensitivity of a landscape and can indicate constraints that are likely to arise in more detailed site selection studies.

Bioenergy crops

12. Landscape attributes that may indicate the sensitivity of a landscape to growth of energy crops (SRC and Miscanthus) include:

Landform – steep landforms are generally more sensitive due to increased opportunity to view the geometric crops in plan form, and from a distance.

Land cover/ land use – the existing land cover and land use of a landscape may indicate which landscapes could accommodate biomass crops. Miscanthus is likely to be more easily absorbed into a landscape that is characterised by large scale cropping systems whereas it would be less easily accommodated in areas that are predominantly pastoral in character. SRC may be more easily absorbed into landscapes characterised by woodland.

Landscape pattern – landscape pattern may indicate where geometric shapes (such as growth of biomass crops) may be suitable. For example, biomass crops may be absorbed into a landscape that is dominated by large scale rectilinear field systems whereas unenclosed moorland or small scale, irregular field patterns are likely to be adversely affected by the introduction of large scale crop plantations.

Sense of enclosure – open landscapes would be changed by the introduction of tall biomass crops whereas landscapes enclosed by hedgerows/hedgerow trees, woodland or landform would absorb biomass crops more easily.

Sense of 'naturalness' – non-native crops and harvesting operations could affect the perceived 'naturalness' of a landscape. Crops are likely to be better integrated into landscapes that are already in cropping use or affected by man-made features such as roads and industry. Moorlands are particularly valued for their wild and natural character.

Inter-visibility/important views – some areas may be more sensitive because they are overlooked by sensitive landscapes or viewpoints.

Sensitive/rare landscape features - the density of sensitive and/or rare landscape features can provide an insight into the potential sensitivity of a landscape and can indicate constraints that are likely to arise in more detailed site selection studies.

13. Bioenergy field crops should only be planted in fields already in arable production rather than converting permanent pasture to cropping – pastoral landscapes therefore have a higher sensitivity than arable landscapes. In the Peak Sub-Region – a predominantly pastoral landscape, particularly within the National Park – this automatically places a constraint on the widespread planting of monoculture Bioenergy crops such as Miscanthus. It should be borne in mind, however, that the future effects of climate change may over the longer term bring further areas (particularly outside the National Park) into arable cultivation, and therefore from a landscape perspective – more suited to the planting of energy crops.

UNDERTAKING THE LANDSCAPE SENSITIVITY ASSESSMENT

Applying the criteria

14. The above criteria were used for each landscape type drawing on the descriptive information contained in the two Landscape Character Assessments covering the Peak Sub-Region.

Undertaking the sensitivity assessment

15. The landscape sensitivity assessment was initially conducted as a desk based exercise using the Peak District and Derbyshire County Landscape Character Assessments supplemented by Google Earth. Draft maps illustrating the results of the initial desk based assessment were presented at a stakeholder workshop on 1 December 2008.

16. Fieldwork was undertaken in November 2008 to verify the results add information to the guidance as necessary.

17. The assessment is presented in tabular form by landscape type and technology type (see the assessment tables at the back of this document). Where possible, landscape types showing similar characteristics as described in the two Landscape Character Assessments were considered under the same assessment to ensure a thorough integration of landscape types across the sub-region, as previously explained in paragraph 9. For example, the ‘Moorland Hills and Ridges ‘ landscape type in the Peak District assessment was considered alongside the ‘Enclosed Moorland’ type of the Derbyshire County assessment, as it was clear from the individual descriptions that their key characteristics are similar enough to be considered together. The use of the coding ‘PD’ (Peak District) and ‘DC’ (Derbyshire County) indicates which assessment the landscape types, and the constituent character areas, come from.

18. Reading from left to right across three columns, the tables are structured as follows:

1st column: contains the landscape attributes of the landscape type applied against the assessment criteria (as described above).

2nd column: summarises the sensitivity judgement and lists the key landscape attributes that would be sensitive to the development of the technology concerned. The overall assessment is based on different levels of impact (see **Table 2** below).

3rd column: provides specific guidance on the siting of the renewable technology concerned within the landscape type.

19. The tables therefore provide a logical sequence across the columns; linking the generic guidance and assessment ‘score’ back to the landscape type’s key landscape attributes. The sensitivity score is based on the different levels of impact that renewables are likely to have on the landscape concerned. **Table 2** sets out this sensitivity scoring.

Table 2: Sensitivity levels and definitions

Sensitivity Level	Definition
High	Key characteristics of the landscape would be adversely affected by the renewable energy development. Such development would result in a significant change in character. Likely to be unsuitable for the renewable energy development.
Moderate-high	Many of the key characteristics of the landscape would be adversely affected by the renewable energy development. Such development would result in a noticeable change in character. There may be some limited opportunity to accommodate the renewable energy development without changing landscape character. Great care would be needed in locating infrastructure.
Moderate	Some of the key characteristics of the landscape are vulnerable and may be adversely affected by the renewable energy development. 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 infrastructure.
Moderate-low	Few key characteristics of the landscape would be adversely affected by the renewable energy development. The landscape is likely to be able to accommodate development without only minor change in character.
Low	Key characteristics of the landscape are robust and would not be adversely affected by the renewable energy development. The landscape is likely to be able accommodate development without a significant change in character.

LANDSCAPE SENSITIVITY FINDINGS FOR WIND AND BIOENERGY CROP PLANTING

20. The Peak Sub-Region comprises a large proportion of land within the Peak District National Park, designated in 1952 as the first national park in England and Wales. Because the National Park is recognised as a nationally important landscape, none of the sensitivity assessment scores (see maps at the end of this document) for wind turbines or Bioenergy crops within its boundary fall below 'moderate', with the majority of landscape types being judged as of either 'moderate-high' or 'high' sensitivity to wind turbine developments and Bioenergy crop planting. The assessment therefore recognises the national importance of this landscape and places it within the UK context – i.e. it uses a sensitivity score applicable to the whole of the UK, with national parks at the top end of this scale.

21. The areas within the sub-region bordering the National Park are also deemed to have a greater degree of sensitivity to development when compared to other landscapes[35]. This is because of their role in providing a setting to the National Park. Any development that could be visible from the National Park, within these bordering areas, is therefore subject to higher constraints than might be the case for other locations. The presence of the Derwent Valley Mills World Heritage Site, and its accompanying buffer, has also been accounted for in the guidance column of the landscape sensitivity assessment. This international designation, which recognises the area's outstanding industrial heritage, places another key sensitivity on parts of the wider Sub-Region within the Derbyshire Dales within or buffering this site to wind or Bioenergy developments.

22. All of this has been borne in mind when making the landscape sensitivity assessments for wind turbines and Bioenergy planting – particularly the former.

23. The landscape sensitivity assessment seeks to concentrate the potential for these types of renewable energy on landscapes which are most capable of absorbing their impacts within existing landscape character. For example, the introduction of wind turbines should focus on areas where man-made structures are already present, whilst Bioenergy crop planting has most potential in the more wooded areas (in the case of Short Rotation Coppice) or areas of existing

[35] The East Midlands Regional Plan (Secretary of State's proposed changes, July 2008) recognises the international designations of the Peak District Special Protection Area and Derwent Valley Mills World Heritage Site within the Sub Region. It states that 'the World Heritage Site's outstanding universal value and unique cultural assets should be afforded appropriate levels of protection'.

arable cultivation, where monoculture crops such as miscanthus could be planted to fit with the existing land use pattern. Other considerations are also made in the assessment in terms of a landscape's capacity for incorporating new development (as per **paragraph 11 above**), for example topography – where sloping land could be used to shield the visual impacts of any new development such as wind turbines from key viewpoints.

24. Some clear patterns have therefore emerged from following this method. For wind turbines, the National Park is clearly a very sensitive landscape particularly in terms of its strong relative senses of tranquillity and remoteness when set in the context of the urban areas edging up against its boundary (particularly the Manchester and Sheffield conurbations). All of the National Park is assessed as being of 'high' sensitivity to large and medium scale turbines, whilst still recognising the presence of some existing built structures which already have a visual impact on the National Park landscape. The Draft Regional Plan (Policy 38) states that 'accommodating large scale renewable generation will always be difficult in the National Park' and that there are 'some opportunities for small wind generation'. It is therefore concluded that turbines of the larger scale categories would, on the whole, be unlikely to be able to be sensitively sited within the protected landscape.

25. The National Park's open moorland landscapes are recognised as being of 'high' sensitivity to **all** sizes of wind turbine, recognising their potential contribution to the sense of remoteness. In all cases, single turbines, rather than clusters of 2-5 structures, are deemed most appropriate for all areas within the National Park.

26. When looking at areas outside the National Park, there are a few locations that might be less sensitive to the development of the larger sizes of turbine. These include locations within the 'Lowland Village Farmlands' (23) landscape type in southern Derbyshire which includes extensive urban fringe development and views of nearby power stations; as well as other areas within the southern part of the sub-region already experiencing significant development pressure and lying some distance from the National Park. There may also be some very limited potential for medium-scale turbines to be located in areas of the 'Enclosed Moors and Heaths' landscape type, where significant coniferous plantations may provide a screening function. However, care would need to be taken when considering the location of any potential wind turbines in terms of their visibility in views from and to the National Park.

27. In terms of the number of turbines, there may be locations which, unlike the National Park, could accommodate more than one turbine structure. In every case, a detailed Landscape and Visual Impact Assessment (LVIA) would be able to ascertain the most appropriate number of turbines any location could sensitively accommodate – but it is clear from the Landscape Sensitivity Assessment that it would only ever be appropriate for small numbers of turbines to be located in one place (i.e. less than five). Again, any visibility of groups of turbines would need to take account of views to and from the National Park.

28. Turning to Bioenergy planting, a clear pattern is also emerging from the landscape sensitivity assessments. For miscanthus planting, which would introduce an intensively farmed, monoculture crop into the landscape, potential is limited. The sub-region is characteristically a pastoral landscape, with few areas of intensive arable cultivation which might indicate suitability for this type of energy crop. Within the Peak District National Park itself, only one small area within the 'Enclosed Gritstone Upland' (5) type falls below 'high' in the sensitivity assessment – where there are some small areas of arable cultivation but this is unlikely to be suitable within local farming systems. Looking outside the National Park, the mixed agricultural landscape defining the southern part of the sub-region indicates a higher potential for miscanthus, where it could be incorporated within areas dominated by arable production.

29. Short Rotation Coppice (SRC) has greater potential within the sub-region where it can be linked to existing woodlands and forestry plantations. Nevertheless, given the overall sensitivity of the landscape within the National Park these areas would be better planted as native woodland but with the clear intention of using it for biomass production for community use. Many parts of the landscape are well-wooded, indicating 'moderate' or 'moderate-high' sensitivity to SRC but with clear potential for woodland / SRC planting if landscape and biodiversity guidelines are followed. Indeed the National Park's Biodiversity Action Plan points to the need to bring areas of existing native upland ash, oak and birch woods back under management, and new woodland planting (including through PAWS restoration) could provide stimulus to this objective. The well-treed and sheltered 'Riverside Meadows' landscape type (8) shows the most potential in landscape terms

for SRC within the National Park, although the damp soils and potential of flooding mean that the area may not be suitable for any type of woodland planting that requires mechanical harvesting.

30. Within the wider sub-region, four of the landscape types within the Derbyshire Dales district are assessed as of 'moderate' sensitivity to the development of SRC, based on the presence of existing woodlands. A further six landscape types within the National Park, and three outside, are assessed as being of 'moderate-high' sensitivity i.e. with localised potential for SRC or woodland expansion.

31. Of course, this landscape-wide assessment has not looked at the bi-products of actively managed woodlands and forestry residues as sources for biomass energy production. This is being considered in another part of this study – recognising the great potential and benefits this might bring to the area through reinvigorating traditional woodland management.

CRITERIA AND GENERIC GUIDANCE FOR OTHER RENEWABLE ENERGY TECHNOLOGIES

32. As explained in **paragraph 4**, a landscape type-scale assessment has not been undertaken for those renewable energy technologies where the landscape impacts associated with their development will vary on a site-specific basis. For these, generic guidance has been prepared to enable the local planning authorities, along with potential developers, to understand what to look for when siting such technologies in terms of potential landscape impacts, and how these can be reduced.

33. The 'landscape attributes' which will be most sensitive to the development of these technologies are listed below, along with the linked generic guidance to inform their siting, by technology type.

Biomass, hydrogen, biogas and anaerobic digestion plants

34. These plant-level technologies are considered together, as they are likely to be operating at a similar scale and with similar infrastructure requirements.

35. The landscape attributes that may indicate the sensitivity of a landscape to biomass, hydrogen, biogas and anaerobic digestion plants are:

Landform and scale - the scale and form of the landscape may indicate whether a landscape could accommodate plant development. Smaller scale, de-centralised plants are likely to be more successfully accommodated in a wider range of landscapes than larger plants.

Sense of enclosure - the sense of enclosure provided by topography or vegetation may indicate the ability of the landscape to accommodate new built development.

Sense of tranquillity/remoteness – new buildings developed for these renewable technologies would introduce a human element to the landscape, with this impact increasing in line with the scale of the plant. The sense of tranquillity or remoteness associated with a landscape may therefore indicate suitability of the landscape to accommodate such structures. Increased traffic to and from the installation will also have an impact on tranquillity.

Settlement /transport network – these types of installation may require access for deliveries of fuel (e.g. biomass, waste). The larger installations will be more industrial in nature; smaller plants could be integrated into farms, and in the case of biomass plants, housing complexes, schools, hospitals etc. The type of settlement, presence of industry, and the transport infrastructure could therefore indicate the suitability of an area to accommodate the different scales of these installations.

Important views / skyline – these types of development may require vents / stacks. It is important therefore to consider whether these new vertical elements might threaten existing interest or introduce visible structures on the skyline. The impact on important views and landmark features also needs consideration.

Sensitive/rare landscape features - the density of sensitive and/or rare landscape features can provide an insight into the potential sensitivity of a landscape and can indicate constraints that are likely to arise in more detailed site selection studies.

36. Generic guidance that should be applied in siting such plants is as follows:

- There may be opportunities for accommodating small scale anaerobic digester plants on or adjacent to existing farm buildings or on existing waste sites.
- Larger biomass or digester plants, which typically have larger buildings and chimneys, should only be accommodated in existing commercial/industrial areas or on existing waste sites.
- Avoid locating installations in prominent locations such as on exposed skylines.
- Ensure existing landmarks (for example church towers and spires) remain prominent and that installations do not detract from existing landmarks.
- Ensure installations are not prominent in key views, particularly from the open moorland landscapes.
- Ensure installations do not affect the historical value of industrial features and remains, or the ecological value of semi-natural habitats.
- Ensure installations do not adversely affect the character and appearance of any Conservation Areas.
- Suitable materials should be used to facilitate the integration of structures with their surroundings, for example, the cladding of buildings and finish colour.

Small scale hydro

37. Landscape attributes that may indicate the sensitivity of a landscape to small scale hydro schemes include:

Landform scale and enclosure - the scale and containment of the landscape may indicate whether a landscape could accommodate a hydro scheme. A hydro development will be most appropriate where it appears as a minor element in a larger scale open landscape, or a larger scale element in an enclosed area.

Sense of tranquillity/remoteness – a hydro scheme would introduce a human element to the landscape which may be inappropriate in the most remote landscapes.

Sensitive landscape features – the construction of a hydro scheme will alter river flows and, where located on estuarine watercourses, disrupt levels of salinity. It is therefore important to account for the location of sensitive habitats and species (including fish) within or on the edge of watercourses. The presence of archaeological features, in schemes involving the restoration of an historic mill, should also be considered.

Built features within the landscape - a hydro scheme would introduce a built element into the landscape. A hydro scheme is more likely to be integrated into a landscape that already contains built elements, particularly if they are related to past water-powered industry.

Important views – schemes may be very prominent if located on hillsides in important views. It is therefore important to consider whether there are any particularly important views in the area to inform siting.

38. Generic guidance that should be applied in siting hydro schemes is as follows:

- Use local materials for weirs and built structures. Utilise the existing structures and locations relating to past water-powered industry in the area where possible.
- Integrate pipes (penstocks) into the landscape - consider burying pipes (in areas where vegetation is likely to successfully re-establish), or colouring pipes to relate to the shades and hues of the surrounding landscape through the seasons.
- In general, open channels (leats) may be more appropriate than pipes (penstocks).
- In some locations it is important to screen the modern structures associated with hydro schemes from view, while in other locations the hydro scheme could be a feature of tourist or industrial interest, perhaps relating to the history of an old mill, or to the modern use of an industrial site.

- Where possible, structures relating to hydro schemes should be located on banks with existing development or built structures, rather than on undeveloped sides.
- Use should be made of existing features such as weirs, sluices, locks and mill buildings to create a head of water and to house hydro plant and pipes etc. Where possible schemes should incorporate the restoration of historic water features such as weirs, mill ponds, millraces or leats, sluice gates, tailrace outlets and derelict mill buildings.
- Archaeological surveys should be undertaken when considering the restoration of historic mills to ensure any important features are protected from the impacts of any new development or excavation.
- Integrate turbine housing into the landscape through careful siting, use of landform (for example partially buried buildings), green roofs, use of existing vegetation or trees, and use of local materials/ architectural features.
- Only use vegetation screening in areas within which vegetation cover is characteristic.
- Although the micro-hydro options being put forward as part of this study are run of river (i.e. water passes through a penstock and back to the stream / river) it will be important to ensure that the construction of a weir will not reduce water levels downstream to the detriment of local amenity and sites of nature conservation importance.
- Aim for a high standard of design in all cases, but particularly in visible locations.
- Ensure fencing is appropriate to the surroundings - stock fencing is more appropriate than industrial style fencing in rural locations.
- Minimise hard surfacing and formal planting associated with any hydro scheme to ensure successful integration into the rural landscape.
- Consider the appearance of hydro schemes in longer distance views, particularly in views from the higher ground and along valleys.
- Ensure structures do not adversely impact on the ecological value of the semi-natural habitats, or the high historical value of industrial features and remains.
- Ensure structures do not adversely impact on the character and appearance of Conservation Areas.
- Incorporate environmental and landscape improvements into the development, for example restoration of natural riverside habitats, or replacing riparian woodland in the vicinity of the proposed development.

LANDSCAPE SENSITIVITY ASSESSMENT TABLES

1) Landscape Type: Open Moors (PD), Open Moors (DC)
Constituent Character Areas: Dark Peak, Derwent Valley, Eastern Moors, South West Peak, North Pennines (PD), Dark Peak (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
	WIND TURBINES	
• **Landform and scale** – Vast open landscape comprised of a high, undulating gritstone plateau with occasional rocky outcrops and tors. • **Landscape pattern** – Open heather and grass moorland surrounded by occasional enclosures of regular medium-large fields. • **Sense of enclosure –** Landscape type is defined by its open character with expansive views. It is a largely treeless landscape with limited areas of scrubby woodland. Occasional enclosure around the moorland edges. • **Sense of tranquillity/ remoteness –** Wild landscape with a strong sense of tranquillity and remoteness. Major roads crossing parts of the moorland erode tranquillity locally. • **Settlement / transport network** – Unsettled landscape with built features such as isolated farm buildings and gamekeepers' lodges only occurring locally. Some historic transport routes as well as more major routes, sometimes bordered by large electricity pylons (e.g. along the A628). • **Skyline** – Open, undeveloped skylines with expansive panoramas over surrounding land. • **Inter-visibility** – Long views across the surrounding hills and lower ground. A wind farm is visible on the horizon at Penistone, beyond the National Park boundary. • **Sensitive/rare landscape features** – Important archaeological features including coal mining relics in the South West Peak, along with valued prehistoric sites and monuments.	The large scale of the moorland expanses could indicate the suitability for incorporating wind turbines into the landscape. However, the lack of significant built development, strong overriding sense of tranquillity and remoteness, valued archaeology and high visibility from surrounding areas all pose serious constraints to the development of wind turbines. This landscape type has therefore been assessed as having a **high** sensitivity to all sizes and scales of wind turbine development. Landscape attributes that are particularly sensitive to the development of wind turbines are: • Its open character with expansive views to and from surrounding landscapes. • Its strong sense of remoteness and tranquillity. • Large tracts of uninterrupted heather and grass moorland. • The absence of modern development – isolated buildings where they exist have a strong historic character. • Strong sense of wildness and 'naturalness' with few man-made intrusions. • Historic and archaeological features including prehistoric sites and monuments.	This landscape type is assessed as having a high sensitivity to any size and scale of wind turbine development, therefore no guidance has been included.

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>• Landform - Vast open landscape comprised of a high, undulating gritstone plateau with occasional rocky outcrops and tors.
• Landcover/land use – Heather and grass moorland predominantly rough grazed by sheep. Parts of the moor are managed for grouse shooting. Some small reservoirs on the edge of the moors.
• Landscape pattern – Open heather and grass moorland surrounded by occasional enclosures of regular medium-large fields.
• Sense of enclosure – Landscape type is defined by its open character with expansive views. It is a largely treeless landscape with limited areas of scrubby woodland. Occasional enclosure around the moorland edges.
• Sense of 'naturalness' – Strong sense of a wild landscape with little human interference. Dominated by semi-natural heather moorland habitats.
• Inter-visibility – Long views across the surrounding hills and lower ground.
• Sensitive/rare landscape features – Important archaeological features including coal mining relics in the South West Peak, along with valued prehistoric sites and monuments.</td><td>This landscape's distinctive open skylines, vast semi-natural moorland expanses, absence of tree cover and cultivated land, high visibility from adjacent areas and important archaeological features all pose severe constraints to bioenergy crop planting.

This landscape type has therefore been judged as having a high sensitivity to both miscanthus and SRC planting. Landscape attributes that are particularly sensitive to bioenergy planting are:
• The distinctive open plateau, dominated by expanses of heather moorland.
• Rough grazing land use, with no improved or cultivated land.
• Lack of enclosure for agriculture.
• Strong sense of wildness and 'naturalness' with few man-made intrusions.
• Expansive views to and from surrounding landscapes.
• Historic and archaeological features including prehistoric sites and monuments.</td><td>This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.</td></tr>
</table>

2) Landscape Type: Densely Enclosed Gritstone Upland (PD)
Constituent Character Areas: Dark Peak Yorkshire Fringe, South West Peak

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3" align="center">WIND TURBINES</td></tr>
<tr><td>

Landform and scale – Undulating upland landscape rising to moorland summits. A number of deeply incised cloughs cut through the rising ground.
Landscape pattern – Well defined small fields contrasting with larger enclosures of moorland and rough grazing.
Sense of enclosure – Small fields enclosed by drystone walls contrast with larger areas of moorland. A lack of tree cover apart from occasional farmstead groups and small coniferous blocks gives the landscape a sense of openness.
Sense of tranquillity/ remoteness – Although well settled, the landscape has a strong sense of remoteness due to its rugged upland character. Some main roads such as the A635 erode levels of tranquillity in places.
Settlement / transport network – Dispersed farmsteads and cottages found across the landscape, including historic weavers' and coal miners' cottages. Lanes, small tracks and footpaths link settlements and builds. Some main roads cross the area.
Skyline – Open, undeveloped skylines affording long views across the landscape.
Inter-visibility –Landscape is framed by the surrounding moorlands.
Sensitive/rare landscape features – Important features relating to the area's industrial heritage, including distinctive weavers' cottages and relict coal mines, including at Goldsitch Moss.

</td><td>
The presence of some built elements (i.e. main roads) within this landscape type could suggest it would be able to accommodate further man-made features. However, its strong sense of remoteness, open character, long views, historic settlement and industrial heritage, areas of open moorland and small scale field pattern all pose constraints to wind turbine developments.

This landscape type is judged as being of high sensitivity to large and medium scale wind turbines and moderate-high sensitivity to small turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are:

Its open character with little tree cover.
The strong sense of remoteness.
Its historic settlement and field pattern.
Long views across the landscape and beyond.
Important features relating to the landscape's industrial heritage.

</td><td>

This landscape would not be suitable for large scale wind turbines because of its open character and long views.
Single small scale turbines are likely to be most appropriate. These should be located close to existing built elements or coniferous plantations to minimise visual impacts.
The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development.
Utilise the screening effects of the area's undulating topography to integrate development into the landscape.
Ensure that the location of turbines and related infrastructure does not affect the character or setting of the historic settlements and buildings (particularly weavers' and coal miners' cottages)
Ensure that features related to past coal mining are protected.
Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.
Maintain key views across the landscape and beyond.

</td></tr>
</table>

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform** – Undulating upland landscape rising to moorland summits. A number of deeply incised cloughs cut through the rising ground. • **Landcover/land use –** Pastoral landscape supporting sheep grazing and some cattle. Some areas of rough grazing associated with heathland. Occasional small blocks of coniferous plantations. • **Landscape pattern** – Well defined small fields contrasting with larger enclosures of moorland and rough grazing. • **Sense of enclosure –** Small fields enclosed by drystone walls contrast with larger areas of moorland. A lack of tree cover apart from occasional farmstead groups and small coniferous blocks gives the landscape an open feel. • **Sense of 'naturalness'** – Areas of moorland habitat and rush dominated fields give a natural feel to the landscape. • **Inter-visibility** – Landscape is framed by the surrounding moorlands. • **Sensitive/rare landscape features** – Important features relating to the area's industrial heritage, including distinctive weavers' cottages and relict coal mines, including at Goldsitch Moss.	This landscape's strong upland character and pastoral/rough grazing land use would make it unsuitable for monoculture energy crops such as miscanthus. However, the presence of small coniferous plantations and undulating landform could indicate that this landscape type may be able to incorporate some SRC planting. Areas of rough grazing and naturalistic moorland habitats, the historic field and settlement patterns and important heritage do provide constraints to this type of energy crop planting. This landscape type is therefore assessed as having a **high** sensitivity to miscanthus and a **moderate-high** sensitivity to SRC. Landscape attributes that would be particularly sensitive to energy crop planting are: • Unimproved pastoral land use with areas of rough grazing. • Open character with little tree cover. • Naturalistic moorland habitats. • Historic settlement and field pattern. • Long views across the landscape and beyond. • Important features relating to the landscape's industrial heritage.	• This landscape would not be suitable for the planting of miscanthus or other monoculture bioenergy crops. • There may be opportunity to link limited amounts of SRC with existing woodlands providing it does not alter their shape or form within the landscape • Plant at the field scale to maintain landscape pattern. • Integrate any planting into existing coniferous plantations to minimise visual impacts. • Ensure bioenergy crop planting does not encroach onto areas of semi-natural moorland or rough grazing. • Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of SRC planting.

3) Landscape Type: Moorland Slopes and Cloughs (PD)
Constituent Character Areas: Eastern Moors, Dark Peak, Dark Peak Western Fringe

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Steep slopes and cloughs rising to open moorland and precipitous gritstone edges. • **Landscape pattern** – Large areas of open moorland with some gritstone walls defining ownership boundaries. Occasional scattered trees, scrub and small plantations break up the open landscape. • **Sense of enclosure –** This is an open, exposed landscape with steep clough sides and dense woodland cover providing enclosure in places. • **Sense of tranquillity/ remoteness –** This is a remote, upland landscape with limited modern development. Main roads within the Eastern Moors landscape type erode tranquillity locally. This landscape is extremely popular for recreation, including climbing on the gritstone edges. • **Settlement / transport network** – Sparse settlement with isolated granite farmsteads, cottages and inns. Stock pens and field barns are also a feature. The moorland slopes are largely inaccessible to transport with the exception of routes that cross the moors. Hollow-ways are visible features within the landscape. • **Skyline** – Open skylines often characterised by gritstone outcrops. • **Inter-visibility** – Exposed, panoramic views over lower ground. Wind farm visible on the horizon at Penistone, outside the National Park. • **Sensitive/rare landscape features** – Moorland habitats including heather, bilberry and acid grasslands; fern banks within cloughs; and scree slopes are all important habitats. Mining and quarrying remains are valued historically.	Although the presence of woodland and a sloping topography could indicate the potential to incorporate wind turbines, this landscape's exposed, undeveloped nature, lack of enclosure, panoramic views, high value for recreation, inaccessibility, valued moorland habitats and important industrial heritage all pose severe constrains to wind turbines. It is therefore judged to be unsuitable for all sizes and scale of turbine. This landscape type is of **high** sensitivity to large and medium scales of wind turbine and of **moderate-high** sensitivity to small turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Its characteristic gritstone landform and famous edges. • Wild, open moorland expanses. • High levels of tranquillity and remoteness. • Panoramic views across lower ground. • Biodiversity-rich moorland and clough-side habitats, including scree slopes. • Important features relating to the landscape's industrial heritage.	• This landscape would not be suitable for large or medium scale wind turbines because of its open character and long views. • Single small scale turbines are likely to be most appropriate. These should be located close to existing built elements (e.g. roads, electricity pylons) to minimise visual impacts. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's undulating topography and dense clough woodlands to integrate development into the landscape. • Ensure that features related to past industrial activity are protected. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Protect areas of semi-natural moorland and scree slopes from the impacts of development. • Maintain key views across the landscape and beyond.

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>Landform – Steep slopes and cloughs rising to open moorland and precipitous gritstone edges.
Landcover/land use – Marginal agriculture with rough sheep grazing dominating. Some localised pastures and coniferous plantations.
Landscape pattern – Large areas of open moorland with some gritstone walls defining ownership boundaries. Occasional scattered trees, scrub and small plantations break up the open landscape.
Sense of enclosure – This is an open, exposed landscape with steep clough sides providing enclosure in places.
Sense of 'naturalness' – There is an overriding sense of naturalness within this landscape, with expanses of moorland and clough-side woodlands and wetlands.
Inter-visibility – Exposed, panoramic views over lower ground.
Sensitive/rare landscape features – Moorland habitats including heather, bilberry and acid grasslands; fern banks within cloughs; and scree slopes are all important habitats. Mining and quarrying remains are valued historically.</td><td>The presence of some plantation woodland and steep clough slopes could indicate limited potential for bioenergy crops within this landscape type. However, the overriding sense of wildness and naturalness associated with moorland expanses, rough grazing land use, panoramic views, valued semi-natural habitats and industrial remains all pose constraints to energy crop planting.

This landscape type is therefore assessed as being of high sensitivity to miscanthus and moderate-high sensitivity to SRC. The landscape attributes that would be particularly sensitive to energy crops include:
Wild, open moorland expanses.
Traditional upland sheep grazing land use.
Panoramic views across lower ground.
Biodiversity-rich moorland and clough-side habitats, including scree slopes.
Important features relating to the landscape's industrial heritage.</td><td>This landscape would not be suitable for the planting of miscanthus or other monoculture bioenergy crops.
Plant at the field scale to maintain landscape pattern.
Integrate any planting into existing coniferous plantations to minimise visual impacts.
Utilise the screening effects of the steep clough sides to minimise the visual impacts of any crop planting.
Ensure bioenergy crop planting does not encroach onto areas of semi-natural moorland, wetlands or rough grazing land.
Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of SRC planting.
Maintain key views across lower landscapes.
Protect the character and setting of any industrial remains, including quarries and coal mining relics.</td></tr>
</table>

4) Landscape Type: Moorland Hills and Ridges (PD)
Constituent Character Areas: South West Peak (PD)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Steep slopes and high ridges with rocky exposures, rising up to open moorland summits in places. • **Landscape pattern –** Areas of moorland divided into large enclosures bounded by gritstone walls. Some areas of smaller fields. • **Sense of enclosure –** Open and exposed landscape with little tree cover. • **Sense of tranquillity/ remoteness –** Remote, lightly settled landscape with high levels of tranquillity. • **Settlement / transport network** – Occasional isolated farmsteads of gritstone are set into the hill slopes for shelter. Few roads cross the landscape, running at an angle to the slopes. • **Skyline** – Rocky outcrops form dramatic features against the skyline. • **Inter-visibility** – Panoramic views to the surrounding hills and over the lowlands to the west. • **Sensitive/rare landscape features** – Several sites of historic stone and roof slate quarries, as well as former coal mines in the upper Dane Valley, parts of the Goyt Valley and Burbage. Dwarf shrub heath, blanket mere and peat are valued upland habitats. Rush pastures are also important wetland habitats, including for ground nesting birds.	This landscape type's open, exposed character could certainly enable wind to be harnessed for renewable energy generation. Its industrial past could also indicate suitability for further man-made structures. However, the lack of tree cover, absence of settlement and modern development, high levels of tranquillity, panoramic views across the surrounding landscapes and valued upland habitats all pose significant constraints to the development of wind turbines. This landscape is judged as being of **high** sensitivity to all sizes and scales of wind turbine. Landscape attributes that would be particularly sensitive to this form of renewable energy development include: • Its open, exposed character with little tree cover. • Lack of modern development and sparse settlement. • Distinctive skylines of rocky outcrops and open moorland. • Panoramic views to the surrounding hills and lowlands to the west. • Historically important slate quarries and former coal mines in the upper Dane Valley, parts of the Goyt Valley and Burbage. • Valued upland moorland habitats including heathland, blanket mere and peat.	This landscape type is assessed as having a high sensitivity to any size and scale of wind turbine development, therefore no guidance has been included.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform –** Steep slopes and high ridges with rocky exposures, rising up to open moorland summits in places. • **Landcover/land use –** Rough grazing with sheep and cattle predominates. Some areas of permanent grassland. A large military training area lies to the south east of the Roaches. • **Landscape pattern –** Areas of moorland divided into large enclosures bounded by gritstone walls. Some areas of smaller fields. • **Sense of enclosure –** Open and exposed landscape with little tree cover. • **Sense of 'naturalness'** – Rough moorland habitats give a strong sense of naturalness to this upland landscape. • **Inter-visibility** – Panoramic views to the surrounding hills and over the lowlands to the west. • **Sensitive/rare landscape features** – Several sites of historic stone and roof slate quarries, as well as former coal mines in the upper Dane Valley, parts of the Goyt Valley and Burbage. Dwarf shrub heath, blanket mere and peat are valued upland habitats. Rush pastures are also important wetland habitats, including for ground nesting birds.	This landscape's distinctive open and rocky skylines, vast semi-natural moorland expanses, absence of tree cover and cultivated land, high visibility from adjacent areas and important historic features all pose severe constraints to bioenergy crop planting. This landscape type has therefore been judged as having a **high** sensitivity to both miscanthus and SRC planting. Landscape attributes that would be particularly sensitive to bioenergy planting are: • Its open, exposed character with little tree cover. • Lack of cultivated land and predominance of traditional rough grazing. • Distinctive skylines of rocky outcrops and open moorland. • Panoramic views and intervisibility with the surrounding hills and lowlands to the west. • Historically important slate quarries and former coal mines in the upper Dane Valley, parts of the Goyt Valley and Burbage. • Valued moorland habitats including heathland, blanket mere and peat.	This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.

5) Landscape Type: Enclosed Gritstone Upland (PD), Moorland Fringe (DC)
Constituent Character Areas: Eastern Moors, Dark Peak, Dark Peak Western Fringe, Dark Peak Yorkshire Fringe, Derbyshire Peak Fringe, Derwent Valley, South West Peak, North Pennines (PD), Dark Peak (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** High rolling hill summits with broad ridgetops and some steeper slopes. The underlying gritstone is exposed in places as tors and edges. • **Landscape pattern –** Fields are mainly medium to large, regular in shape. There are some remaining areas of unenclosed moor and areas of smaller, irregular fields (e.g. medieval fields around Robin Hood, Farley and Burley Fields in the Eastern Moors). Occasional tree groups, shelterbelts and plantations add texture to the landscape. • **Sense of enclosure –** The gently rolling topography, high elevations and sparse tree cover give a sense of openness to this landscape. • **Sense of tranquillity/ remoteness –** This is a remote landscape with sparse settlement and often limited access. As such it retains high levels of tranquillity. Main roads within the Derbyshire Peak Fringe LCA erode tranquillity locally. • **Settlement / transport network** – The higher, open moorland is largely unsettled. Isolated, stone farmsteads are the dominant settlement type, mainly linked by straight roads. • **Skyline** – Open skylines enabling long, uninterrupted views across the landscape. • **Inter-visibility** – Extensive views across lower ground.	The presence of some main roads and past industry could suggest that this landscape type might be able to accommodate limited wind turbine development. However, its broad landform, sparse tree cover, strong sense of openness, high levels of tranquillity and remoteness, very sparse settlement, valued upland habitats and historic industrial remains all place significant sensitivities on the development of wind turbines. This landscape type is assessed as being of **high** sensitivity to large and medium turbines and **moderate-high** sensitivity to small scale turbines. Landscape attributes that would be particularly sensitive to this form of renewable energy development include: • The broad, sweeping topography with wide panoramas. • Areas of historic enclosure, e.g. medieval fields around Robin Hood, Farley and Burley Fields in the Eastern Moors LCA). • High levels of remoteness, with sparse settlement and limited access. • Open, undeveloped skylines. • Long views across lower ground. • Valued upland habitats including heathland, acid grasslands and wetlands.	• This landscape would not be suitable for large or medium scale wind turbines because of its open, remote character and lack of modern development. • Single small scale turbines are likely to be most appropriate. These should be located close to existing built elements (e.g. farm buildings, main roads) or areas of tree cover. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's steeper slopes to integrate development into the landscape. • Ensure that features related to past mining and quarrying are protected. • Protect the character and setting of mill buildings within Charlesworth Conservation Area from the visual impacts of wind turbine development. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Protect valued upland habitats, including heathland, acid grasslands and rush-dominated wetlands. • Maintain key views across the landscape and beyond.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Sensitive/rare landscape features** – Patches of semi-natural vegetation on verges and steeper slopes are important – including heathland, acid grasslands and rush-dominated wetlands of importance for birds. Coal, lead mining and quarrying remains are valued historically in many parts of the landscape (e.g. remains of 18th century lead mining near Eyam in the Derwent Valley, and relict quarries at Chinley Churn in the Dark Peak Western Fringe). Mill buildings within the Charlesworth Conservation Area are also historically important.	• Historically important mining and quarrying remains, including lead mining near Eyam.	
BIOMASS – ENERGY CROPS		
• **Landform –** High rolling hill summits with broad ridgetops and some steeper slopes. The underlying gritstone is exposed in places as tors and edges. • **Landcover/land use –** Mainly permanent pasture supporting sheep and cattle grazing, with some rough grazing and dairying in places. Limited areas of arable fields and re-seeded grass leys in Dark Peak character areas. • **Landscape pattern –** Fields are mainly medium to large, regular in shape. There are some remaining areas of unenclosed moor and areas of smaller, irregular fields (e.g. medieval fields around Robin Hood, Farley and Burley Fields in the Eastern Moors). Occasional tree groups, shelterbelts and plantations add texture to the landscape. • **Sense of enclosure –** The gently rolling topography, high elevations and sparse tree cover give a sense of openness to this landscape. • **Sense of 'naturalness'** – Patches of semi-natural habitat and trees add a sense of naturalness into the farmed landscape. • **Inter-visibility** – Extensive views across lower ground.	The presence of limited areas of arable cultivation and intensive grass leys could allow for the integration of bioenergy planting into parts of this landscape. However, the dominance of pastoral farming, little tree cover, areas of unenclosed moorland and rough grazing, the presence of naturalistic upland habitats and valued industrial heritage all pose sensitivities to bioenergy crops. This landscape type is assessed as being of **high** sensitivity to both SRC and miscanthus (this assessment is lowered to **moderate-high** sensitivity for miscanthus only in the Dark Peak). Landscape attributes that would be particularly sensitive to bioenergy planting include: • The pastoral land use with some areas of rough moorland grazing. • The lack of tree or woodland cover. • Strong sense of openness with long views across the landscape and beyond.	• SRC planting would not be suitable in this open, unwooded landscape. • Miscanthus planting should be limited to the very small areas already under arable cultivation or intensive grass leys (i.e. in parts of the Dark Peak), rather than through converting pastoral areas to energy crops. • Utilise the sloping topography to minimise the visual impact of bionergy crops within the landscape. • Plant at the field scale to maintain landscape pattern. • Aim for irregular patterns of planting rather than geometric blocks to maintain the characteristic field patterns. • Avoid vast swathes of energy crop planting. • Ensure bioenergy crop planting does not encroach onto areas of heathland, acid grassland and wetlands. • Ensure planting does not interrupt important, long views across the landscape.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Sensitive/rare landscape features** – Patches of semi-natural vegetation on verges and steeper slopes are important – including heathland, acid grasslands and rush-dominated wetlands of importance for birds. Coal, lead mining and quarrying remains are valued historically in many parts of the landscape (e.g. remains of 18th century lead mining near Eyam in the Derwent Valley; relict quarries at Chinley Churn in the Dark Peak Western Fringe). Mill buildings within the Charlesworth Conservation Area are also historically important.	• Patches of naturalistic habitat including heathland, acid grasslands and wetlands. • Important mining and quarrying relicts, contributing to an historic sense of place.	• Protect the character and setting of the area's industrial heritage features, including coal and lead mining remains and quarries. • Protect the character and setting of mill buildings within Charlesworth Conservation Area from the visual impacts of bioenergy planting.

6) Landscape Type: Reservoir Valleys with Woodland (PD)
Constituent Character Areas: Dark Peak

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Steep sided valleys cutting into the gritstone moorland; in some places dissected by deep cloughs. • **Landscape pattern** – Landscape dominated by reservoirs fringed by extensive woodlands and plantations. • **Sense of enclosure –** High woodland cover gives a sense of enclosure. The Longdendale Valley is characterised by small scale fields. • **Sense of tranquillity/ remoteness –** The reservoirs and cycle track along the former railway in the Longdendale Valley are very popular for recreation, which can impact on the area's tranquillity. Major roads such as the A57 and A628 also have significant impacts on feelings of remoteness within the areas through which they pass. However, the landscape's unsettled nature contributes to an overall sense of tranquillity and remoteness. • **Settlement / transport network** – Generally unsettled with occasional granite farmsteads. Area dominated by the presence of large reservoirs. • **Skyline** – Skyline characterised by woodland with views of the surrounding moorland. • **Inter-visibility** – Landscape framed by the bleak moorlands of the Dark Peak. • **Sensitive/rare landscape features** – Patches of ancient semi-natural woodland and acid grassland are valued semi-naturals habitats. The foundations of the former temporary settlement of Birchinlee on the banks of Ladybower Reservoir are of historical value.	The presence of large scale reservoirs, related infrastructure and main roads within this landscape type could indicate that it would be able to accommodate further man-made structures. High levels of woodland cover could also help screen any new development. However, the area's unsettled character, valued semi-natural woodland and grassland habitats, close visual relationship with the surrounding moorlands and its undeveloped skylines all place sensitivities to this type of development. This landscape type is therefore assessed as being of **high** sensitivity to large and medium scale turbines, and **moderate-high** sensitivity to small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Lack of settlement or modern development. • The small scale, intimate landscape of the Longendale Valley. • Valued semi-natural woodlands and areas of acid grassland. • The landscape's strong historic sense of place in relation to the 19th and early 20th century development of the reservoirs. • The close visual relationship between the valleys and the surrounding moorlands. • The wooded, undeveloped skylines.	• This landscape would not be suitable for large or medium scale wind turbines. • Single small scale turbines are likely to be most appropriate in this enclosed valley landscape. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Link any development to existing points of focus in the landscape – i.e. the reservoirs and their related development. • Utilise the screening effects of the area's woodlands and the steep valley topography to integrate development into the landscape. • Maintain views of the surrounding moorland of the Dark Peak. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Protect the area's ancient semi-natural woodlands and patches of acid grassland from loss to development. • Avoid siting turbines in the Longendale Valley due to its small scale, intimate character.

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>Protect the character and setting of the former temporary settlement of Birchinlee on the banks of Ladybower Reservoir.</td></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>
Landform – Steep sided valleys cutting into the gritstone moorland; in some places dissected by deep cloughs.
Landcover/land use – This landscape is dominated by large reservoirs and coniferous plantations. There is some low intensity pastoral farming in some parts of the valleys.
Landscape pattern – Landscape dominated by reservoirs fringed by extensive woodlands and plantations.
Sense of enclosure – High woodland cover gives a sense of enclosure. The Longdendale Valley is characterised by small scale fields.
Sense of 'naturalness' – The dominance of the reservoirs and conifer plantations give this landscape a man-made feel, particularly in comparison with the surrounding undeveloped moorlands. Patches of ancient woodland and acid grasslands contribute to a sense of naturalness.
Inter-visibility – Landscape framed by the bleak moorlands of the Dark Peak.
Sensitive/rare landscape features – Patches of ancient semi-natural woodland and acid grassland are valued semi-natural habitats. The foundations of the former temporary settlement of Birchinlee on the banks of Ladybower Reservoir are of historical value.
</td><td>The large areas of woodland and plantations within this landscape type, along with the presence of significant reservoir development, could present opportunities for bioenergy crop planting. However, the absence of intensive agricultural land uses or cropping, the pastoral character of available farmland, the presence of valued semi-natural woodland and grassland habitats and strong visual relationship with the surrounding moorlands all pose constraints.

This landscape type is therefore assessed as being of high sensitivity to miscanthus planting and moderate sensitivity to SRC. Landscape attributes that are particularly sensitive to bioenergy planting are:
Absence of intensive farming or cropping systems.
Pastoral character of available farmland.
Lack of settlement or modern development.
The small scale, intimate landscape of the Longendale Valley.
The landscape's strong historic sense of place in relation to the 19th and early 20th century development of the reservoirs.
Valued semi-natural woodlands and areas of acid grassland.
The close visual relationship between the valleys and the surrounding moorlands.
</td><td>
This landscape would not be suitable for the planting of miscanthus or other monoculture bioenergy crops.
There may be opportunity to link some SRC with existing woodlands – including to soften the edges of existing coniferous plantation blocks.
Integrate any planting into existing coniferous plantations to minimise visual impacts.
Ensure bioenergy crop planting does not encroach onto areas of semi-natural habitat, particularly acid grasslands and ancient semi-natural woodlands.
Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of SRC planting.
Protect views to the surrounding moorlands of the Dark Peak.
</td></tr>
</table>

7) Landscape Type: Pastoral Valleys with Industry (PD), Settled Valley Pastures (DC)
Constituent Character Areas: Dark Peak Western Fringe, Manchester Pennine Fringe (PD), Dark Peak (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Low-lying undulating valleys with rounded hills and shallow to steep valley sides. Incised by steeper cloughs in places. • **Landscape pattern** – Mainly small to medium irregular fields. Some medieval strip fields e.g. near Hadfield, Padfield and Glossop. Frequent broadleaved woodlands along watercourses and as shelterbelts give the impression of a well-wooded landscape. • **Sense of enclosure –** This landscape type's steep valley sides and high woodland cover contribute to a sense of enclosure. • **Sense of tranquillity/ remoteness –** The presence of busy roads linking to adjacent urban centres lie in contrast to peaceful agricultural land elsewhere. • **Settlement / transport network** – Settled landscape with distinctive gritstone mill settlements, dispersed farmsteads and hamlets. Terraces of weavers' cottages are particularly distinctive. Area is crossed by busy roads with smaller winding lanes linking areas of settlement. • **Skyline** – Skyline defined by rising, unsettled pastures and moorlands. • **Inter-visibility** – Valleys framed by the surrounding uplands. • **Sensitive/rare landscape features** – Surviving industrial mills in the valley bottoms are important historic features (including as part of the Conservation Areas at Little Hayfield, Holehouse, Howard Town, Old Glossop, Padfield, Combs, Simmondley and Kettleshulme), along with rare examples of Cornish steam engine houses and other	The presence of development and the landscape's industrial heritage could indicate that it would be able to accommodate further man-made elements. Aspects that pose constraints to wind turbines include the small scale landscape pattern, peaceful character of much of the area, the historic importance of the valley mills and valued ancient semi-natural woodlands. This landscape type is therefore assessed as being of **high** sensitivity to large and medium scale wind turbines, and of **moderate-high** sensitivity to small scale wind turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • The intimate pattern of small fields and woodlands. • The overall levels of peace and tranquillity in contrast to the nearby urban centres. • The strong historic character of the area's mills and other industrial structures. • The valued areas of ancient semi-natural woodland. • Views to and from the surrounding uplands.	• This landscape would not be suitable for large or medium scale wind turbines. • Single small scale turbines are likely to be most appropriate in this intimate, rural landscape. These should be located close to existing built elements (such as farm buildings). • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Site turbines close within or on the fringes or within areas of built development (e.g. Glossop, Whaley Bridge, New Mills) to take advantage of the existing location of development. • Utilise the screening effects of the area's woodlands and sloping topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not affect the character or setting of historic mills and other industrial heritage features in the valleys. • Ensure that vertical structures associated with the mills and engine houses remain the prominent features on the valley skylines, including within the Conservation Areas at Little Hayfield, Holehouse, Howard Town, Old Glossop, Padfield, Combs, Simmondley and Kettleshulme.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
colliery structures. Scattered ancient woodlands and wetlands are valued for biodiversity.		• Protect the area's ancient woodlands from the impacts of turbine development. • Protect key viewpoints to and from the surrounding uplands.
	BIOMASS – ENERGY CROPS	
• **Landform** – Low-lying undulating valleys with rounded hills and shallow to steep valley sides. Incised by steeper cloughs in places. • **Landcover/land use –** Pastoral landscape of cattle and sheep grazing, with some areas of intensive dairying and stock rearing. Reservoirs are also present – e.g. Dovestone, Coombes and Bottoms Reservoirs. • **Landscape pattern** – Mainly small to medium irregular fields. Some medieval strip fields e.g. near Hadfield, Padfield and Glossop. Frequent broadleaved woodlands along watercourses and as shelterbelts give the impression of a well-wooded landscape. • **Sense of enclosure –** This landscape type's steep valley sides and high woodland cover contribute to a sense of enclosure. • **Sense of 'naturalness'** – Stream-side woodlands and shelterbelts, as well as scattered ancient woodlands, contribute to a sense of naturalness. • **Inter-visibility** – Valleys framed by the surrounding uplands. • **Sensitive/rare landscape features** – Surviving industrial mills in the valley bottoms are important historic features (including as part of the Conservation Areas at Little Hayfield, Combs, Simmondley and Kettleshulme), along with rare examples of Cornish steam engine houses and other colliery structures. Scattered ancient woodlands and wetlands are valued for biodiversity.	The presence of some areas of intensive farming and frequent areas of woodland indicates that this landscape type may be able to accommodate some areas of bioenergy planting. Aspects that pose constraints to planting include the pastoral land use, small scale landscape pattern, peaceful character of much of the area, the historic importance of the valley mills and valued ancient semi-natural woodlands. This landscape is judged to have a **moderate to high** sensitivity to SRC and a **high** sensitivity to miscanthus planting. The landscape attributes that would be particularly sensitive to bioenergy crop planting are: • The intimate pattern of small fields and woodlands. • The strongly pastoral character of the landscape. • Medieval strip fields near Hadfield, Padfield and Glossop. • The historic significance of the area's mills and other industrial structures. • The presence of important areas of ancient semi-natural woodland.	• This landscape type would not be suitable for miscanthus or other monoculture crops because of its strongly pastoral character. • Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of energy crop planting. • There may be opportunity to link some SRC with existing woodlands whilst maintaining their shape and scale within the landscape. • Ensure bioenergy crop planting does not encroach onto areas of ancient semi-natural woodland. • When planting, consider views along the valleys to the mills and other industrial heritage features, including within the Conservation Areas at Little Hayfield, Combs, Simmondley and Kettleshulme.

8) Landscape Type: Riverside Meadows (PD, DC)
Constituent Character Areas: Dark Peak Western Fringe, Derbyshire Peak Fringe, Derwent Valley, South West Peak, Cheshire & Staffordshire Plain (PD), Dark Peak, Derbyshire Peak Fringe and Lower Derwent (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Flat, meandering river channels within alluvial floodplains. Where passing over gritstone, some channels are narrower with steep valley sides, such as in part of the upper Dove Valley. • **Landscape pattern** – Rivers fringed by a mixture of regular and irregular small to medium sized fields. Distinctive medieval strip fields downstream from Parwich. Areas of wetland vegetation and dense tree cover along watercourses add texture to the landscape. • **Sense of enclosure –** Hedgerows and dense tree cover give a strong sense of enclosure to the landscape. Narrow and steep valleys in places also enhance the feeling of enclosure. • **Sense of tranquillity/ remoteness –** The low levels of settlement and built forms within the landscape give it a tranquil and remote feel. Some isolated modern development can erode tranquillity in places. • **Settlement / transport network** – Generally an unsettled landscape due to the wet nature of the floodplain and risk of flooding. Scattered farmsteads on higher ground along with former mills in the valleys are distinctive. • **Skyline** – Undeveloped skylines largely characterised by trees and woodlands. • **Inter-visibility** – Limited views out from these landscapes due to the high density of woodland cover and sloping topography.	Although there are signs of former industry, and some isolated locations of modern development, this landscape's largely unsettled character, the intimate feel of the meandering river channels, valued wetlands and internationally important industrial heritage all pose constraints to wind turbine developments. This landscape type is judged to be of **high** sensitivity to both large and medium size turbines, and a **moderate-high** sensitivity to small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Small scale landscape character of intimate river valleys. • Low levels of settlement and built development – high levels of tranquillity. • Historic mills and other important industrial heritage features, including within the Derwent Valley Mills World Heritage Site. • Archaeologically valued medieval strip fields and ridge and furrow downstream from Parwich. • Undeveloped, wooded skylines.	• This landscape would not be suitable for large or medium scale wind turbines. • Single small scale turbines are likely to be most appropriate in this intimate, rural landscape. These should be located close to existing built elements. • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Site any turbines next to or within existing areas of modern development. • Utilise the screening effects of the area's woodlands and sloping topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not detract from the presence of historic mills and other industrial heritage features in the valleys. • Avoid locations within view of the medieval strip fields / ridge and furrow downstream from Parwich to protect their character and setting. • Do not locate turbines within the boundary or buffer of the Derwent Valley Mills World Heritage Site to protect its historic integrity.

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td>Sensitive/rare landscape features – The medieval strip fields and surviving ridge and furrow in the valley downstream from Parwich are valued historic landscape features. The presence of mill buildings, ponds, weirs and races reflect the landscape's industrial heritage, including as part of the Derwent Valley Mills World Heritage Site (within the Derbyshire Peak Fringe and Lower Derwent Character Area).</td><td></td><td>Ensure that vertical structures associated with the mills, and their character and setting, are protected. This particularly applies to the Conservation Areas at Castletop, Lea Bridge & High Peak Junction, Ashford-in-the-Water, Bakewell, Bamford, Buxworth, Calver, New Mills and Whaley Bridge.</td></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>Landform – Flat, meandering river channels within alluvial floodplains. Where passing over gritstone, some channels are narrower with steep valley sides, such as in part of the upper Dove Valley.
Landcover/land use – Pastoral landscape with permanent pasture dominating due to seasonal waterlogging.
Landscape pattern – Rivers fringed by a mixture of regular and irregular small to medium sized fields. Distinctive medieval strip fields downstream from Parwich. Areas of wetland vegetation and dense tree cover along watercourses add texture to the landscape.
Sense of enclosure – Hedgerows and dense tree cover give a strong sense of enclosure to the landscape. Narrow and steep valleys in places also enhance the feeling of enclosure.
Sense of 'naturalness' – The lack of significant built features, wetland vegetation and the landscape's dense tree cover give a strong sense of naturalness.
Inter-visibility – Limited views out from these landscapes due to the high density of woodland cover and sloping topography.</td><td>Dense tree cover along watercourses and the steep landform in places could indicate that this landscape type would be able to integrate limited areas of bioenergy (SRC) planting. However, its pastoral character, susceptibility to waterlogging, strong naturalistic character and industrial heritage all present sensitivities to bioenegy planting.

This landscape type is therefore assessed as having a moderate sensitivity to SRC and a high sensitivity to miscanthus planting. The landscape attributes that would be particularly sensitive to bioenergy crop planting are:
The wet, pastoral character of the landscape.
High levels of naturalistic land cover.
Medieval strip fields and ridge and furrow downstream from Parwich.
Valued industrial heritage features, including mill buildings, ponds, weirs and races, including within the Derwent Valley Mills World Heritage Site.</td><td>This landscape type would not be suitable for monoculture bioenergy crops such as miscanthus.
There may be opportunity to link small areas of SRC with existing riverside woodlands whilst maintaining their shape and scale within the landscape.
Ensure bioenergy crop planting does not encroach onto areas of semi-natural wetlands.
When planting, consider views along the valleys to the mills and other industrial heritage features.
Do not introduce significant areas of planting within the boundary or buffer of the Derwent Valley Mills World Heritage Site to protect its historic integrity.
When planting, consider views along the landscape to and from mills and other industrial heritage features, including within the Conservation Areas at Castletop, Lea Bridge & High Peak Junction, Ashford-in-the-Water, Bakewell, Bamford, Buxworth, Calver, New Mills and Whaley Bridge.</td></tr>
</table>

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Sensitive/rare landscape features** – The medieval strip fields and surviving ridge and furrow in the valley downstream from Parwich are valued historic landscape features. The presence of mill buildings, ponds, weirs and races reflect the landscape's industrial heritage, including as part of the Derwent Valley Mills World Heritage Site.		• Plant at the field scale to maintain landscape pattern. • Aim for irregular patterns of planting rather than geometric blocks to maintain the characteristic field patterns. Avoid vast swathes of energy crop planting. • Avoid any planting in locations of medieval strip fields or ridge and furrow downstream of Parwich.

9) Landscape Type: Upper Valley Pastures (PD)
Constituent Character Areas: Dark Peak, South West Peak

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Low-lying valley slopes incised by streams draining from the surrounding high moors. • **Landscape pattern** – Varied landscape pattern with a mixture of field sizes and shapes, but many are irregular (pre-Parliamentary Enclosure). • **Sense of enclosure –** The valley slopes and cloughs give this landscape type a sense of enclosure, particularly in contrast to the surrounding open moors. Frequent field boundary trees and woodlands along watercourses also provide enclosure. • **Sense of tranquillity/ remoteness –** The landscape's lightly settled character and minor road network contribute to feelings of remoteness and tranquillity. The Snake Pass road and the Sheffield to Manchester railway line erode tranquillity locally. • **Settlement / transport network** – Dispersed settlement pattern of gritstone farmsteads and cottages, often found at water crossing points or along valley bottoms/slopes. Landscape mainly crossed by narrow winding lanes, with the Snake Pass being the main route through the area. The Hope Valley railway line passes through Edale. • **Skyline** – The valleys are framed by the surrounding moors. Skylines are undeveloped and open. • **Inter-visibility** – The high moors form a backdrop to this landscape type.	This landscape's sloping topography and the presence of intrusive transport infrastructure could mean that it would be able to support wind turbine development. However, its lightly settled character, strong sense of remoteness away from the main transport routes, open skylines with moorland views and valued semi-natural habitats all present sensitivities to this form of renewable energy development. This landscape type is judged to be of **high** sensitivity to large and medium scale turbines and **moderate-high** sensitivity to small scale wind turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Its lightly settled character and historic settlement pattern of 'Booths'. • Strong feelings of remoteness and tranquillity away from the main transport networks. • Undeveloped, open skylines with views of the surrounding moorlands. • Unimproved pastures, hay meadows and wet flushes of wildlife importance.	• Single small scale turbines are likely to be most appropriate in this lightly settled, upland landscape. These should be located close to existing built elements. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's woodlands and sloping topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not detract from the historic settlement pattern of farmsteads and cottages ('Booths'). • Protect the area's semi-natural habitats, particularly remnant hay meadows, from the impacts of any development. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Maintain important views to the surrounding moorland.

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td>Sensitive/rare landscape features –Distinctive mixture of farmsteads and cottages (‘Booths’) linked to the medieval Royal Forest in the Edale Valley. Jacob’s Ladder, an old packhorse route, forms part of the popular Pennine Way walking route. Unimproved pastures and hay meadows, along with wet flushes, are important for biodiversity.</td><td></td><td></td></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>Landform – Low-lying valley slopes incised by streams draining from the surrounding high moors.
Landcover/land use – Pastoral landscape with sheep and cattle rearing and some dairying. Kinder Reservoir lies within this landscape type.
Landscape pattern – Varied landscape pattern with a mixture of field sizes and shapes, but many are irregular (pre-Parliamentary Enclosure).
Sense of enclosure – The valley slopes and cloughs give this landscape type a sense of enclosure, particularly in contrast to the surrounding open moors. Frequent field boundary trees and woodlands along watercourses also provide enclosure.
Sense of ‘naturalness’ – This is an agricultural landscape with scattered trees, hay meadows, rushes and wetlands contributing to a sense of naturalness. Some fields are highly improved for silage production.
Inter-visibility – The high moors form a backdrop to this landscape type.
Sensitive/rare landscape features –Distinctive mixture of farmsteads and cottages (‘Booths’) linked to the medieval Royal Forest in the Edale Valley are valued historically. Unimproved pastures and hay meadows, along with wet flushes, are important for biodiversity.</td><td>The presence of some areas of improved agriculture, frequent woodlands along watercourses and sloping topography could provide the potential for integrating some bioenergy planting into this landscape type. However, its strong pastoral character, naturalistic meadow and wetland habitats, views of the surrounding moorlands and strong historic settlement pattern all present constraints.

This landscape type is assessed as having a moderate-high sensitivity to SRC and high sensitivity to miscanthus planting. The landscape attributes that would be particularly sensitive to energy crops are:
The pastoral land use.
Irregular, historic field pattern in many places.
Open skylines with views of the surrounding moorlands.
The historic settlement pattern of farmsteads and cottages (‘Booths’).
Unimproved pastures, hay meadows and wet flushes of wildlife importance.</td><td>This landscape type would not be suitable for miscanthus or other monoculture crops because of its strongly pastoral character.
Aim for irregular patterns of planting rather than geometric blocks to maintain the characteristic field patterns.
Avoid vast swathes of energy crop planting.
There may be opportunity to link some SRC with existing woodlands whilst maintaining their shape and scale within the landscape.
Utilise the landscape’s sloping topography to minimise the visual impacts of any planting.
Ensure bioenergy crop planting does not encroach onto areas of hay meadows, wetlands and unimproved pastures.
Maintain important views to the surrounding moorland.</td></tr>
</table>

10) Landscape Type: Village Farmlands on Shale Ridges (PD), Settled Farmlands (DC)
Constituent Character Areas: Derbyshire Peak Fringe (PD), Derbyshire Peak Fringe and Lower Derwent, Needwood and South Derbyshire Claylands (DC)

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3">WIND TURBINES</td></tr>
<tr><td>
Landform and scale – Small scale upland landscape with gently rolling plateau summits.
Landscape pattern – Well defined pattern of small to medium fields, with ridge and furrow and medieval strip fields remaining in places (e.g. around Brassington, Parwich, Thorpe, Hollington and Boylestone).
Sense of enclosure – Dense hedgerows and hedgerow trees provide shelter and enclosure within this landscape. Estate woodlands are associated with the parklands at Tissington and Longford Park.
Sense of tranquillity/ remoteness – There is a strong sense of tranquillity with peaceful rural villages and a lack of modern development. The only intrusions are main roads which pass through parts of the landscape.
Settlement / transport network – Clustered pattern of villages within a scattering of outlying farmsteads. Tissington has a strong historic feel due to development being controlled by the Tissington Hall estate. Modern infill development affects some settlements outside the National Park. Carsington Reservoir and quarrying at Ballidon have localised landscape impacts.
Skyline – Skyline often defined by mature hedgerow trees and estate woodlands.
Inter-visibility – Dense tree cover, particularly along watercourses and within hedgerows, can filter and restrict views.
</td><td>This landscape type's rolling topography, well treed character and the presence of some main roads and modern development suggest that it may be able to accommodate further built elements. However, its strong sense of peace and tranquillity, lack of modern development and historic sense of place all present sensitivities to this form of renewable energy development.

This landscape type is assessed as being of high sensitivity to large and medium scale turbines and moderate-high sensitivity small scale wind turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are:
The small scale of the landscape.
The strong sense of peace and tranquillity.
The historic settlement pattern – particularly at Tissington.
Archaeologically important strip fields and ridge and furrow.
Biodiversity-rich hay meadows and grass verges and rush pasture (e.g. at Mercaston Marsh SSSI).
</td><td>
This landscape is not suitable for large or medium scale turbines owing to its small scale character and strong sense of peace and tranquillity.
Single small scale turbines are likely to be most appropriate in this lightly settled, upland landscape. These should be located close to existing built elements or industrial areas.
Small clusters of small turbines should only be considered outside the National Park, providing the guidance is closely followed.
The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development.
Utilise the screening effects of the area's trees, hedgerows and sloping topography to integrate development into the landscape.
Ensure that the location of turbines and related infrastructure does not detract from the area's historic settlement pattern, particularly at Tissington.
Protect the landscape's semi-natural habitats, particularly remnant hay meadows and rush pasture at Mercaston Marsh SSSI (Needwood & S. Derbys Claylands CA) from the impacts of any development.
</td></tr>
</table>

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Sensitive/rare landscape features** – Fossilised strip fields and ridge and furrow are important features in the landscape. The historic built form of the landscape's villages, particularly Tissington, is key to landscape character. Hay meadows, flower-rich verges and streamside pastures (e.g. at Mercaston Marsh SSSI) are valued for biodiversity.		• Locate any turbines away from key areas of designed parkland at Tissington and Longford Park to protect its historic character and integrity. • Do not locate turbines within or close to areas of strip fields and ridge and furrow around Brassington, Parwich Thorpe, Hollington and Boylestone. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.
	BIOMASS – BIOENERGY CROPS	
• **Landform** – Small scale upland landscape with gently rolling plateau summits. • **Landcover/land use –** Permanent pasture dominates this landscape with a mixture of improved and semi-improved fields. Some arable cultivation around Shirley, Brailsford and Somersal Herbert. Estate land characterises the landscape around Tissington. • **Landscape pattern –** Well defined pattern of small to medium fields, with ridge and furrow and medieval strip fields remaining in places (e.g. around Brassington, Parwich, Thorpe, Hollington and Boylestone). • **Sense of enclosure –** Dense hedgerows and hedgerow trees provide shelter and enclosure within this landscape. • **Sense of 'naturalness'** – The landscape's strong pastoral character, thick hedgerows, dense treelines along watercourses and remnant hay meadows contribute to a sense of naturalness within the landscape.	The presence of some agriculturally improved land, dense tree cover and sloping topography could allow for the integration of bioenergy crop planting. Sensitivities are apparent for this landscape type due to its strong pastoral character, the presence of estate land, historic field patterns and biodiversity-rich hay meadows. This landscape type is therefore judged to be of **moderate-high** sensitivity to SRC and **high** for miscanthus (falling to **moderate-high** for miscanthus in the Needwood & South Derbyshire Claylands character area outside the National Park). Landscape attributes that would be particularly sensitive to energy crop planting are: • The small scale of the landscape. • The pastoral land use and areas of estate land around Tissington and Longford Park.	• Focus bioenergy crops in fields already under intensive farming systems, rather than converting other pastoral areas to energy crops. Particularly focus on areas under arable cultivation in the Needwood and South Derbyshire Claylands character area. • Plant at the field scale to maintain landscape pattern. • Aim for irregular patterns of planting rather than geometric blocks to maintain the characteristic field patterns. • Avoid vast swathes of energy crop planting. • There may be opportunity to link some SRC with existing tree lines whilst maintaining their shape and scale within the landscape. • Protect the historic character and integrity of parkland landscapes by planting away from the most visible locations.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Inter-visibility** – Dense tree cover, particularly along watercourses and within hedgerows, can filter and restrict views. • **Sensitive/rare landscape features** – Fossilised strip fields and ridge and furrow are important features in the landscape. The historic built form of the landscape's villages, particularly Tissington, is key to landscape character. Hay meadows, flower-rich verges and streamside pastures (e.g. at Mercaston Marsh SSSI) are valued for biodiversity.	• Archaeologically important strip fields and ridge and furrow around Brassington, Parwich, Thorpe, Hollington and Boylestone. • Biodiversity-rich hay meadows and grass verges.	• Do not plant in fields with surviving ridge and furrow, or in the medieval strip fields around Brassington, Parwich, Thorpe, Hollington and Boylestone. • Ensure bioenergy crop planting does not encroach onto areas of hay meadows, rush pasture at Mercaston Marsh SSSI (Needwood & S. Derbys Claylands CA) and other semi-natural habitats.

11) Landscape Type: Gritstone Village Farmlands (PD)
Constituent Character Areas: Derwent Valley

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Small-scale, rolling topography of gritstone uplands. • **Landscape pattern –** Small fields with sinuous gritstone wall boundaries. Medieval open field system of small, narrow fields north of Abney. • **Sense of enclosure –** Open landscape with few trees. The high topography affords wide views across the landscape and beyond. • **Sense of tranquillity/ remoteness –** The landscape's lightly settled character, lack of major roads and remote upland feel contribute to its strong sense of tranquillity. • **Settlement / transport network** – Main settlement at the nucleated villages of Abney and Birchover. Isolated farmsteads lie outside the villages. Settlement is linked by narrow winding roads, footpaths and historic tracks. • **Skyline** – Open, undeveloped skylines affording wide vistas. • **Inter-visibility** – Wide views to and from the surrounding hills and moorland. • **Sensitive/rare landscape features** – Fossilised medieval open field systems are valued landscape features. The traditional gritstone and slate buildings are characteristic of the area. Localised meadows are valued for their wildlife interest.	Although this upland, exposed landscape is likely to be able to effectively harness wind power, its open character and wide views, small scale field pattern, light settlement and strong historic sense of place all pose serious constraints to wind turbine development. This landscape type is therefore assessed as being of **high** sensitivity to large and medium scale turbines and **moderate-high** sensitivity to small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Its small scale character. • The strong historic field and settlement pattern. • Its remote, upland feel with an absence of modern development. • Wide, panoramic views to and from the surrounding hills and moorland. • The important medieval open field systems north of Abney.	• This landscape would not be suitable for large or medium scale wind turbines because of its open character, long views and strong historic sense of place. • Single small scale turbines are likely to be most appropriate. These should be located close to existing built elements. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's rolling topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not affect the character or setting of the historic settlements and buildings. • Do not locate turbines within or in close proximity to the open field system near Abney. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Maintain key views to and from the surrounding hills and moorland.

Landscape attributes based on criteria for each technology type	**Sensitivity Judgement and key Landscape Sensitivities**	**Guidance**
	BIOMASS – ENERGY CROPS	
• **Landform –** Small-scale, rolling topography of gritstone uplands. • **Landcover/land use –** Permanent pasture dominates, with cattle and sheep grazing. Tree cover is limited to small groups around settlements and boundary trees. • **Landscape pattern –** Small fields with sinuous gritstone wall boundaries. Medieval open field system of small, narrow fields north of Abney. • **Sense of enclosure –** Open landscape with few trees. The high topography affords wide views across the landscape and beyond. • **Sense of 'naturalness'** – Improved pasture dominates the landscape with some localised patches of bracken and meadows. • **Inter-visibility** – Wide views to and from the surrounding hills and moorland. • **Sensitive/rare landscape features** – Fossilised medieval open field systems are valued landscape features. The traditional gritstone and slate buildings are characteristic of the area. Localised meadows are valued for their wildlife interest.	This landscape type's strong pastoral character, historic field pattern, lack of tree cover and wide views to adjacent landscapes all pose serious constraints to the planting of bioenergy crops. It has therefore been assessed as of **high** sensitivity to both SRC and miscanthus crops. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • The landscape's strong pastoral character. • The small scale of the landscape and its field patterns. • Its strong sense of openness and lack of tree cover. • The wide views to and from the surrounding hills and moorland. • The presence of archaeologically important medieval field systems. • The presence of meadows and naturalistic bracken habitats.	This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.

12) Landscape Type: <u>Valley Farmlands with Villages (PD)</u>
Constituent Character Areas: Derwent Valley

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Low lying, gently undulating topography associated with the Derwent Valley and its tributaries. • **Landscape pattern –** Mixture of regular and irregular small to medium sized fields forming a patchwork with small woodland blocks. Medieval open fields are a feature of some locations including the Hope Valley. • **Sense of enclosure –** The valley landscape by its very nature is enclosed. Within the sweeping valley itself some enclosure is provided by small woodlands and hedgerow trees. • **Sense of tranquillity/ remoteness –** This is predominantly a peaceful, rural landscape. Tranquillity is broken locally by the main Sheffield to Manchester railway line, the prominent cement works at Hope and some major roads. • **Settlement / transport network** – Mixture of villages, hamlets and farmsteads. Scattered villages are mainly concentrated in the valley. Simple stone barns are occasionally found in field corners. Settlement linked by a comprehensive network of major and minor roads. • **Skyline** – Open, undeveloped skylines in the main. The cement works are a prominent feature within the Hope Valley. • **Inter-visibility** – Views to and from the surrounding uplands.	The presence of the prominent cement works in the Hope Valley, the landscape's comprehensive transport network and areas of development within the valleys might allow for opportunities for wind turbine development. However, its peaceful rural character overall, important medieval open field systems, and valued semi-natural habitats all present sensitivities to this type of renewable energy development. This landscape type is judged to be of **high** sensitivity to large and medium scale wind turbines and **moderate-high** sensitivity to small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Important medieval open field systems, including in the Hope Valley. • Overall feelings of peace and tranquillity. • A strong settlement pattern with a lack of modern intrusions overall. • Ancient woodlands, hedgerows and wet flushes of wildlife importance. • Features associated with the landscape's industrial heritage, including mill buildings.	• Single small scale turbines are likely to be most appropriate in this peaceful, rural landscape. • There may be the potential for single turbines where linked to existing development (such as the Hope Cement Works) and following the guidance below. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Turbines should be linked to or located within areas of existing development where possible. • Utilise the screening effects of the area's woodlands and sloping topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not detract from the historic settlement and field pattern, particularly in the valley. • Protect the area's semi-natural habitats, particularly ancient semi-natural woodlands and wetlands, from the impacts of development. • Ensure that vertical structures associated with the mills, and their character and setting, are protected. This particularly applies to the Conservation Areas at Calver, Edale, Ashford-in-the-Water and Bamford.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Sensitive/rare landscape features** – Habitats of importance include woodland ground flora and discreet blocks of ancient semi-natural woodland, mixed species hedgerows and wet flushes. Fossilised medieval open fields are valued historic landscape features, as are the remaining stone field barns. Features associated with the valley's industrial heritage, including mill buildings, are important features of the Conservation Areas at Calver, Edale, Ashford-in-the-Water and Bamford.		• Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Maintain important views to the surrounding moorlands.
BIOMASS – ENERGY CROPS		
• **Landform –** Low lying, gently undulating topography associated with the Derwent Valley and its streams. • **Landcover/land use –** Permanent pasture is the dominant land use with the cement works at Hope being a prominent atypical feature. • **Landscape pattern –** Mixture of regular and irregular small to medium sized fields forming a patchwork of small woodland blocks. Medieval open fields are a feature of some locations including the Hope Valley. • **Sense of enclosure –**The valley landscape by its very nature is enclosed. Within the sweeping valley itself some enclosure is provided by small woodlands and hedgerow trees. • **Sense of 'naturalness'** – Pasture land dominates this landscape, with small woodland blocks, wetlands and hedgerows providing a sense of naturalness. • **Inter-visibility** – Views to and from the surrounding uplands. • **Sensitive/rare landscape features** – Habitats of importance include woodland ground flora and discreet blocks of ancient semi-natural woodland, mixed species hedgerows and wet flushes. Fossilised medieval open fields are valued historic landscape features, as are the remaining stone field barns.	The presence of woodland blocks and the enclosure provided by both topography and vegetation could indicate that this landscape might be suitable for bioenergy crop planting. However, the dominance of a pastoral land use, historic field patterns, and the presence of naturalistic woodland and wetland habitats all pose constraints to crop planting. This landscape type is assessed as being of **high** sensitivity to miscanthus planting and **moderate-high** sensitivity to SRC planting. The landscape attributes that would be particularly sensitive to energy crop planting are: • The landscape's strong pastoral character. • Valued medieval open field systems, including in the Hope Valley. • Naturalistic ancient woodland, wetland and hedgerow habitats.	• This landscape would not be suitable for the planting of miscanthus or other monoculture bioenergy crops. • There may be opportunity to link limited amounts of SRC with existing woodlands providing it does not alter their shape or form within the landscape • Plant at the field scale to maintain landscape pattern. • Use the screening effects of the landscape's topography, hedgerows and woodlands to minimise the visual impacts of planting. • Ensure bioenergy crop planting does not encroach onto valued areas of ancient semi-natural woodlands or wetlands. • When planting, consider views along the landscape to and from mills and other industrial heritage features, including within the Conservation Areas at Calver, Edale, Ashford-in-the-Water and Bamford. • Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of SRC planting.

13) Landscape Type: Estatelands (PD)
Constituent Character Areas: Derwent Valley

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Varied, undulating topography with steep slopes in places. An isolated limestone ridge is a feature of Cracknowl Pasture, to the north of Bakewell. • **Landscape pattern –** Mosaic of regular fields of different sizes interlocking with extensive coniferous woodlands and parkland. • **Sense of enclosure –** Extensive tree cover throughout the area gives a strong sense of enclosure. • **Sense of tranquillity/ remoteness –** The area has a strong, historic feel which conveys a sense of remoteness. However, the presence of major roads crossing the valley in places, as well as its popularity for tourism, can impact on levels of tranquillity. • **Settlement / transport network** – Strong nucleated pattern of discrete villages, large estate buildings and outlying farms. These are linked by a network of narrow winding lanes and footpaths. Some major roads cross the valley in places and the former Buxton to Matlock railway line has been converted into a recreational route (the Monsal Trail). • **Skyline** – Undeveloped skylines are often characterised by trees and woodlands. • **Inter-visibility** – Views to and from the surrounding slopes and uplands. • **Sensitive/rare landscape features** – Designed parkland is a particular feature of this landscape, at Chatsworth, Haddon, Hassop and Thornbridge. Other features associated with the estatelands are	The presence of extensive woodlands and plantations, sloping topography and main roads indicates that this landscape may be able to incorporate the development of wind turbines. However, its strong historic estateland character, valued woodland and grassland habitats, and the characteristic scale and style of the area's buildings and settlements all pose constraints to this form of renewable energy development. This landscape type is therefore assessed as being of **high** sensitivity to large and medium scale turbines and **moderate-high** sensitivity to small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Strong historic character and land use. • Overall feelings of tranquillity and remoteness. • Valued designed parkland and semi-natural habitats including woodlands and acid grassland. • Views framed by the higher ground, including moorlands. • Distinctive vernacular styles and settlement forms – including the estate houses themselves (e.g. Chatsworth, Haddon, Hassop and Thornbridge) and estate villages, such as Edensor.	• This landscape would not be suitable for large or medium scale wind turbines because of its strong historic character and lack of modern built features. • Single small scale turbines are likely to be most appropriate. These should be located close to or within existing built elements or coniferous plantations to minimise visual impacts. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's undulating topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not affect the character or setting of large estate houses and historic settlements such as Edensor. • Protect the area's valued semi-natural woodlands and grasslands from the impacts of development. • Locate any turbines away from key areas of designed parkland to protect its historic character and integrity. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
important historically; particularly the houses themselves and the estate village of Edensor. Remnants of acid grassland, isolated patches of semi-improved grassland and the area's woodlands are valued for biodiversity.		
	BIOMASS – ENERGY CROPS	
• **Landform –** Varied, undulating topography with steep slopes in places. An isolated limestone ridge is a feature of Cracknowl Pasture, to the north of Bakewell. • **Landcover/land use –** Intensively managed permanent pasture dominates, forming a pattern with extensive coniferous woodlands and parkland. • **Landscape pattern –** Mosaic of regular fields of different sizes interlocking with extensive coniferous woodlands and parkland. • **Sense of enclosure –** Extensive tree cover throughout the area gives a strong sense of enclosure. • **Sense of 'naturalness'** – This is a designed, managed landscape but with a strong historic character. Extensive woodlands and patches of semi-natural habitat introduce a sense of naturalness to the landscape. • **Inter-visibility** – Views to and from the surrounding slopes and uplands. • **Sensitive/rare landscape features** – Designed parkland is a particular feature of this landscape, at Chatsworth, Haddon, Hassop and Thornbridge. Other features associated with the estatelands are important historically; particularly the houses themselves and other estate buildings, including the village of Edensor. Remnants of acid grassland, isolated patches of semi-improved grassland and the area's woodlands are valued for biodiversity.	The presence of extensive woodland and plantation cover within this landscape type, along with its sloping topography, could enable the sensitive integration of bioenergy crop planting. However, its strong historic estateland character, predominantly pastoral land use, valued woodland and grassland habitats, and the characteristic scale and style of the area's buildings and settlements all pose constraints to this form of renewable energy development. This landscape type is judged to be of **high** sensitivity to miscanthus and **moderate-high** sensitivity to SRC. The landscape attributes that would be particularly sensitive to energy crop planting are: • Pastoral and distinctive estate land uses. • Strong historic landscape character. • Valued designed parkland and naturalistic habitats including woodlands and acid grassland. • The traditional setting of the estate houses and settlements within the landscape.	• This landscape would not be suitable for the planting of miscanthus or other monoculture bioenergy crops because of its strong pastoral and historic parkland land uses. • There may be opportunity to link limited amounts of SRC with existing woodlands providing it does not alter their shape or form within the landscape • Plant at the field scale to maintain landscape pattern. • Integrate any planting into existing coniferous plantations to minimise visual impacts. • Ensure bioenergy crop planting does not encroach onto areas of semi-natural woodlands or acid grasslands. • Protect the historic character and integrity of parkland landscapes by planting away from the most visible locations. • Ensure that any planting does not affect the distinctive historic character or setting of the estate houses and settlements. • Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of SRC planting.

14) Landscape Type: Upland Pastures (PD)
Constituent Character Areas: South West Peak

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Undulating upland landscape with incised valleys. • **Landscape pattern –** Pattern of irregular and sub-rectangular fields enclosed by gritstone walls and thorn hedges with scattered trees. Some medieval strip fields remain near villages. • **Sense of enclosure –** Enclosure is provided by field boundaries and the steep topography of valleys cutting through the landscape. Elsewhere, a lack of tree cover provides a feeling of openness. • **Sense of tranquillity/ remoteness –** Peaceful, rural landscape with high levels of tranquillity. Its upland location produces a feeling of remoteness. • **Settlement / transport network** – Dispersed farmsteads and a few villages of granite and some limestone, linked by sinuous lanes, tracks and footpaths. • **Skyline** – Open and unwooded skylines with no built intrusions. • **Inter-visibility** – Open views to the surrounding higher ground. • **Sensitive/rare landscape features** – Species-rich pastures and meadows are highly valued for the wildlife interest. Wet grasslands, patches of acid grassland and heathy vegetation are also important habitats. Medieval strip fields and historic buildings, including mill buildings at Edale, are valued landscape features.	The steep valley topography could allow for the integration of wind turbines into this landscape type. However, its strong historic field pattern, lack of tree cover, high levels of peace and tranquillity, low density of settlement, open skylines with wide views and important semi-natural habitats all pose constraints to wind turbine development. This landscape type is judged to be of **high** sensitivity to both large and medium scale turbines, and **moderate-high** sensitivity to small wind turbines. Landscape attributes that would be particularly sensitive to this form of renewable energy development include: • Historic field pattern with medieval strip fields in places. • Strong feelings of openness and tranquillity. • Its sparse and traditional settlement pattern with a lack of modern development. • Open views to the surrounding landscapes. • Valued semi-natural habitats including species-rich meadows.	• This landscape would not be suitable for large or medium scale wind turbines because of its open character, lack of modern development and strong historic sense of place. • Single small scale turbines are likely to be most appropriate. These should be located close to existing built elements, such as farm buildings and villages. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's rolling topography to integrate development into the landscape. • Do not locate turbines within or in close proximity to the medieval field systems remaining near villages. • Maintain the character and form of the landscape's stone villages, including the mill buildings in Edale Conservation Area. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings. • Maintain key views to and from the surrounding uplands.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform –** Undulating upland landscape with incised valleys. • **Landcover/land use –** Pastoral landscape with sheep and cattle rearing and some dairying. Some hay meadows and rough grazing pastures remain. • **Landscape pattern –** Pattern of irregular and sub-rectangular fields enclosed by gritstone walls and thorn hedges with scattered trees. Some medieval strip fields remain near villages. • **Sense of enclosure –** Enclosure is provided by field boundaries and the steep topography of valleys cutting through the landscape. Elsewhere, a lack of tree cover provides a feeling of openness. • **Sense of 'naturalness'** – Hay meadows, wet grasslands, patches of acid grassland and heathy vegetation add a sense of naturalness to this pastoral landscape. • **Inter-visibility** – Open views to the surrounding higher ground. • **Sensitive/rare landscape features** – Species-rich pastures and meadows are highly valued for the wildlife interest. Wet grasslands, patches of acid grassland and heathy vegetation are also important habitats. Medieval strip fields and historic buildings are valued landscape features.	Although the steep topography of the valleys could help minimise the impacts of planting, this landscape type's pastoral character, naturalistic habitats, lack of tree cover and open views all place serious constraints on the planting of bioenergy crops. It has therefore been assessed as of **high** sensitivity to both SRC and miscanthus. Landscape attributes that would be particularly sensitive to bioenergy planting are: • The pastoral land use. • Strong irregular field pattern and valued medieval strip fields remaining around villages. • Lack of tree cover. • Naturalistic hay meadows, wet grasslands and patches of acid grassland and heath.	This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.

15) Landscape Type: Limestone Village Farmlands (PD), Limestone Slopes (DC)
Constituent Character Areas: White Peak

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Gently undulating plateau with more sloping land at its edges. • **Landscape pattern –** Strong sub-regular pattern of small to medium sized fields enclosed by limestone walls. Medieval strip fields survive in many places. Small groups of trees form part of the landscape pattern. • **Sense of enclosure –** Views are typically framed by surrounding hills or rising ground. Trees around village margins create intimate rural scenes. • **Sense of tranquillity/ remoteness –** Strong historic sense of place with traditional settlements in a peaceful rural setting. • **Settlement / transport network** – Strong, nucleated pattern of limestone villages and farmsteads linked by a network winding lanes. • **Skyline** – Open skylines with an absence of vertical structures apart from occasional trees. • **Inter-visibility** – Views to the surrounding hills and rising ground. • **Sensitive/rare landscape features** –Relict mine shafts, associated lead mining remains and dewponds are valued historic features within this landscape. Mill buildings also related to the area's industrial heritage are important features in places (including as part of the buffer to the Derwent Valley Mills World Heritage Site). The distinctive field and settlement pattern, unified by the use of limestone, is key to the area's sense of place.	The presence of settlement and past industrial activity within this landscape could indicate that it would be able to accommodate the development of wind turbines. However, its strong field patterns, views of the surrounding uplands, historic sense of place, peaceful and rural setting, lack of modern development and valued historic landscape features all pose constraints to this form of renewable energy development. This landscape type has been assessed as being of **high** sensitivity to both large and medium-scale turbines, and **moderate-high** sensitivity to small turbines. Landscape attributes that would be particularly sensitive to this form of renewable energy development include: • The strong historic field pattern, including many medieval strip fields. • Open landscape with views framed by surrounding hills and uplands. • High levels of peace and tranquillity and an absence of modern development. • Distinctive settlement pattern and strong local vernacular. • Valued historic landscape features including dewponds, mining remains and mills.	• This landscape would not be suitable for large or medium scale wind turbines because of its strong rural and historic character. • Single small scale turbines are likely to be most appropriate. These should be located close to or within existing built elements (such as villages or farm buildings). • Small clusters of small scale turbines should only be considered outside the National Park. • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's undulating topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not affect the character or setting of the landscape's nucleated limestone villages. • Protect the landscape's important historic features from the impacts of development, such as lead mining relics and dewponds. • Ensure that vertical structures associated with the mills, and their character and setting, are protected. This particularly applies to the Conservation Areas at Cromford, Bakewell, Cressbrook and Litton and the World Heritage Site buffer at Cromford and Matlock Bath.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
		• Do not locate wind turbines on or close to areas of medieval strip fields. • Ensure the location of turbines does not interrupt key views of the surrounding hills and rising ground. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.
BIOMASS – ENERGY CROPS		
• **Landform –** Gently undulating plateau with more sloping land at its edges. • **Landcover/land use –** Pastoral landscape dominated by stock rearing and dairying. • **Landscape pattern –** Strong sub-regular pattern of small to medium sized fields enclosed by limestone walls. Medieval strip fields survive in many places. Small groups of trees form part of the landscape pattern. • **Sense of enclosure –** Views are typically framed by surrounding hills or rising ground. Trees around village margins created intimate rural scenes. • **Sense of 'naturalness'** – This is a strongly farmed landscape with scattered trees providing an element of naturalness. • **Inter-visibility** – Views to the surrounding hills and rising ground. • **Sensitive/rare landscape features** – Relict mine shafts, associated lead mining remains and dewponds are valued historic features within this landscape. The distinctive field and settlement pattern, unified by the use of limestone, is key to the area's sense of place.	This landscape type's traditional pastoral character, strong historic field patterns, wide views, and lack of tree cover all place serious constraints on the planting of bioenergy crops. It has therefore been assessed as of **high** sensitivity to both SRC and miscanthus. Landscape attributes that would be particularly sensitive to bioenergy planting are: • Traditional, pastoral land use dominating the landscape. • The strong historic field pattern, including many medieval strip fields. • Open landscape with views framed by surrounding hills and uplands. • Valued historic landscape features including dewponds and mining remains.	This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.

16) Landscape Type: Limestone Plateau Pastures (PD), Plateau Pastures (DC)
Constituent Character Areas: White Peak

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3">WIND TURBINES</td></tr>
<tr><td>
Landform and scale – Gently rolling limestone plateau landscape.
Landscape pattern – Strong, distinctive pattern of straight stone walls bounding small to medium fields. Sub-rectangular and irregular fields exist in some areas. Linear or rectangular shelter belts, often on former lead rakes, are distinctive features.
Sense of enclosure – Fairly open character with restricted tree cover.
Sense of tranquillity/ remoteness – Peaceful landscape with low levels of development giving a strong feeling of tranquillity. Some modern quarries lie within this landscape type outside the National Park, eroding tranquillity locally.
Settlement / transport network – Isolated stone farmsteads and scattered field barns characterise the settlement pattern. Nucleated villages are present at Monyash, Chelmorton and Taddington. These are linked by straight roads defined by stone walls, along with occasional tracks and footpaths.
Skyline – Open skylines afford long views across the landscape, interrupted only by shelterbelt plantings.
Inter-visibility – Wide views to and from the surrounding higher ground.
Sensitive/rare landscape features – Prehistoric monuments, Neolithic chambered tombs and round barrows are valued archaeological features. The landscape's rich industrial heritage is reflected in the remains of limekilns, shallow quarries, lead rakes and mills, including around Dove Holes and Peak Forest and as part of the Derwent Valley Mills World Heritage Site buffer (in Bonsall). Dewponds and field kilns are also valued historically. Small areas of unimproved limestone grassland are important for biodiversity.
</td><td>This landscape's open character, strong historic field patterns, lack of settlement and development, long views to the surrounding uplands and valued archaeological and historic features all pose significant constraints to the development of wind turbines.

This landscape type is therefore assessed as being of high sensitivity to all sizes and scales of wind turbine. Landscape attributes that would be particularly sensitive to this form of renewable energy development include:
The gently rolling, plateau landform.
Strong and distinctive field pattern.
Open character with little tree cover and wide views, including to the surrounding uplands.
The presence of important archaeological features including prehistoric monuments, dewponds, lead mining and mill heritage remains.
</td><td>This landscape type is assessed as having a high sensitivity overall to any size and scale of wind turbine development, therefore no guidance has been included.</td></tr>
</table>

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
	BIOMASS – ENERGY CROPS	
• **Landform –** Gently rolling limestone plateau landscape. • **Landcover/land use –** When compared to the surrounding uplands, this is an intensive pastoral landscape with stock rearing and dairying the main land uses. • **Landscape pattern –** Strong, distinctive pattern of straight stone walls bounding small to medium fields. Sub-rectangular and irregular fields exist in some areas. Linear or rectangular shelter belts, often on former lead rakes, are distinctive features. • **Sense of enclosure –** Fairly open character with restricted tree cover. • **Sense of 'naturalness'** – Patches of unimproved grassland, including on abandoned lead rakes, add a sense of naturalness to the farmed landscape. • **Inter-visibility** – Wide views to and from the surrounding higher ground. • **Sensitive/rare landscape features** – Prehistoric monuments, Neolithic chambered tombs and round barrows are valued archaeological features. The landscape's rich industrial heritage is reflected in the remains of limekilns, shallow quarries and lead rakes and mills, including around Dove Holes and Peak Forest including around Dove Holes and Peak Forest and as part of the Derwent Valley Mills World Heritage Site buffer (at Bonsall). Dewponds and field kilns are also valued historically. Small areas of unimproved limestone grassland are important for biodiversity.	The presence of some intensively farmed land within this landscape could indicate that it could integrate bioenergy crop planting. However, its open character, pastoral land use, strong historic field patterns, long views to the surrounding uplands, presence of unimproved limestone grasslands and valued archaeological and historic features all present sensitivities to bioenergy crop planting. This landscape is assessed as of **high** sensitivity to both SRC and miscanthus. Landscape attributes that would be particularly sensitive to bioenergy planting are: • Traditional, pastoral land use dominating the landscape. • Strong and distinctive field pattern. • Open character with little tree cover and wide views, including to the surrounding uplands. • Flower-rich unimproved limestone grasslands. • The presence of important archaeological features including prehistoric monuments, dewponds and lead mining remains. • The presence of important archaeological features including prehistoric monuments, dewponds, lead mining and mill heritage remains.	This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.

17) Landscape Type: Limestone Dales (PD), Limestone Dales (DC)
Constituent Character Areas: White Peak

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Steeply sloping dale landscape with limestone outcrops, cliffs and scree slopes. Most of the larger dales have fast moving rivers flowing within rocky river beds. • **Landscape pattern –** Mainly an unenclosed landscape with occasional stone walls marking large enclosures within valleys. Deciduous woodlands along dalesides are important features. • **Sense of enclosure –** Unenclosed landscape with shelter provided by steep valley sides and woodlands. • **Sense of tranquillity/ remoteness –** The inaccessibility of the limestone dales gives the landscape a strong sense of tranquillity and remoteness. The only man-made activities to impact significantly on the area are mills – including water-powered textile mills in the Wye valley. • **Settlement / transport network –** No human settlement within most of the dales due to their inaccessibility. However, the Victorian settlement of Matlock Bath and the surrounding area of Matlock Dale includes some extensive development. Some access roads cross through dales to the White Peak, including the main A6 passing through the Wye Valley. The Monsal Trail is a popular walking route on a former railway line. • **Skyline –** Undeveloped, open skylines with frequent limestone outcrops. • **Inter-visibility –** The steep sided topography of the dales means views to other landscapes are limited.	The steep valley topography, significant woodland cover and limited views to and from the landscape could indicate that it might be able to integrate wind turbine developments – as would the development within the Matlock dale. Aspects of the landscape that would be sensitive to wind turbines include its high levels of tranquillity and remoteness, lack of settlement or other development, distinctive rocky skylines, valued industrial remains and extensive limestone grasslands. This landscape type is therefore assessed as of **high** sensitivity to large and medium scale turbines and **moderate-high** sensitivity to small turbines. Landscape attributes that would be particularly sensitive to this form of renewable energy development include: • Distinctive limestone landscape with outcrops, crags and scree slopes. • Strong sense of tranquillity and remoteness owing to a lack of access, settlement and other development. • Important lead mining, quarrying remain and mills, including as part of the Derwent Valley Mills World Heritage Site. • Extensive flower-rich limestone grasslands and valued ash woodlands.	• This landscape would not be suitable for large or medium scale wind turbines because of its intimate scale and lack of modern built features. • Single small scale turbines are likely to be most appropriate in this largely undeveloped, tranquil landscape. • Opportunities should be sought to link turbine development into any new development, particularly in the Matlock dale. • The location of single turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's woodlands and steep valley sides to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not detract from the presence of historic mills (including in the Conservation Areas of Cromford, Litton Mill, Milldale, Miller's Dale, Cressbrook and Bonsall) and other industrial heritage features. • Do not locate turbines within the boundary or buffer of the Derwent Valley Mills World Heritage Site to protect its historic integrity (Cromford, Matlock Bath and Bonsall Conservation Areas).

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td>Sensitive/rare landscape features – Remains of lead mining, quarrying and industrial mills are important features of the Wye Valley, Lathkill Dale and the Via Gelia (including as part of the Derwent Valley Mills World Heritage Site and buffer). Extensive flower-rich limestone grasslands and daleside ash woodlands are of high wildlife value.</td><td></td><td>Do not locate turbines on important skylines, particularly those visible from the Monsal Trail.
Protect valued ash woodlands and limestone grasslands from the impacts of development.</td></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>Landform – Steeply sloping dale landscape with limestone outcrops, cliffs and scree slopes. Most of the larger dales have fast moving rivers flowing within rocky river beds.
Landcover/land use – Rough grazing on dale slopes is the main land use, with extensive areas of semi-natural woodlands and mining/quarry remains elsewhere.
Landscape pattern – Largely an unenclosed landscape with occasional stone walls marking large enclosures within valleys. Deciduous woodlands along dalesides are important features.
Sense of enclosure – Unenclosed landscape with shelter provided by steep valley sides and woodlands.
Sense of 'naturalness' – This landscape has a strong, natural feel with large swathes of flower-rich grasslands and woodlands.
Inter-visibility – The steep sided topography of the dales means views to other landscapes are limited.
Sensitive/rare landscape features – Remains of lead mining and quarrying are important features of the Wye Valley, Lathkill Dale and the Via Gelia(including as part of the Derwent Valley Mills World Heritage Site and buffer). Extensive flower-rich limestone grasslands and daleside ash woodlands are of high wildlife value.</td><td>This landscape's lack of agricultural land, extensive limestone grasslands, steep topography and valued industrial heritage all pose serious constraints to bioenergy planting. It is therefore judged as unsuitable for any type of energy crop.

This landscape is assessed as being of high sensitivity to both SRC and miscanthus. Landscape attributes that would be particularly sensitive to this form of renewable energy development include:
Distinctive limestone landscape with outcrops, crags and scree slopes.
Lack of agricultural land – landscape characterised by semi-natural limestone grasslands.
Important lead mining, quarrying remain and mills, including as part of the Derwent Valley Mills World Heritage Site.</td><td>This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.</td></tr>
</table>

18) Landscape Type: Limestone Hills and Slopes (PD), Limestone Moorland (DC)
Constituent Character Areas: White Peak

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Most elevated landscape in the White Peak; undulating topography with numerous hill summits and patches of exposed rocks, including distinctive tors. • **Landscape pattern –** Medium to large, regular fields bounded by straight limestone walls. • **Sense of enclosure –** Exposed landscape on higher summits, whilst the slopes and regular enclosures provide shelter and enclosure elsewhere. • **Sense of tranquillity/ remoteness –** The landscape is sparsely settled with a high sense of tranquillity. Some industrial development around Harpur Hill impacts on these qualities. • **Settlement / transport network –** Sparse settlement with occasional large stone farmsteads and a scattering of medieval granges on the higher parts of the plateau. Roads, where they exist, are straight and defined by stone walls. • **Skyline –** Undeveloped, open skylines affording wide views to distant skylines. • **Inter-visibility –** This is a visually prominent landscape, visible from most other locations in the White Peak. • **Sensitive/rare landscape features –** Large number of prehistoric monuments, often prominently sited on highest hilltops. Small areas of rare limestone heath, calcareous and acid grasslands, isolated hay meadows and unimproved pastures are valued for biodiversity.	Although there are limited areas of industrial development, this landscape's high visual prominence within the wider White Peak, distinctive rocky skylines, overall lack of development, high levels of tranquillity, rich archaeological heritage and important limestone grassland and heath habitats would all be extremely sensitive to wind turbine development. This landscape type would therefore be unsuitable for any size and scale of wind turbines. This landscape type is judged to be of **high** sensitivity to all sizes of wind turbine. The landscape attributes that would be particularly sensitive to this form of renewable energy development include: • Distinctive tors and open, elevated skylines. • Lack of development and high levels of tranquillity. • Wide views across the White Peak and to distant skylines. • High concentration of prehistoric monuments, often in prominent hilltop locations. • Valued limestone heath and grassland habitats, including isolated hay meadows.	This landscape type is assessed as having a high sensitivity to any size and scale of wind turbine development, therefore no guidance has been included.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
	BIOMASS – ENERGY CROPS	
• **Landform –** Most elevated landscape in the White Peak; undulating topography with numerous hill summits and patches of exposed rocks, including distinctive tors. • **Landcover/land use –** Pasture with localised hay meadows and rough grazing on steeper slopes / summits. • **Landscape pattern –** Medium to large, regular fields bounded by straight limestone walls. • **Sense of enclosure –** Exposed landscape with little tree cover. The sloping topography provides shelter in places. • **Sense of 'naturalness'** – Areas of heath, rough grassland and scrub are naturalistic habitats within this landscape. • **Inter-visibility –** This is a visually prominent landscape, visible from most other locations in the White Peak. • **Sensitive/rare landscape features –** Large number of prehistoric monuments, often prominently sited on highest hilltops. Small areas of rare limestone heath, calcareous and acid grasslands, isolated hay meadows and unimproved pastures are valued for biodiversity.	This landscape's high visual prominence within the wider White Peak, pastoral land use with valued limestone heath and grassland habitats, little tree cover and rich archaeological heritage all present severe constraints to the introduction of bioenergy crop planting. It would therefore be unsuitable for any type of energy crop. This landscape type is judged to be of **high** sensitivity to both SRC and miscanthus. The landscape attributes that would be particularly sensitive to energy crop planting include: • Distinctive tors and open, elevated skylines. • Pastoral and rough grazing land use. • Peak and to distant skylines. • High concentration of prehistoric monuments, often in prominent hilltop locations. • Valued limestone heath and grassland habitats, including isolated hay meadows.	This landscape type is assessed as having a high sensitivity to bioenergy planting; therefore no guidance has been included.

19) Landscape Type: Enclosed Moors and Heaths, Enclosed Moorland (DC)
Constituent Character Areas: Derbyshire Peak Fringe and Lower Derwent, Dark Peak (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale –** Rolling hill summits and moorland plateaux with some gentle valleys becoming deeper as they fall off to the adjacent slopes. • **Landscape pattern –** Regular enclosures on the higher ground bounded by drystone walls, with more irregular fields near Shottle. Occasional small plantations and scrubby woodland add texture to the landscape, with more extensive plantations on the moorland of Matlock and Hackney Moors. • **Sense of enclosure –** This landscape has a strong sense of openness broken only by the presence of occasional plantations. • **Sense of tranquillity/ remoteness –** The sparse settlement and open character conveys high levels of tranquillity and remoteness. . • **Settlement / transport network –** Scattered farmsteads define the landscape pattern. These are linked mainly by straight roads. • **Skyline –** Crich Stand, although outside the Sub Region, is a distinctive landmark feature on the open skyline,. • **Inter-visibility –** Expansive views across the surrounding landscapes. • **Sensitive/rare landscape features –** Patches of heathy acid grassland and heather moorland are valued habitats, including at Alport Heights. Industrial remains relating to past industry are internationally valued as part of the Derwent Valley Mills World Heritage Site.	This landscape type's open character, wide, expansive views, lack of modern development and strong sense of tranquillity all pose serious constraints to the development of wind turbines. However, the presence of some main roads crossing the landscape, its large scale, along with some areas of sloping topography and plantations, could indicate the possibility for integrating wind turbine development into the landscape. The landscape type has been judged to be of **high** sensitivity to large and **moderate-high** sensitivity to medium and small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development include: • Its open character with expansive views. • High levels of tranquillity and a lack of modern development. • Sparse settlement and a minor road network. • Valued areas of heathland, including at Alport Heights. • Internationally important industrial remains falling within the Derwent Valley Mills World Heritage Site.	• This landscape would be very sensitive to large scale wind turbines because of its open character and overall lack of modern development. • Single or small clusters of small scale turbines are likely to be most appropriate. These should be located close to or within existing built elements (such as farm buildings). • Medium-scale turbines might be appropriate only where linked to existing development and taking account of the guidance below. • The screening effects of coniferous plantations on Matlock and Hackney Moors could be used to incorporate larger turbines in the small and medium size brackets. • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's sloping valley topography and plantations to integrate development into the landscape. • Ensure the location of turbines does not interrupt key views across the surrounding landscapes. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
		• Ensure any development does not detract from the prominent landmark feature of Crich Stand, visible on the horizon outside the Sub-Region. • Do not locate turbines within the boundary or buffer of the Derwent Valley Mills World Heritage Site or buffer to protect its historic integrity. • Ensure that vertical structures associated with the mills, and their character and setting, are protected. This particularly applies to the Conservation Areas at Lumsdale, Wirksworth and Charlesworth. • Protect valued areas of remnant heath, including at Alport Heights.
BIOMASS – ENERGY CROPS		
• **Landform –** Broad, rolling hill summits with gentle valleys becoming deeper as they fall off to the adjacent slopes. • **Landcover/land use –** Improved pasture is the dominant land use, with dairying and sheep grazing. • **Landscape pattern –** Regular enclosures on the higher ground, with more irregular fields near Shottle. Occasional small plantations and scrubby woodland add texture to the landscape. • **Sense of enclosure –** This landscape has a strong sense of openness owing to a lack of tree cover. • **Sense of 'naturalness'** – Patches of remnant heath, acid grasslands and scrubby woodlands retain a sense of naturalness within this upland landscape. • **Inter-visibility –** Expansive views across the surrounding landscapes. • **Sensitive/rare landscape features –** Patches of heathy acid grassland habitats are valued habitats, particularly at Alport Heights.	The presence of some areas of plantations and scrubby woodlands, along with sloping land in the valleys, could indicate the potential for bioenergy crop planting. However, the landscape's open character, overall lack of tree cover, pastoral land use, high visibility and areas of naturalistic heathland habitats all present constraints to the planting of energy crops. This landscape type is judged to be of **high** sensitivity miscanthus and of **moderate-high** sensitivity to SRC. The landscape attributes that would be sensitive to bioenergy crop planting include: • Its open character with expansive views. • Pasture as the dominant land use.	• This landscape would not be suitable for the planting of miscanthus or other monoculture bioenergy crops. • There may be opportunity to link limited amounts of SRC with existing woodlands providing it does not alter their shape or form within the landscape, and the overall open feel is maintained. • Plant at the field scale to maintain landscape pattern. • Use the screening effects of the landscape's valley topography and small woodlands to minimise the visual impacts of planting. • Ensure bioenergy crop planting does not encroach onto valued areas of remnant heath, particularly at Alport Heights.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
	• Distinctive irregular field patterns near Shottle and Crich. • Valued areas of naturalistic heathland habitats, particularly at Alport Heights.	• Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of SRC planting. • Do not introduce significant areas of planting within the boundary or buffer of the Derwent Valley Mills World Heritage Site to protect its historic integrity. • When planting, consider views along the landscape to and from mills and other industrial heritage features, including within the Conservation Areas at Lumsdale, Wirksworth and Charlesworth.

20) Landscape Type: Slopes and Valleys with Woodland (PD), Wooded Slopes and Valleys, Wooded Farmlands (DC)
Constituent Character Areas: Dark Peak Yorkshire Fringe, Derbyshire Peak Fringe, Derwent Valley, South West Peak (PD), Derbyshire Peak Fringe and Lower Derwent (DC)

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3">WIND TURBINES</td></tr>
<tr><td>

Landform and scale – Upland, undulating ground rising up to moorland. Steep slopes along stream valleys.
Landscape pattern – Small, irregular fields defined by hedgerows on lower ground, with regular fields bounded by walls on higher ground. Dense tree cover, including hedgerow trees and ancient woodlands on slopes contributes to the landscape pattern.
Sense of enclosure – The presence of significant tree and woodland cover within this landscape contributes to a feeling of enclosure. Higher ground is more open and exposed.
Sense of tranquillity/ remoteness – This is a peaceful, rural landscape with a lack of modern development or intrusions.
Settlement / transport network – Dispersed sandstone farmsteads and farmstead groups define the settlement pattern, linked by a network of winding lanes. Red brick housing a feature of settlement on the edges of Chesterfield.
Skyline – Undeveloped skylines often characterised by woodland. Riber Castle is an important landmark feature overlooking Matlock.
Inter-visibility – Views to and from the surrounding higher land, including the open moors.
Sensitive/rare landscape features – Ancient semi-natural woodlands, including upland oakwoods, and wet woodland are valued for biodiversity. Ornamental parkland at Lyme Park and Swythamley Hall is important historically.

</td><td>
This landscape's sloping topography and high woodland cover could provide opportunities to integrate some wind turbine development into the landscape. However, its strong rural character, lack of modern development and valued ancient semi-natural woodlands all pose sensitivities to this form of renewable energy development.
This landscape type is therefore assessed as being of high sensitivity to large scale wind turbines and moderate-high sensitivity to medium and small turbines (this should be upgraded to high for medium scale turbines in areas of the landscape type falling within the National Park). The landscape attributes that would be particularly sensitive to this form of renewable energy development include:

Small fields and woodlands creating an intimate pattern.
High levels of peace and tranquillity.
Views across the landscape from higher ground.
The presence of important ancient semi-natural woodlands and other habitats.
Historic designed landscapes at Lyme Park and Swythamley Hall.

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This landscape is not suitable for large scale turbines owing to its small scale character and strong sense of peace and tranquillity. Medium turbines should only be considered outside the National Park and should follow the guidance set out below.
Single small scale turbines are likely to be most appropriate in this lightly settled landscape. Small clusters of turbines should only be considered outside the National Park. These should be located close to or within existing built elements where possible.
The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development.
Utilise the screening effects of the area's hedgerows, trees, woodlands and sloping topography to integrate development into the landscape.
Protect the landscape's semi-natural habitats, particularly ancient semi-natural woodlands, from the impacts of any development.
Protect views to, and the setting of, the prominent landmark feature of Riber Castle.
Do not locate turbines within the boundary or buffer of the Derwent Valley Mills World Heritage Site or buffer to protect its historic integrity.

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</table>

<table>
<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td>Also of importance is the area's industrial heritage, including features within the Derwent Valley Mills World Heritage Site and a number of Conservation Areas.</td><td>• Industrial heritage features including mills and buildings as part of the Derwent Valley Mills World Heritage Site.</td><td>• Ensure that vertical structures associated with the mills, and their character and setting, are protected. This particularly applies to the area's Conservation Areas, including Kettleshulme, Rainow, Cromford, Lumsdale, Wirksworth, Gorsey Bank, and Castletop, Lea Bridge & High Peak Junction.
• Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.
• Locate any turbines away from key areas of designed parkland at Lyme Park and Swythamley Hall to protect its historic character and integrity.</td></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
<tr><td>• Landform – Upland, undulating ground rising up to moorland. Steep slopes along stream valleys.
• Landcover/land use – The dominant land use is permanent grassland for sheep and dairy cattle. Occasional arable fields on better drained soils outside the National Park.
• Landscape pattern – Small, irregular fields defined by hedgerows on lower ground, with regular fields bounded by walls on higher ground. Dense tree cover, including hedgerow trees and ancient woodlands on slopes contribute to the landscape pattern.
• Sense of enclosure – The presence of significant tree and woodland cover within this landscape contributes to a feeling of enclosure. Higher ground is more open and exposed.
• Sense of 'naturalness' – The landscape's significant woodland cover, and localised patches of heathy grassland and bracken are naturalistic habitats within the landscape.</td><td>The presence of some arable fields and extensive woodland cover indicates that this landscape type could potentially incorporate bioenergy planting. However, its mainly pastoral land use, small scale field pattern, long views across the landscape and valued ancient semi-natural woodlands all pose sensitivities to energy crops.

This landscape type is judged to be of moderate-high sensitivity to SRC and high sensitivity to miscanthus (reduced to moderate-high outside the National Park). The landscape attributes that would be sensitive to bioenergy crop planting include:
• Predominantly pastoral land use.
• Small fields and woodlands creating an intimate pattern.
• Views across the landscape from the surrounding higher ground.</td><td>• Focus bioenergy crops in fields already under arable, rather than converting pastoral areas to energy crops.
• Areas within the National Park are unlikely to support miscanthus planting because of their pastoral character.
• Plant at the field scale to maintain landscape pattern.
• Aim for irregular patterns of planting rather than geometric blocks to maintain the characteristic field patterns.
• Avoid vast swathes of energy crop planting.
• There may be opportunity to link some SRC with existing woodlands whilst maintaining their characteristic shape and size within the landscape.</td></tr>
</table>

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
• **Inter-visibility –** Views to and from the surrounding higher land, including the open moors. • **Sensitive/rare landscape features –** Ancient semi-natural woodlands, including upland oakwoods, and wet woodland are valued for biodiversity. Ornamental parkland at Lyme Park and Swythamley Hall is important historically.	• The presence of important ancient semi-natural woodlands and other habitats. • Historic designed landscapes at Lyme Park and Swythamley Hall.	• Maintain key views across the landscape by ensuring planting does not encroach onto important skylines. • Ensure bioenergy crop planting does not encroach onto areas of ancient semi-natural woodland or wet woodland. • Protect the historic character and integrity of the parkland landscapes at Lyme Park and Swthamley Hall by planting away from the most visible locations. • Do not introduce significant areas of planting within the boundary or buffer of the Derwent Valley Mills World Heritage Site to protect its historic integrity. • When planting, consider views along the landscape to and from mills and other industrial heritage features, including within the Conservation Areas at Kettleshulme, Rainow, Cromford, Lumsdale, Wirksworth, Gorsey Bank, and Castletop, Lea Bridge & High Peak Junction.

21) Landscape Type: Riverside Meadows (DC)
Constituent Character Areas: Trent Valley Washlands, Needwood and South Derbyshire Claylands (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Flat floodplains containing meandering rivers and streams. Floodplain broadens out at the lower reaches of the rivers Dove, Derwent and Trent to give the feeling of a large scale landscape. • **Landscape pattern** – Open bodies of water fringed by medium to large sub-regular fields bounded by tall and often gappy hedgerows. Lines of trees along watercourses and within hedgerows are features within the landscape. • **Sense of enclosure –** Tall hedgerows provide feelings of enclosure across parts of this landscape. The landscape is more open along the lower stretches of the rivers. • **Sense of tranquillity/ remoteness –** Although historically there would have been little development on the floodplain, the impacts of gravel extraction, drainage and flood protection works, visibility of large adjacent power stations and major transport corridors all have a significant impact on tranquillity. • **Settlement / transport network** – Occasional red brick farmsteads on the higher ground, linked by narrow lanes. Main roads including the A514 cross raised embankments. • **Skyline** – Power stations are visible on the skyline when looking towards the Lowland Village Farmlands landscape type (Trent Valley Washlands). • **Inter-visibility** – Long distance views tend to be restricted by the rising topography, and trees filter views in places. Dominant views of large power stations within the adjacent Lowland Village Farmlands type (Trent Valley Washlands). • **Sensitive/rare landscape features** –Freshwater habitats and river corridors are important ecologically.	The presence of prominent power stations on the edge of part of this area, the impacts of other industrial and transport development, the large scale of the lower stretches of the floodplain and tall vegetation enclosing views, could indicate that this landscape type may be able to accommodate wind turbine developments. Aspects that present sensitivities include an historic lack of development on the floodplain and the presence of important freshwater habitats. This landscape type is judged to be of **moderate-high** sensitivity to large and medium scale turbines, and of **moderate** sensitivity to small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Open views across the lower floodplains. • Historic lack of development on the floodplain – no settlement in these locations • Valued wetland habitats and river corridors.	• Large or medium scale turbines may be appropriate only where they are linked visually to existing industry of a similar scale (i.e. power stations fringing the area). • Single or small clusters of small turbines are likely to be most appropriate, and should be linked to existing development where possible. • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Site any turbines next to or within existing areas of modern development or industrial works. • There may be opportunity to link turbines into new developments, providing they are sympathetic in scale. • Utilise the screening effects of the area's trees and sloping valley topography to integrate development into the landscape. • Protect remaining areas of freshwater habitat and unimproved pasture.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform** – Flat floodplains containing meandering rivers and streams. Floodplain broadens out at the lower reaches of the rivers Dove, Derwent and Trent to give the feeling of a large scale landscape. • **Landcover/land use –** Predominantly pasture with some arable fields where land has been drained (e.g. the lower Dove Valley). • **Landscape pattern** – Open bodies of water fringed by medium to large sub-regular fields bounded by tall and often gappy hedgerows. Lines of trees along watercourses and within hedgerows are features within the landscape. • **Sense of enclosure –** Tall hedgerows provide feelings of enclosure across parts of this landscape. The landscape is more open along the lower stretches of the rivers. • **Sense of 'naturalness'** – Fragmented areas of unimproved wet pasture, tree lines and scrub are naturalistic habitats within a landscape that has been subject to significant human intervention. • **Inter-visibility** – Long distance views tend to be restricted by the rising topography, and trees filter views in places. Dominant views of large power stations within the adjacent Lowland Village Farmlands type (Trent Valley Washlands). • **Sensitive/rare landscape features** –Freshwater habitats and river corridors are important ecologically.	The presence of improved fields of arable cropping and the landscape's well-treed character could indicate potential for the careful siting of bioenergy crops. Sensitivities to bioenergy crop planting include the landscape's predominantly pastoral character, open views across the lower river floodplains and areas of important wetland habitats. This landscape type is therefore assessed as having a **moderate** sensitivity to both SRC and miscanthus planting. The landscape attributes that would be particularly sensitive to bioenergy crop planting are: • The predominantly pastoral land use. • Open views across the lower floodplains. • Valued wetland habitats and river corridors.	• Focus bioenergy crops in fields already under intensive farming systems, rather than by converting other pastoral areas to energy crops. Arable land, particularly in the Lower Dove valley, should be considered for planting above improved pasture. • There may be opportunity to link small areas of SRC with existing riverside trees and secondary woodlands whilst maintaining their shape and scale within the landscape. • SRC planting could be used to provide a screen to dominant views of power stations within the adjacent Lowland Village Farmlands type. • Ensure bioenergy crop planting does not encroach onto areas of semi-natural wetlands and unimproved pasture. • When planting, consider views across the floodplains in the lower reaches of the valleys. • Plant at the field scale to maintain landscape pattern. • Aim for irregular patterns of planting rather than geometric blocks to maintain the sub-regular field patterns. Avoid vast swathes of energy crop planting.

22) Landscape Type: Estate Farmlands (DC)
Constituent Character Areas: Needwood and South Derbyshire Claylands

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
	WIND TURBINES	
• **Landform and scale –** Gently rolling lowland with some steeper slopes where over sandstone. • **Landscape pattern –** Variety of field sizes and shapes but generally small-to medium and sub-regular. Some fields have been amalgamated for intensive farming. Small woodland blocks contribute to landscape pattern. • **Sense of enclosure –** Hedgerows, woodland blocks and lines of trees along watercourses provide enclosure within this landscape. • **Sense of tranquillity/ remoteness –** A strong historic sense of place conveys a sense of tranquillity. Some modern infill development within villages erodes tranquillity locally. • **Settlement / transport network –** Dense network of winding lanes, footpaths and green lanes link nucleated villages and sparsely scattered red-brick farmsteads. • **Skyline –** Wide, open skylines often defined by trees and woodlands. • **Inter-visibility –** Views are often restricted or filtered by tree cover, although where hedgerow trees are absent woodlands frame longer views to other landscapes. • **Sensitive/rare landscape features –** The estate influence on this landscape type, particularly linked to Kedleston Hall which lies outside the Sub-Region to the east, contributes to its historic sense of place.	The presence of significant woodland cover and some locations of modern development could suggest potential for incorporating wind turbines into this landscape type. However, its strong historic sense of place, sense of tranquillity and sparse settlement pattern present sensitivities to wind turbine development. The landscape type has been judged to be of **high** sensitivity to large scale turbines, and **moderate-high** sensitivity to medium and small turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development include: • Strong historic sense of place and estate influences. • Tranquil character with sparse settlement. • Undeveloped, wooded skylines. • Some long views to adjacent landscapes.	• This landscape would not be suitable for large scale wind turbines because of its historic character and strong rural feel. • Single or small clusters of small scale turbines are likely to be most appropriate. These should be located close to or within existing built elements (such as farm buildings). • There may be limited opportunities for medium scale turbines only in sensitively sited locations (see guidance below). • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's undulating topography to integrate development into the landscape. • Ensure that the location of turbines and related infrastructure does not affect the character or setting of Kedleston Hall and its surrounding estate, which lies outside the Sub-Region boundary to the east. • There may be opportunity to link turbines into new developments within villages, providing they are sympathetic in scale. • Ensure the location of turbines does not interrupt key views across the surrounding landscapes. • Locate any wind energy developments away from the most prominent rural skylines and consider the impact of tracks and ancillary buildings.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform –** Gently rolling lowland with some steeper slopes where over sandstone. • **Landcover/land use –** Mixed farming, with intensive arable cropping and permanent pasture. • **Landscape pattern –** Variety of field sizes and shapes but generally small-to medium and sub-regular. Some fields have been amalgamated for intensive farming. Small woodland blocks contribute to landscape pattern. • **Sense of enclosure –** Hedgerows, woodland blocks and lines of trees along watercourses provide enclosure within this landscape. • **Sense of 'naturalness'** – Frequent trees and woodlands, along with wet pasture and marsh, retain a sense of naturalness within this farmed landscape. • **Inter-visibility –** Views are often restricted or filtered by tree cover, although where hedgerow trees are absent woodlands frame longer views to other landscapes. • **Sensitive/rare landscape features –** The estate influence on this landscape type, particularly linked to Kedleston Hall which lies outside the Sub-Region to the east, contributes to its historic sense of place.	The presence of intensive arable cropping systems and significant woodland cover indicates that this landscape would be able to accommodate bioenergy planting. Landscape sensitivities include its historic estateland character, locally dominant pastoral land use, naturalistic woodlands and wetlands and the important house and estate at Kedleston. This landscape type is judged to be of **moderate** sensitivity to both miscanthus and SRC. The landscape attributes that would be sensitive to bioenergy crop planting include: • Strong historic sense of place and estate influences. • Areas of pastoral farming. • Some long views to adjacent landscapes. • Nationally important historic building and estate at Kedleston Hall. • Valued wet pasture and marsh, particularly at Mercaston Marsh SSSI.	• Focus bioenergy crops in fields already under arable, rather than converting pastoral areas to energy crops. • Plant at the field scale to maintain landscape pattern. • Aim for irregular patterns of planting rather than geometric blocks. • Avoid vast swathes of energy crop planting. • There may be opportunity to link some SRC with existing woodlands whilst maintaining their characteristic shape and size within the landscape. • Protect the historic character and integrity of the adjacent estateland at Kedleston Hall, by avoiding planting within key views of this nationally important parkland. • Maintain key views across the landscape by ensuring planting does not encroach onto important skylines. • Ensure bioenergy crop planting does not encroach onto wetlands or other valued habitats.

23) Landscape Type: Lowland Village Farmlands (DC)
Constituent Character Areas: Trent Valley Washlands (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Gently rolling, almost flat lowland with river terraces. Topography gives a sense of scale. • **Landscape pattern** – Prominent field patterns of medium to large semi-regular and regular fields bounded by hedgerows and hedgerow trees. Some smaller fields and areas of ridge and furrow around settlements. • **Sense of enclosure –** Gappy hedgerows and a lack of woodland cover gives this landscape an open feel. • **Sense of tranquillity/ remoteness –** Modern development on the edges of villages along with large power stations and mineral extraction works outside the Sub-Region have a significant impact on tranquillity. • **Settlement / transport network** – Nucleated settlements including expanding villages and scattered farmsteads are linked by organic country lanes and major transport routes including the A50 and A515. • **Skyline** – Large power stations and associated plant works and overhead cables are prominent features on the skyline outside the Sub Region. • **Inter-visibility** – Views to and from the adjacent Riverside Meadows character type owing to the flat and open topography. • **Sensitive/rare landscape features** –Wetland habitats are important for nature conservation. The historic field pattern and ridge and furrow remains are valued historically.	The presence of prominent power stations and associated infrastructure, urban fringe development on the edge of villages, intrusive transport routes and the large scale, open feel of the landscape indicate that it could accommodate wind turbine developments. Aspects that present sensitivities include the prominent field pattern (including areas of ridge and furrow) and locally important wetland habitats. This landscape type is judged to be of **moderate-high** sensitivity to large scale turbines, and of **moderate** sensitivity to medium and small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Open views across the landscape and beyond. • Important wetland sites for nature conservation. • Some areas of ridge and furrow and a prominent field pattern.	• Single large-scale turbines may be appropriate only where they are linked visually to existing industry and vertical structures (i.e. power stations). • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Single or small clusters of medium or small turbines are likely to be most appropriate - these should be linked to or within existing modern development or on brownfield sites. • New development on the edge of settlements may provide opportunities for integrating small or medium scale wind turbine developments. • Utilise the screening effects of the area's trees and small woodlands to integrate development into the landscape. • Do not locate turbines within or close to areas of medieval field systems and ridge and furrow outside villages. • Protect remaining areas of freshwater habitat.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform** – Gently rolling, almost flat lowland with river terraces. Topography gives a sense of scale. • **Landcover/land use** – Mixed farming with arable crops and improved pasture. • **Landscape pattern** – Prominent field patterns of medium to large semi-regular and regular fields bounded by hedgerows and hedgerow trees. Some smaller fields and areas of ridge and furrow around settlements. • **Sense of enclosure –** Gappy hedgerows and a lack of woodland cover gives this landscape an open feel. • **Sense of 'naturalness' –** Tree-lined watercourses and wetland habitats retain a sense of naturalness within this urban fringe landscape. • **Inter-visibility** – Views to and from the adjacent Riverside Meadows character type owing to the flat and open topography. • **Sensitive/rare landscape features** – Wetland habitats are important for nature conservation. The historic field pattern and ridge and furrow remains are valued historically.	The presence of mixed agriculture and arable cropping could indicate this landscape's suitability for bioenergy crop planting. Sensitivities would be presented by the survival of medieval fields and ridge and furrow in places, a lack of woodland cover and open landform, important wetland habitats and the historic estate of Elvaston Castle. This landscape type is therefore assessed as having a **moderate** sensitivity to both SRC and miscanthus. The landscape attributes that would be particularly sensitive to bioenergy crop planting are: • Areas of pastoral land use. • Small medieval fields with ridge and furrow on the edge of settlements. • Open views across the landscape and beyond. • Locally important wetland sites for nature conservation.	• Focus bioenergy crops in fields already under intensive farming systems, particularly arable cropping. • There may be opportunity to link small areas of SRC with existing riverside tree lines whilst maintaining their shape and scale within the landscape. • SRC planting could be used to provide a screen to dominant views of power stations and related infrastructure within this landscape type. • Ensure bioenergy crop planting does not encroach onto areas of semi-natural wetlands. • Plant at the field scale to maintain landscape pattern. • Avoid planting in or near to the remaining medieval fields with ridge and furrow on the edge of settlements. • Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of energy crop planting.

24) Landscape Type: Settled Plateau Farmlands (DC)
Constituent Character Areas: Needwood and South Derbyshire Claylands (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Gently rolling upland plateau with well defined ridge tops rising between gentle valleys. • **Landscape pattern** – Medium sized semi-regular fields of varying shapes including curving strip fields and regular enclosures of former commons. Ancient fields remain in places, including around Hole in the Wall near Yeldersley. Occasional woodland blocks, shelter belts and some parkland plantings add texture to the landscape. • **Sense of enclosure –**Boundary trees and woodlands provide enclosure within this landscape. • **Sense of tranquillity/ remoteness –** Main roads (A52 and A517) cross the ridgelines, eroding tranquillity in these areas. Many settlements have been subject to significant growth in recent years. Two former military airfields south of Ashbourne have significant landscape impacts. • **Settlement / transport network** – Widely scattered farmsteads and villages define the settlement pattern, along with wayside cottages associated with former commons. Suburban ribbon development has affected the form of some settlements. A dense network of lanes links settlement, with main roads following the ridgetops. • **Skyline** – Open, wide skylines often defined by trees. • **Inter-visibility** – Extensive views over lower ground filtered by trees. • **Sensitive/rare landscape features** – Important semi-natural habitats including wetlands associated with marl pits, unimproved wet pasture, and lowland bog and heath at Hulland Moss SSSI. Ancient field systems and the estate village / parkland of Osmaston are important historically.	This landscape type's rolling topography, frequent tree cover, presence of modern development and brownfield land on former airfields could indicate its suitability for wind turbines. Sensitivities are presented through the presence of some ancient field systems, open views from higher ground, and valued semi-natural habitats. This landscape type is judged to be of **moderate-high** sensitivity to large scale turbines, and of **moderate** sensitivity to medium and small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Ancient field systems, particularly near Yeldersley. • Open views to and from the lower ground from the ridgetops. • Important semi-natural habitats associated with marl pits and wet pasture, as well as heath and bog at Hulland Moss SSSI. • Intact estate village and parkland at Osmaston.	• Large or medium-scale turbines may be appropriate only where they can be linked to brownfield land (e.g. former airfields) or other modern development. • Single or small clusters of small turbines are likely to be most appropriate - these should be linked to or within existing modern development or on brownfield sites. • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • New development on the edge of settlements may provide opportunities for integrating small or medium scale wind turbine developments. • Utilise the screening effects of the area's trees and small woodlands to integrate development into the landscape. • Protect the character and setting of Osmaston estate village and park by locating any turbines away from key views to and from this area. • Do not locate turbines within or close to areas of ancient field systems, including around Yeldersley. • Protect areas of semi-natural habitat, including wetlands associated with marl pits, wet pasture, and heath and bog at Hulland Moss SSSI.

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
BIOMASS – ENERGY CROPS		
• **Landform** – Gently rolling upland plateau with well defined ridge tops rising between gentle valleys. • **Landcover/land use** – Mixed farming dominated by dairying and improved grassland. Cereal fields are found throughout, but particularly in the east. • **Landscape pattern** – Medium sized semi-regular fields of varying shapes including curving strip fields and regular enclosures of former commons. Ancient fields remain in places, including around Hole in the Wall near Yeldersley. Occasional woodland blocks, shelter belts and some parkland plantings add texture to the landscape. • **Sense of enclosure –**Boundary trees and woodlands provide enclosure within this landscape. • **Sense of 'naturalness' –** Boundary trees, small woodland blocks and naturalistic habitats including wetlands and remnant heath. • **Inter-visibility** – Extensive views over lower ground filtered by trees. • **Sensitive/rare landscape features** – Important semi-natural habitats including wetlands associated with marl pits, unimproved wet pasture, and lowland bog and heath at Hulland Moss SSSI. Ancient field systems and the estate village / parkland of Osmaston are important historically.	The presence of mixed agriculture and significant areas of cereal cropping, along with some woodland cover could indicate this landscape's suitability for bioenergy crop planting. Sensitivities would be presented by the survival of ancient small-scale fields, dominance of dairying and improved grassland, open views from the ridgetops over lower ground and naturalistic habitats. This landscape type is therefore assessed as having a **moderate** sensitivity to both SRC and miscanthus. The landscape attributes that would be particularly sensitive to bioenergy crop planting are: • Large areas of dairying and improved pasture. • Ancient field systems, particularly near Yeldersley. • Open views to and from the lower ground from the ridgetops. • Important semi-natural habitats associated with marl pits and wet pasture, as well as nationally important heath and bog at Hulland Moss SSSI. • Intact estate village and parkland at Osmaston.	• Focus bioenergy crops in fields already under intensive farming systems, particularly cereal cropping in the east. • There may be opportunity to link small areas of SRC with existing small woodland blocks and shelterbelts whilst maintaining their shape and scale within the landscape. • Ensure bioenergy crop planting does not encroach onto areas of semi-natural wetlands (including marl pits) and remnant heath and bog at Hulland Moss SSSI. • Protect the character and setting of Osmaston village and estate by planting away from key viewpoints and valued areas of historic parkland. • Plant at the field scale to maintain landscape pattern. • Avoid planting in or near to the remaining ancient field systems, particularly around Yeldersley. • Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of energy crop planting.

25) Landscape Type: Sandstone Slopes and Heaths (DC)
Constituent Character Areas: Needwood and South Derbyshire Claylands (DC)

Landscape attributes based on criteria for each technology type	Sensitivity Judgement and key Landscape Sensitivities	Guidance
WIND TURBINES		
• **Landform and scale** – Moderate to steep sandy slopes with prominent rounded undulations and hillocks. • **Landscape pattern** – Small to medium fields, becoming smaller and more irregular on sloping land. Frequent boundary trees and small woodlands contribute to landscape pattern. • **Sense of enclosure –** The undulating landform provides a strong sense of enclosure. • **Sense of tranquillity/ remoteness –** Sparse settlement gives a sense of remoteness, with tranquillity eroded locally by quarrying works and factory buildings. • **Settlement / transport network** – Sparse settlement of red brick farmsteads and cottages, with some larger estate farms and wayside cottages associated with former commons. Narrow lanes link settlements and the main A517 cuts through the area. • **Skyline** – Skyline defined by rounded hills and lines of trees. • **Inter-visibility** – Open views from the higher ground across adjacent areas. Views within the landscape are often restricted by the sloping topography and tree cover. • **Sensitive/rare landscape features** – Remains of a medieval deer park are important at Mansell Park. Mature hedgerow and parkland trees are valued landscape features linking to the estate influence on this area.	This landscape type's rolling topography, frequent tree cover, and presence of industrial features could indicate its suitability for wind turbines. Sensitivities are presented through the small-scale field pattern, sparse and historic settlement, open views to and from adjacent areas, and important remnant parkland and estate buildings. This landscape type is judged to be of **moderate-high** sensitivity to large scale turbines and **moderate** sensitivity to medium and small scale turbines. The landscape attributes that would be particularly sensitive to this form of renewable energy development are: • Small scale field pattern, particularly on slopes. • Sparse settlement and transport pattern. • Open views to and from adjacent landscapes from the higher land. • Historically important remains of medieval deer parks and estate buildings at Mansell Park. • Strong historic sense of place, including through the presence of mature parkland and hedgerow trees.	• Large or medium-scale turbines may be appropriate only where they can be linked to brownfield land or other industrial development. • Single or small clusters of small scale turbines are likely to be most appropriate – these should be linked to existing building clusters where possible. • The location of turbines should take into account their potential inter-visibility with other turbine locations to minimise the impacts of cumulative development. • Utilise the screening effects of the area's trees and sloping topography to integrate development into the landscape. • Protect the character and setting of medieval deer parks and estate buildings at Mansell Park by locating turbines away from key views and valued areas of parkland.

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<tr><th>Landscape attributes based on criteria for each technology type</th><th>Sensitivity Judgement and key Landscape Sensitivities</th><th>Guidance</th></tr>
<tr><td colspan="3">BIOMASS – ENERGY CROPS</td></tr>
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Landform – Moderate to steep sandy slopes with prominent rounded undulations and hillocks.
Land cover/land use – Predominantly pastoral land use with some arable cultivation on slopes.
Landscape pattern – Small to medium fields, becoming smaller and more irregular on sloping land. Frequent boundary trees and small woodlands contribute to landscape pattern.
Sense of enclosure – The undulating landform provides a strong sense of enclosure.
Sense of 'naturalness' – Hedgerows, boundary trees, parkland plantings, small woodlands and areas of scrub contribute to a sense of naturalness within this landscape.
Inter-visibility – Open views from the higher ground across adjacent areas. Views within the landscape are often restricted by the sloping topography and tree cover.
Sensitive/rare landscape features – Remains of a medieval deer park are important at Mansell Park. Mature hedgerow and parkland trees are valued landscape features linking to the estate influence on this area.

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The presence of some areas of arable cultivation and patches of woodland could indicate this landscape's suitability for Bioenergy crop planting. Sensitivities are presented through the small-scale field pattern, open views to and from adjacent areas, and important remnant parkland (including mature parkland trees).
This landscape type is therefore assessed as having a moderate sensitivity to both SRC and miscanthus. The landscape attributes that would be particularly sensitive to Bioenergy crop planting are:

Predominantly pastoral land use, with cropping restricted to some slopes.
Woodland cover restricted to small patches within the landscape.
Small scale fields, particularly on slopes.
Open views to and from adjacent landscapes from the higher land.
Historically important remains of a medieval deer park and estate buildings at Mansell Park.
Historically important mature hedgerow and parkland trees reflecting an estate influence.

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Focus Bioenergy crops in fields already under intensive farming systems, particularly cereal cropping in the east.
There may be opportunity to link small areas of SRC with existing small woodlands whilst maintaining their shape and scale within the landscape.
There may be an opportunity to use SRC planting to screen the impacts of industrial activity / development.
Protect the character and setting of medieval parkland at Mansell Park by planting away from key viewpoints and valued areas of historic parkland.
Protect valued mature trees as landscape features, by planting away from key locations where they are present.
Plant at the field scale to maintain landscape pattern.
Aim for irregular patterns of planting rather than geometric blocks. Avoid vast swathes of energy crop planting.

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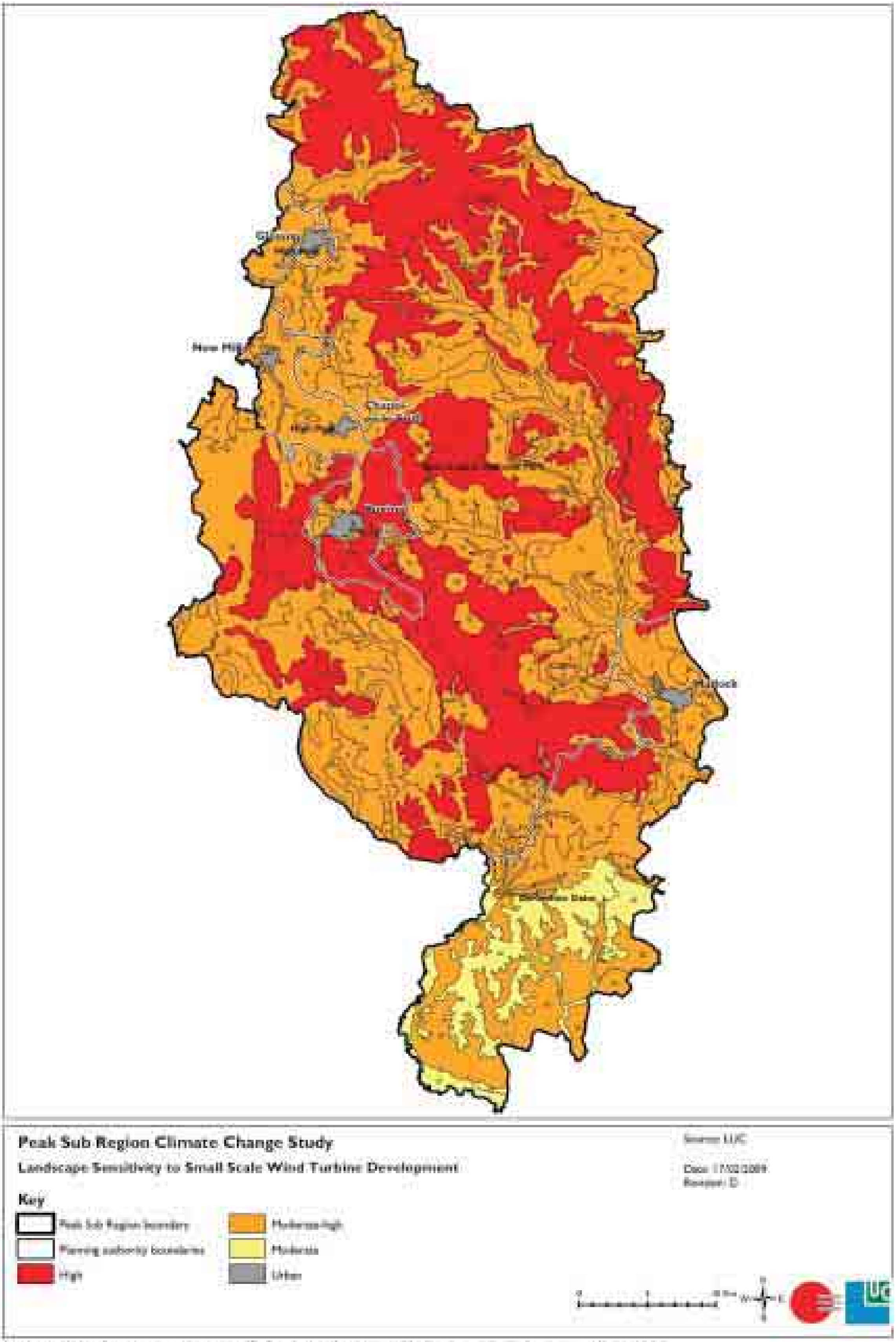
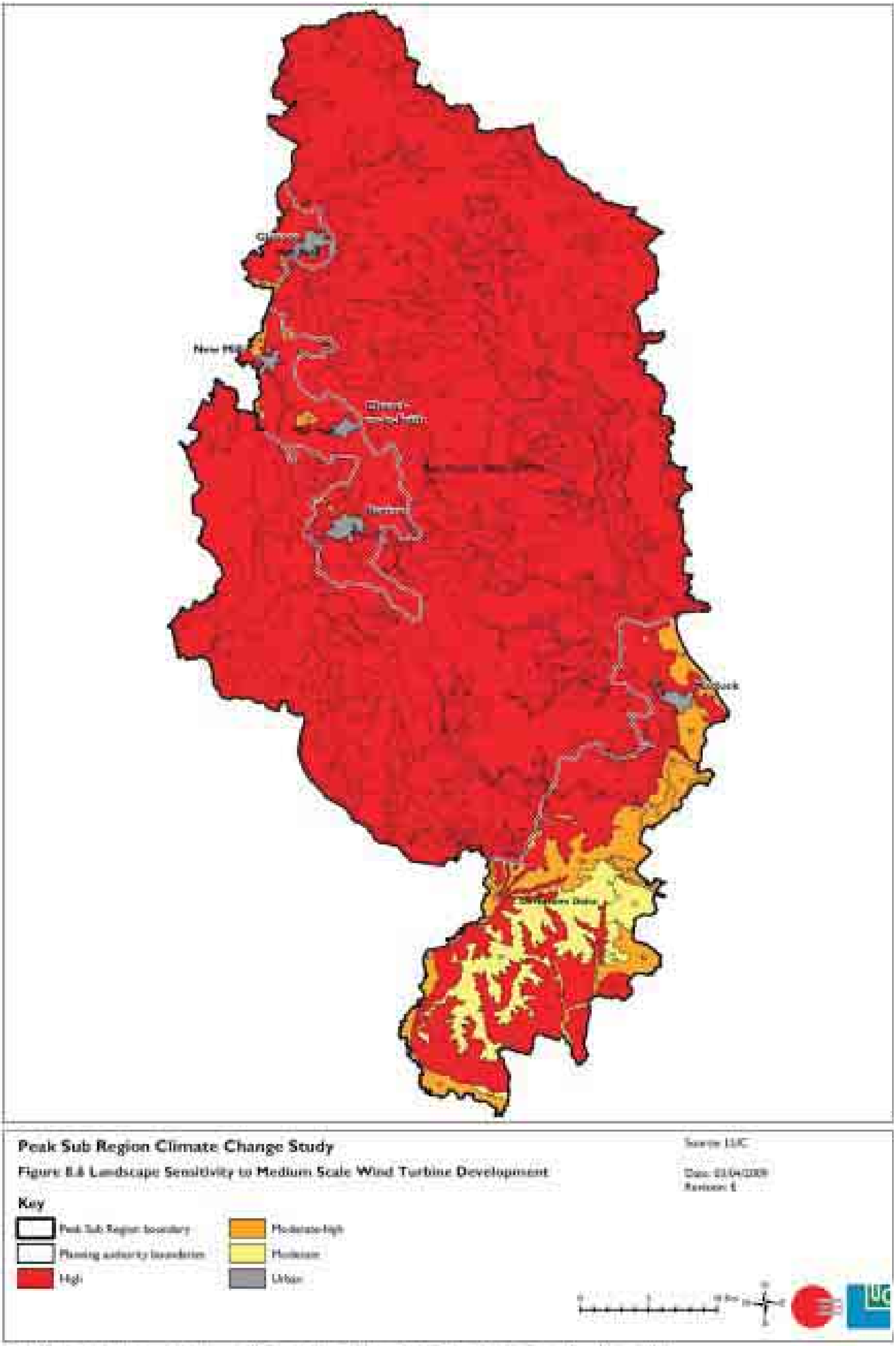
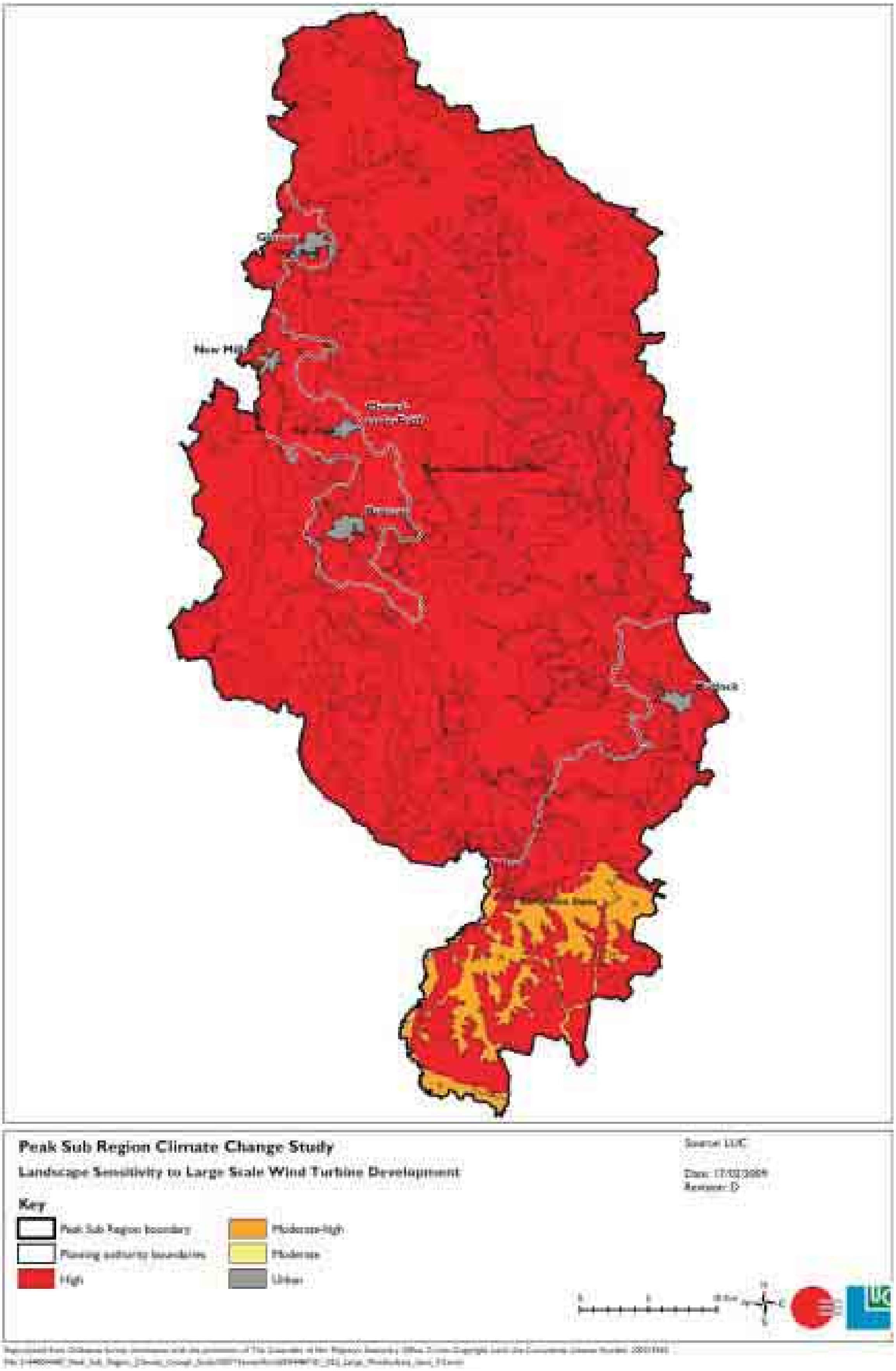
LANDSCAPE SENSITIVITY MAPS – WIND



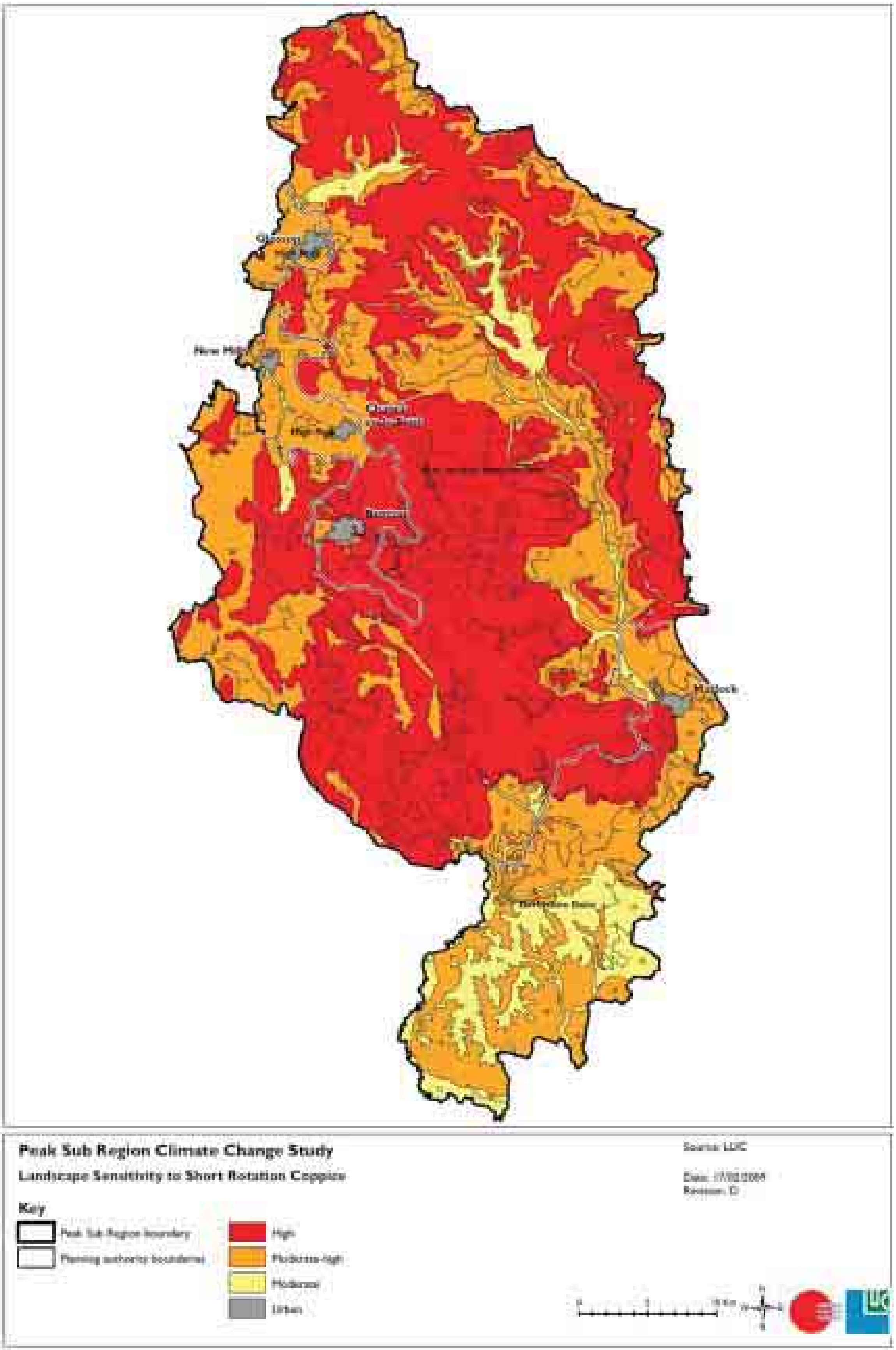


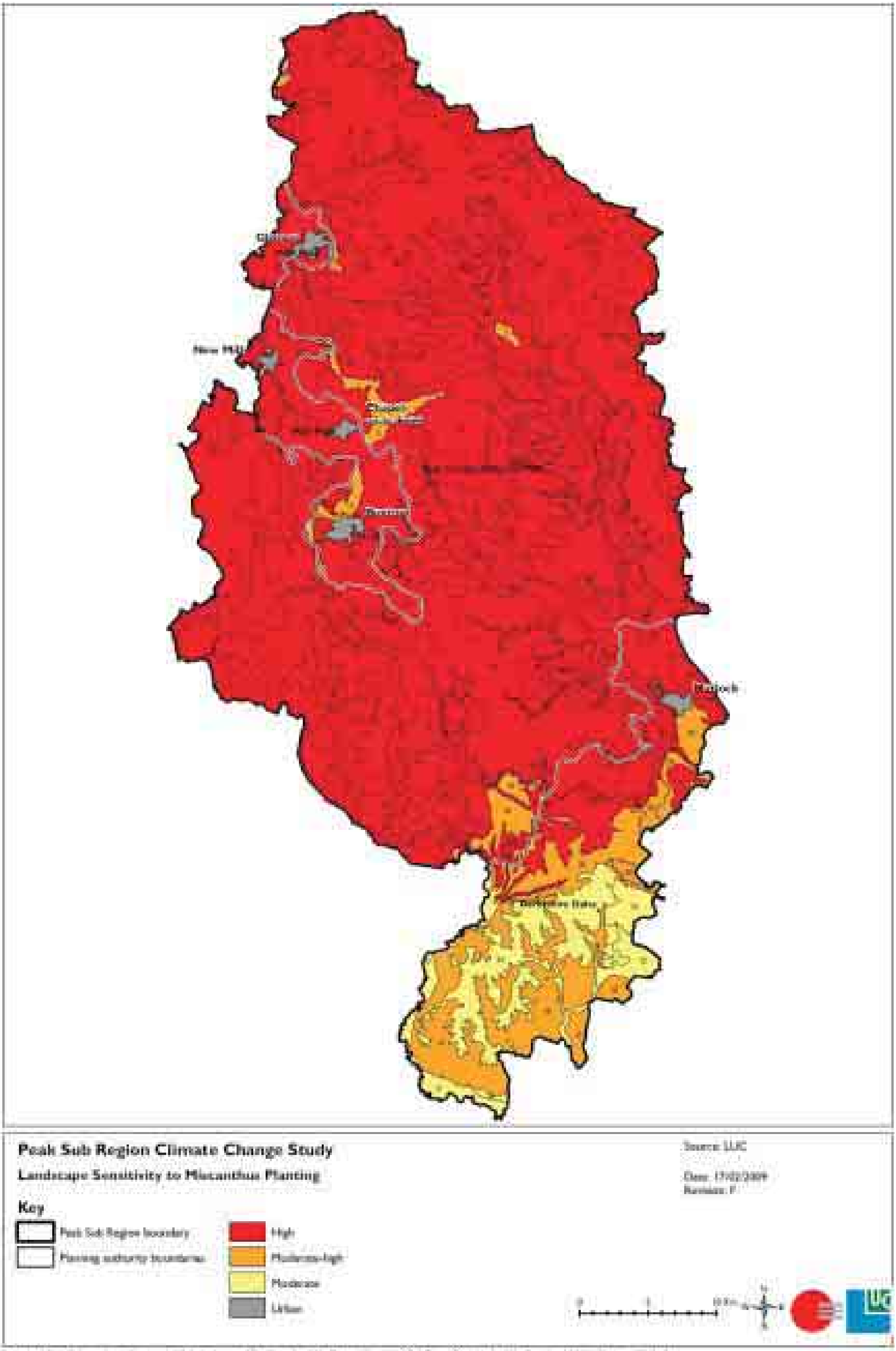
Peak Sub Region Climate Change Study

Figure 8.8 Landscape Sensitivity to Medium Scale Wind Turbine Development


New Mill
Peak Sub Region Climate Change Study
Landscape Sensitivity to Large Scale Wind Turbine Development
Source: LUC
Revision: D
Key
Peak Sub Region boundary
Planning authority boundaries
High
Moderate-high
Moderate
Urban

LANDSCAPE SENSITIVITY MAPS – BIOENERGY CROPS




New Mill
Matlock
Peak Sub Region Climate Change Study
Landscape Sensitivity to Miscanthus Planting
Key
Peak Sub Region boundary
Planning authority boundaries
High
Moderate-high
Moderate
Urban
Source: LUC
Date: 17/02/2009
Revision: F

APPENDICES

APPENDIX 1. RENEWABLE ENERGY TECHNOLOGIES

BIOMASS

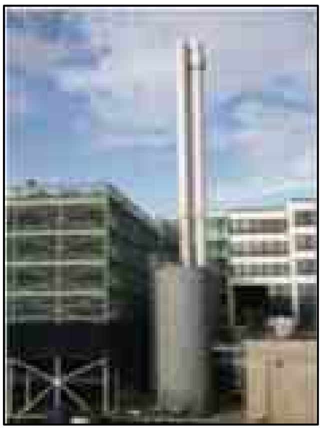
Principles of the Technology

In all cases biomass plants are concerned with producing heat from the burning of plant materials. The final output will either be heat or electricity with the heat / steam used to turn a turbine.

There are currently three basic categories of biomass plant:

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 utilised. These plants are major multi-million pound developments and are unlikely to be suitable within the Peak Sub Region. They are therefore not considered further here.

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 3 to 30 MW thermal total 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 between 1.5 and 2.5 times the electrical output. The example shown here is in Milton Keynes and is a 3.2MW gas fired CHP plant providing heat and power for a school, flats, offices and retail premises. The boiler is able to convert to biomass in future.



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. Size can range from a few kilowatts to above 5 MW thermal. This example is in Sheffield, using a 320KW biomass boiler catering for 97 homes.

Types of Plant

The size of **medium-scale plants**, such as CHP plants used in community schemes, schools and industrial units will depend on power output. A small heat plant for a school might consist of a boiler house some 4m x 4m with a fuel bunker of similar proportions and would cost in the range £20 - £30,000. The bunker may be semi-underground (bringing practical benefits for re-filling) with a lockable steel lid. The chimney will be 3m – 10m 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.

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. Costs range between £1,500 - £3,000. Where there is no existing chimney a separate internal stainless steel flue can be used, which can provide an additional source of heat. The standard fuel is wood logs. Household biomass boilers connected to central heating and hot water systems are generally larger than 15 kW and utilise either wood pellets or woodchip. They typically cost between £5,000 and £10,000. The main space requirement is for the storage of the fuel, typically 7m^3 of pellets or 21 – 35m^3 of woodchip, and access to accommodate bulk deliveries of wood fuel by lorry or tanker.

Types of Biomass

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

Sawn logs

The main sources of sawn logs generally are 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. According to the Forestry Commission the revenue from logs is increasing which highlights a growing market for biomass products.

Woodchips

The best quality woodchip comes from dried roundwood, medium quality from Short Rotation Coppice (SRC) and Miscanthus (although there can be purity issues), and poorer quality chip from forestry residues. Materials can be mixed to improve calorific value.

Pellets

Pellets are a refined, solid fuel biomass with low moisture content, easy to transport and store. Although energy demanding in their production, pellets are easier to utilise 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.

Energy crops

Energy crops do not have the same level of environmental benefit as the management of existing woodlands but are important in developing a sufficient quantity of biomass to support local schemes.

Short Rotation Coppice (SRC)

SRC uses high yielding willows and poplars planted at some 15,000 cuttings per hectare. After one year these are cut back to base (i.e. coppiced) to encourage multiple shooting. These are then cropped on a 2 – 4 year cycle thereafter by cutting back to base. This cycle of harvest and re-growth can be repeated up to an expected lifespan of 15-25 years (corresponding to around six harvests). The shoots are usually harvested during the winter as chips, short billets or as whole stems.

Miscanthus

Miscanthus or elephant grass is a perennial, rhizomatous grass originating from Asia that once established can be harvested every year for 15 years. It grows to about 3 metres in height and can produce very high yields with little pesticide or fertiliser use. By the third year harvestable yields are between 10-13 tonnes per hectare. Peak harvestable yields of 20 tonnes per hectare have been recorded.

ANAEROBIC DIGESTION

Principles of the Technology

Anaerobic digestion (AD) is a method of waste treatment that can either produce a biogas with high methane content or following a similar process produces hydrogen, both from organic materials such as agricultural, household and industrial residues and sewage sludge (feedstocks). The methane or hydrogen can be used to produce heat, electricity, or a combination of the two. Alternatively hydrogen can be used for storage of energy in hydrogen cells or as a medium for transporting energy for use elsewhere. The demand for sustainably produced hydrogen for energy generation is expected to grow considerably in the next 10 – 20 years in the UK.

Types of AD Plant

An AD plant typically consists of a digester tank, buildings to house ancillary equipment, a biogas storage tank and a flare stack (3 – 10m in height). The digester tank is usually cylindrical or egg shaped, its size being determined by the projected volume and nature of the waste and the temperature and retention time in the digester.

Broadly there are two scales of AD plant of relevance to three planning authorities in the Peak Sub Region.

Small-scale plants dealing with the waste from a single farm (generating in the region of 10kW) with the biogas potentially used to heat the farmhouse and other farm buildings in the winter when farm wastes are available. These are likely to be part of an integrated farm management system in which the feedstocks and products all play a part. Typically a plant using residues from 100 head of cattle will cost in the region of £60,000 - £70,000, and will be capable of producing electricity for approximately 13 homes, with running costs of £10,000 a year. Revenue from the sale of electricity is approximately £5-6,000 pa. rising as energy prices increase. Income also comes from the sale of Renewable Obligation Certificates (ROCs) (**Appendix 3**). Other financial offsets include using or selling the digestate as a fertiliser. Farming Futures www.farmingfutures.org has a number of case studies for further information on the advantages of biogas from AD.

A medium-sized centralised facility processing wastes from several farms supplemented by other feedstocks and potentially producing up to 2MW.

AD plants will be most cost effective if considered as part of waste management plans for farms, commercial processed food companies and local authorities. This photo is of a demonstration digester built by Greenfinch in Ludlow, Shropshire as part of a pilot project funded by the DTI in 1998 to recycle kitchen waste from 1,200 local households. www.greenfinch.co.uk .

Opportunities and Constraints for Anaerobic Digestion Plants

Environmental, farming and community benefits

The following list is taken from the Farming Futures Fact Sheet on AD www.farmingfutures.org.uk which outlines benefits to the environment and to the farmer and community for investing in AD:

Environmental Benefits

Emissions of methane (a greenhouse gas which is 23 times more potent than carbon dioxide) from the decomposing feedstock are captured within the digester, rather than released into the atmosphere from conventional manure storage systems or landfill sites.

The captured methane can be used to generate electricity and heat which can displace the use of conventional energy generated using fossil fuels, reducing emissions of carbon dioxide.

If digestate is used efficiently and replaces manufactured nitrogen fertiliser, it can have some effect on reducing greenhouse gas emissions associated with the production of manufactured fertiliser.

Farming & Community Benefits

Potential to power and heat the farm and other buildings or power processes using the energy produced by the digester, and sell any surplus electricity back to the grid.

Income from electricity sales from new double Renewable Obligation Certificates (ROCs) allowances through Combined Heat and Power generation – this can also reduce heating and electricity costs on the farm as well as possibly supplying local energy needs too.

Reductions in methane and carbon dioxide emissions (from the better management of manure) will reduce the farm's environmental footprint and provide a point of product differentiation.

Potential to transform manures and slurries into a material that is easier to spread and handle, with known nutrient properties, therefore allowing more accurate matching of nutrient requirements.

Potential to save money (and reduce greenhouse gas emissions) by replacing some of the farm's manufactured fertiliser requirement with digestate.

Possibility to provide organic waste management collection and disposal to local villages/other farms.

Potential income as a local waste processor (subject to the required permits) means gate fees generated can add another revenue stream, improving commercial viability.

Constraints

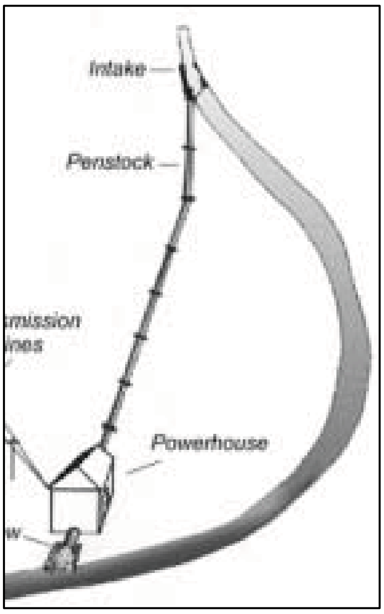
Not withstanding the benefits highlighted above, there are also a number administrative and technical challenges in setting up and operating an anaerobic digestion plant. For example, as with any industrial facility, anaerobic digestion plants are subject to regulations to protect the environment and human health relating to issues such as environmental impact, hazardous substances, visual impact of plant and access.

In addition there are other factors identified[36] which can act as barriers to the uptake of anaerobic digestion. These can be summarised primarily as poor awareness of potential i.e. the perception of agricultural waste as 'waste' rather than a valuable resource; a lack of proper synergy with the food waste and waste management sectors; a lack of national policy support and inadequate incentives; restrictive environmental legislation requiring reassessment, and technology issues such as a lack of a mature supplier base, and the need for more research regarding the suitability of certain feedstocks.

[36] Rural Climate Change Forum Paper 07/04. Developments in UK Policy on Anaerobic Digestion - March 2007 http://www.defra.gov.uk/environment/climatechange/uk/agriculture/rccf/pdf/rccf-07-04.pdf

SMALL AND MICRO SCALE HYDRO

Principles of the Technology



Water flowing from a higher to a lower point is used to drive a turbine which can be used to drive machinery directly, or can drive a generator to produce electricity. A range of turbines can be used, depending on the water's flow rate and the height (or head) that the water falls.

The various types of hydro sites can be divided into low head, medium head and high head, where the height drop is greater. These opportunities occur where a stream runs down a hillside or a river passes over a waterfall or man-made weir, or where a reservoir discharges water back into the main river.

The scheme's actual output will depend on how efficiently it converts the power of the water into electrical power (maximum efficiencies of over 90% are possible but for small systems 60 - 80% is more realistic). In addition to the turbine, civil works are required to divert water from a river or stream into the turbine, and return it afterwards. This is in most cases environmentally benign, any dam or barrage being quite small, usually just a weir, and little or no water is stored. Consequently these run-of-river installations do not have the same kinds of adverse effect on the local environment such as large-scale hydro schemes.

Types of Technology

Small scale hydro is defined as a hydro plant producing less than 5 MW of electricity, whereas a micro hydro plant is one that generates less than 100kW.

Improvements in small turbine and generator technology mean that micro hydro schemes are an attractive means of producing electricity. Useful power may be produced from even a small stream

Micro-hydro schemes are often in off-grid areas, so any electricity produced is often used in a 'mini grid' for a village or town, selling power to households and businesses. The income is used to pay for operation and maintenance of the scheme, and sometimes to pay back a loan used to fund the construction. Micro-hydro is cheap to operate, but capital-intensive to install, so a subsidy is often required, unless loans are available of favourable terms.

Hydro costs are very site specific and are related to energy output. For low head systems (assuming there is an existing pond or weir), costs may be in the region of £4,000 per kW installed up to about 10kW and would drop per kW for larger schemes. For medium heads, there is a fixed cost of about £10,000 and then about £2,500 per kW up to around 10kW - so a typical 5kW domestic scheme might cost £20-£25,000. Unit costs drop for larger schemes. Maintenance costs vary but small scale hydro systems are very reliable.

GROUND SOURCE HEAT PUMPS

Principles of the Technology

Ground source heat pumps: Ground source heat pump systems capture the energy stored in the ground surrounding (or even underneath) buildings or from water (rivers, canals, lakes or underground aquifers). Essentially they use low grade thermal energy from the ground and a refrigeration cycle to deliver heat energy at higher temperatures, (typically 40-45^{o}C) or low temperatures, using a reverse cycle, for cooling (typically 6-12^{o}C). They also offer a considerable reduction in carbon emissions when compared with even the most efficient forms of traditional heating systems e.g. gas condensing boilers. They can be made 100% renewable if solar PV or some other form of renewable electricity generating system is installed to offset the use of grid electricity needed to provide continuous power for the operation of the compressor and pump.

Air source heat pumps: An air source heat pump uses the air as a heat source for heating a building. 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, can be visually intrusive (as they tend to be mounted external to a property) and occasionally noisy.

Types of Plant

Ground source heat pumps: Many systems collect or deliver heat using ground collectors (typically coils or loops of pipe laid in trenches in the ground or vertical boreholes), in which a heat exchange fluid circulates in a closed loop and transfers heat via a heat exchanger to/ or from the heat pump. Economically, the preference is for trenched and surface water schemes. Vertical closed loop systems are economic for larger non-domestic buildings (energy piles where applicable). Open loop systems are more expensive and generally used only where space is restricted and an aquifer exists (typically inner cities).

The heat pump itself is a similar size to a large fridge and is situated inside the building. A typical ground-source heat pump (GSHP) system has three major components: a heat pump, an earth collector loop (which may be laid in a trench or in boreholes) and an interior heating or cooling distribution system. Boreholes are drilled to a depth of between 15 - 150 metres and benefit from higher ground temperatures than trenches (refer to illustration below).

A typical 8kW system costs £6,400-£9,600 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. Currently GSHPs are most competitive in terms of running costs when compared to alternative conventional heating systems where mains gas is not available and where the building is well insulated.

Typical layout of a ground source heat pump

Vertical

Horizontal

Heat recovery using canal loops: British Waterways have installed heat pump technology to provide heating and hot water to a number of their canal side developments and marinas. Polyethylene loops are sunk into the water and refrigerant circulated through them. It is recommended that there be a least depth of 2m and approximately 9m^2 surface area is required per kW energy output required. These pipes absorb heat from the water and the temperature of the circulating fluid is raised a few degrees, typically in the range of 5 to +2ºC.

Source: British Waterways Auchinstarry heat pump case study

Air source heat pumps: An air source heat pump (ASHP) is similar to (and are in effect) an air-conditioning unit running in reverse. They can either be mounted directly on an external wall (sometimes under a window), or can feed a centralised ducted warm air central heating system. They can therefore be considered for retrofitting to previous gas systems installed in the1960s/70s. Air source heat pumps generally have lower running costs and CO_2 emissions than electric storage heaters, but are likely to be more expensive to operate (with higher CO_2 emissions) than a well designed gas condensing boiler system. However they may be a sensible retrofit option where mains gas is unavailable.

Currently there are few air source heat pumps installed in the UK. Transco has supported some trials, and the largest known installation is a mixed renewables scheme serving 112 homes in Bishop Auckland, County Durham, where a community wind turbine is supported by Ground Source Heat Pumps, Air Source Heat Pumps (ASHPs) and storage heaters.

Resources

Trench (horizontal) systems require **good ground conditions** ie. the top soil layer must be at least 1.5-2m deep; there should be **no steep gradients or permanently wet top soil** which can affect access, and there should be sufficient **space for the trench**.

Bore hole (vertical) systems **prefer hard rock rather than loose material**, so avoidance of sand and gravel and spent mine or mineral working areas is required; open space nearby.

Open loop systems are only possible where there is a **good aquifer (chalk or sandstone)** at some depth below the surface (water flow of 10-15 l/s typically required; typical depth of aquifer >20m below the surface).

Surface water systems – such as **ponds** close to houses; **large lakes and reservoirs** near larger public or commercial buildings may be suitable; buildings close to mill races, **canals, sizeable rivers** where there is potential to use the water as a heat source.

Clearly there is no resource restriction on the location of air source heat pumps.

SOLAR TECHNOLOGIES

Principles of the Technology

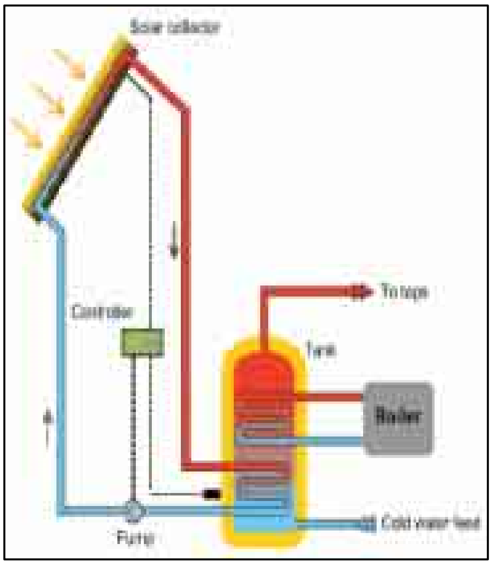
All these technologies are concerned with capturing energy from the sun. The two technologies considered here are solar hot water (SHW) and Photovoltaics (PV).

Solar hot water (SHW)

Solar water heating is deployed primarily as a building mounted technology serving the needs of the building with which it is associated. It involves collecting heat from the sun via highly heat-absorbent collectors. Two main types are common in the UK: flat plate collectors and evacuated tube collectors, the latter being more effective throughout the year but more expensive. In both types, radiation from the sun is collected by an absorber plate in the collector, and is transferred as heat to a liquid, which may be either water, or a special fluid employed to convey the energy to the hot water system using a heat exchanger.

These systems are a long established renewable technology. They are generally easy to install and can heat water throughout the year. They work best alongside existing water heating systems which can help top up the heat required in winter months when solar energy is less.

System sizes vary in scale so can be used for a variety of applications for the production of domestic or industrial hot water or the heating of swimming pools. The typical installation cost for a domestic system is £2,000 - £5,000 providing 50-70% of annual household hot water needs. They have a life of 20 – 30 years and little maintenance is needed.



Typical solar hot water system

Photovoltaics (PV)

Solar Photovoltaics (PV) produce electricity from the light of the sun. PV can either be roof mounted or free-standing in modular form, or integrated into the roof or facades of buildings through the use of solar shingles, solar slates, solar glass laminates and other solar building design solutions. The most common form of device comprises a number of semiconductor cells which are interconnected and encapsulated to form a solar panel or module. There is considerable variation in appearance, but many solar panels are dark in colour, and have low reflective properties.

Solar panels are typically 0.5 to 1m^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 to 18m^2, and would produce 1 to 2 kW peak output. The electricity produced can either be stored in batteries or excess fed into the grid via the mains supply.

PV remains expensive even though prices are falling. Prices vary, depending on the size of the system, type of PV cell used and type of building that it serves. The size of the system is dictated by the amount of electricity required, with the average domestic system costing around £4,000- £9,000 per kW peak 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. Maintenance requirements are low and PV cells can be expected to last for 30 – 40 years.

WIND POWER

Principles of the Technology

Wind turbines are one of the best known and understood renewable technologies. Wind turbines use the wind's lift forces to rotate aerodynamic blades that turn a rotor that creates a mechanical force that creates electricity. The amount of energy derived from a wind turbine depends on wind speed and the swept area of the blade (the greater the swept area, the more power the turbine will generate).

Wind turbines can be deployed singly, in small clusters, (2 – 5 turbines) or in larger groups as wind farms (typically 5 or more turbines). In the Peak Sub Region, the only potential will be as single turbines or, in very specific cases, small clusters, as set out in the separate landscape sensitivity study.

Types of Technology

In all cases wind turbines consist of the tower, hub, blades, nacelle (which contains the generator and gear boxes) and a transformer that can be housed either inside the nacelle or at the base of the tower.

Wind energy developments are unique in relation to other tall structures, in that they introduce a source of movement into the landscape. In most current designs the turbine blades turn around a horizontal axis but in some designs the blades turn around a vertical axis. These latter designs generate similar quantities to other turbines of equivalent size and are generally less visually intrusive as the turbine blades are less visible.

Large-scale turbines (65m – 125m producing 330kW – 3MW):

Turbines of this scale will normally be operated commercially with electricity sold to the grid. For the purposes of comparison a turbine of this scale could serve the electricity needs of the following number of households:

1 x 330kW turbine serving 219 households
1 x 800kW turbine serving 564 households
1 x1.3 MW turbine serving 796 households
1 x1.8 MW turbine serving over 1,000 households

The infrastructure requirements for large-scale turbines, in addition to the turbine itself, include:

- road access to the site
- on-site tracks
- turbine foundations
- temporary crane hard standing areas
- one or more anemometer masts
- temporary construction compound
- electrical cabling and an electrical sub-station/control building plus connection to the grid

Despite the high capital costs, on a site with good wind speeds, large-scale wind turbines are currently one of the most economically viable forms of renewable energy due the support given to wind through the Renewables Obligation (**Appendix 4**).
Large-scale wind turbines are generally more efficient and deliver greater carbon savings than smaller turbines. Typical commercial scale turbines of 500kW – 2 MW can pay back the energy used in their manufacture and construction within approximately six months, depending on location. The turbines can have a life of up to 25 years but will require daily/weekly maintenance checks.

Medium-scale turbines (15m – 65m producing 50kW - 330kW):

Turbines of this scale may be developed for commercial production but, more often may be deployed singly in support of individual developments (with an 80kW turbine producing sufficient electricity to serve 58 households); as part of a community project or linked to a farm, production unit or school. In addition to the turbine, which may have a lattice base, the other elements of infrastructure needed are as for a large scale turbine.

Although potentially focusing on serving local energy needs, nearly all turbines in this category will be connected to the grid, allowing the sale of unused electricity generated.

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). Medium-scale wind turbines are generally less efficient and deliver lower carbon savings than larger turbines but can still pay back the energy used in their manufacture and construction within approximately 1.5 years, depending on location.

Small-scale turbines (up to 15m producing 10kW – 50kW):

At the larger end of the range, small scale turbines are used in commercial developments, or to provide power to a community hall or other public building. A 15kW turbine could provide enough electricity to serve the needs of 4 – 8 households. A typical 6kW mast mounted turbine (such as a Proven WT 6000) has a height to blade tip of 19m. Small-scale turbines can either be connected to the grid or operated with battery storage systems.

The lower end of the power output range are typically used for small scale industrial, farms of by individual households (although the optimal size for an average sized household would be in the range 1.5kW – 3kW dependent on level of electricity use).

Micro-scale turbines:

These can be either building or mast mounted turbines. A typical turbine such as the Swift has a rated output of 1.5kW and a blade length of 1m. The present electricity generation of micro-turbines is relatively inefficient and does not appear to be delivering the power outputs advertised. Nor do these turbines deliver carbon savings.

DISTRICT HEATING

Community or district heating uses a central boiler plant or building based systems to supply heat to dwellings via insulated underground water mains.

Until recently, community heating in the UK was relatively uncommon and mainly used in larger urban areas by local authorities providing heating for social housing via community blocks/estates. Other examples have included military barracks, large colleges, hospital complexes, leisure and tourism complexes and other large institutions.

More recently, district heating has received resurgence in interest, primarily because of its more efficient use of fuel and therefore reduced carbon dioxide emissions, particularly where biomass is used in place of gas or oil; its financial savings from reduced maintenance costs and from bulk fuel purchasing. This has led to a ‘step-change’ in the delivery of heat energy in both new and regeneration developments leading to social, economic and environmental benefits, both local and more broadly.

The London Renewables renewable energy toolkit outlines the following advantages of modern community heating systems to be:

Having one central boiler plant provides greater flexibility to change fuel sources, e.g. if gas becomes expensive while biomass fuel sources become cheaper and more widely available.

Central systems can reduce maintenance costs (and legal bills resulting from access problems) particularly for housing associations or local authorities who are obliged to undertake annual inspections of individual gas appliance. Related to the above, the systems are safer as they avoid combustion appliances in the home.

The use of central plant can allow better matching of heat generation to demand resulting in improvements in efficiency. It allows bulk purchasing of fuel, potentially leading to reduced running costs for occupants. The heat exchanger unit, which is similar to a conventional wall hung boiler in size, does not have to be mounted on an external wall as there is no flue.

An Energy Services Company or ESCo is required to install, manage and operate the scheme including billing to occupiers for the energy used. The capital cost of a community heating system, taking into account the installation of the heat main, is likely to be more than providing individual boiler. The main factor affecting cost is the density of homes and the number of connections that need to be made to the underground heat main.

A community heating network could be fuelled either by high efficiency gas boilers, biomass fuelled boilers or by a combination of boilers and Combined Heat and Power (CHP) plant. The use of biomass requires a reliable supply of appropriate fuel to be sourced as locally as possible to reduce overall costs.

APPENDIX 2. RENEWABLE ENERGY FEASIBILITY CASE STUDIES - NEW DEVELOPMENTS

Presented in the following sections are **case-studies** of **renewable energy feasibility studies.** The case-studies are concerned with a selection of sites due to be or currently being developed for **domestic** and **non-domestic** end-uses over the course of the next five years.

The non-domestic sites are**:**

- Tongue Lane Industrial Estate, **Buxton** (NLP142, 143 and 144);
- Ashbourne Industrial Estate, **Ashbourne** (NLP 016); and
- Hall Farm, **Hathersage** (NLP 063).

The domestic sites are:

- Bakewell Road, **Matlock** (W2396);
- Chequer's Farm, **Millers Green** (DD713);
- Main Street, **Kniveton** (DD694);
- St Georges Road, **New Mills** (HP179);
- Glossop Road, **Charlesworth** (HP844);
- Brown Edge Road, **Buxton** (HP160); and
- Highfield Road, **Bakewell** (NP/DDD/0401/163 15th July 2002).

Sites were selected to collectively represent the range of developments likely to occur in each of the three planning authority areas. Site-specific and end-use specific opportunities and constraints for renewable energy can be extrapolated from the case studies to apply to any future non-domestic developments proposed within the three planning authority areas.

Methodology

Typical energy demands were quantified for each site through assessment of the likely energy intensity and size of each given development according to its end use. The volume of CO_2 emissions attributable to these energy demands were then quantified with the assumption that natural gas and grid electricity were as the comparable conventional fuels in each of the case studies. The carbon conversion factors for energy consumption are presented in the following table (**Appendix Table 1**).

Fuel	Carbon Conversion Factor (kg CO_2 per kWh)
Biomass	0.035
Natural Gas	0.19
Electricity	0.537

Table 1: DEFRA Carbon Conversion Factors

[http://www.defra.gov.uk/environment/business/envrp/pdf/ghg-cf-guidelines-annexes2008.pdf]

Having ascertained the attributable energy demands and CO_2 emissions, the feasibility of each of the applicable low and zero carbon technologies was examined to determine the extent to which CO_2 emissions could be reduced without negatively impacting on the character and sensitivity of the landscape in which they would be situated.

For this purpose, GIS mapping of the regional and local opportunities and constraints for renewable energy generation was employed.

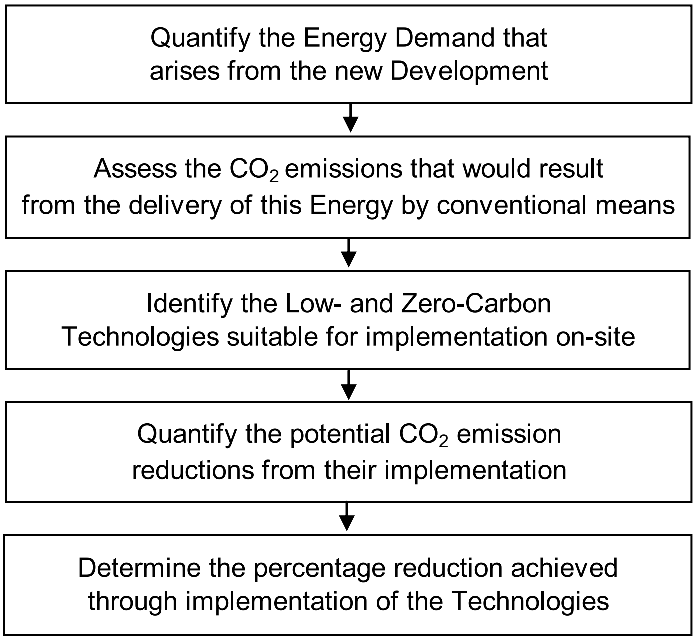
As the energy intensity and specificity of industrial processes vary widely, the figures presented in this report only serve as an approximation of what may occur. It is for this reason that CO_2 emission reductions are presented as relative reductions, rather than as absolute reductions against scenarios of conventional energy consumption (mains natural gas and grid electricity). For non-domestic developments, the cost of a one tonne reduction in CO_2 emissions was quantified for each system to enable the comparison of environmental attributes of each installation.

The specification of renewable energy technologies in each case study is based on a variety of assumptions. In the event of a development occurring on one of the given sites, assessment of the true renewable resource and energy demands will provide a more appropriate base for the specification of renewable energy systems and the quantification of the CO_2 reductions they provide.

The case studies are hereby presented under the following sections:

1. Non-Domestic Case Studies;
2. Summary of Findings: Renewable Energy in Non Domestic Developments;
3. Domestic Case Studies; and
4. Summary of Findings: Renewable Energy in Domestic Developments.

The following flow chart presents a simplified representation of the methodology used in these case studies:



RENEWABLE ENERGY FEASIBILITY CASE STUDIES - NON-DOMESTIC

Case Study 1: Tongue Lane Industrial Estate, Buxton

Site Name: Tongue Lane Industrial Estate, Buxton
Site Ref NLP 142, 143 and 144
Planning Authority: High Peak Planning Authority

The Tongue Lane Industrial Estate, situated off Tongue Lane, Buxton is the potential site of 3 non-domestic developments. The sites have a gross area of over 4 hectares (approx 1, 2 and 2.5 ha respectively). The site is near to the A6, A515, A53 and B6230 but is currently served directly by only small local roads and lanes (e.g. Tongue Lane and Roach Lane). Access to the A6, the nearest major road, is via Waterswallows Road and a number of small residential streets. Growth in this area is linked to the development of the Fairfield Link Road, designed to alleviate traffic problems on narrow roads in Fairfield and provide better access to the industrial estate. The sites are presented in the following maps (**Figure 1**).

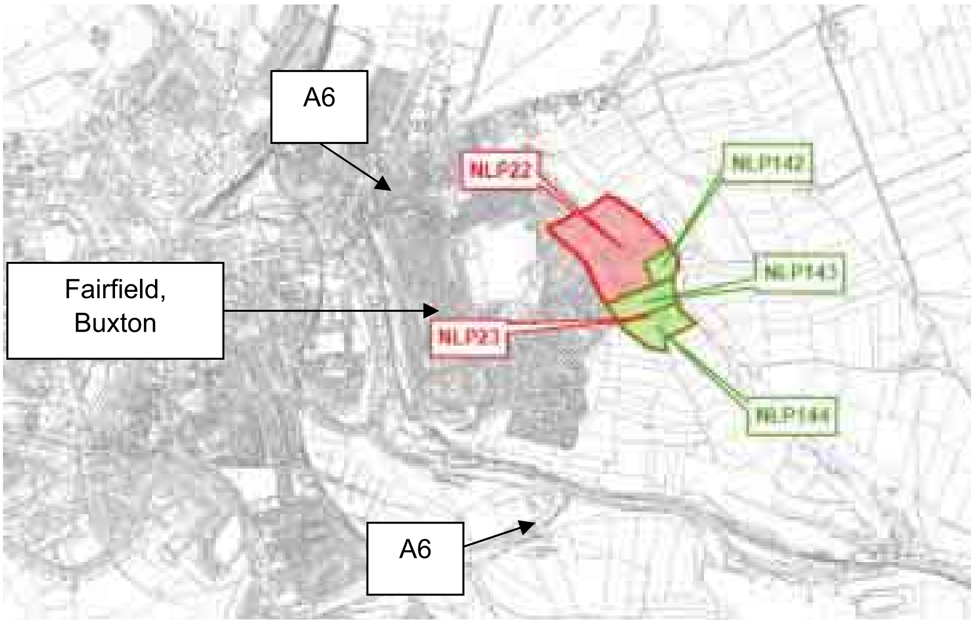


Figure 1: Tongue Lane Industrial Estate (NLP 142, NLP 143 and NLP 144) and access

Assuming a mixed end-use of both industry and administration and compliance with post 2010 regulations, the anticipated heat and electricity demands are as presented in the following table (**Table 2**). Approximately 75% of the heat demand from these sites was assumed to be attributable to industrial processes and 25% for space and domestic water heating.

Site Ref.	Site Name	Heat for Space and DHW (MWh/year)	Heat for Industrial Processes (MWh/year)	Total Heat (MWh/year)	Tonnes CO_2 (Heat)	Elec. (MWh/year)	Tonnes CO_2 (Elec.)	Total Heat and Elec. (GWh/year)	Total CO_2 (Tonnes)
NLP142	Tongue Lane, Buxton	95	285	380	88	506	272	886	359
NLP143	Tongue Lane, Buxton	197	591	788	181	1,047	562	1,835	744
NLP144	Tongue Lane, Buxton	218	655	873	201	1,161	623	2,034	825
	3 Sites Cumulatively	510	1,531	2,041	470	2,714	1,458	4,755	1,928

Table 2: Anticipated Heat and Electricity Demands for developments at Tongue Lane Industrial Estate (NLP 142, 143 and 144)

Biomass: To maximise system efficiency, it is common practice for Biomass systems to be sized to deliver 60% of the peak load (90% of the annual heat demand) with a supplementary secondary heating system (usually a conventional system e.g. natural gas) installed to deliver the remainder of the heat in times of peak demand. Satisfaction of this heat demand with Biomass would necessitate monthly deliveries from approximately:

- Two or four 40-tonne lorries of wood pellets or chips respectively; or
- Four or fourteen 18-tonne lorries of wood pellets or chips respectively.

Planned improvements to the Fairfield Link Road would be necessary to permit access for 40-tonne Lorries to the site. Due to the higher energy density of wood pellets and the resulting reduced number of deliveries required, wood pellets can be a more suitable fuel for sites with a large heat demand and poor access. Guideline capital costs for the applicable Biomass systems for each site are presented in **Table 3**. Costs include boiler, installation and basic pipe work.

Site Ref.	Site Name	Biomass System Installed Capacity (kW_p)	System Cost (£)
NLP142	Tongue Lane, Buxton	150	61,500
NLP143	Tongue Lane, Buxton	250	102,500
NLP144	Tongue Lane, Buxton	300	123,000
3 Sites Cumulative including District Heating Network		700	197,500

Table 3: Biomass System Costs

Were Biomass systems to provide 90% of the heat demand for these sites, an 18% reduction in total CO_2 emissions could be realised. (A further installed capacity of 20, 30 and 40 kW_p would be required to meet peak demands in each site respectively). If installed individually, the systems could be expected to payback with 20, 10 and 9 years respectively. NLP 143 and 144 “Return on Investment” (ROI) in approximately half of the time of NLP 142 due to economies of scale.

A biomass district heating scheme linking each of the three sites could be expected to pay back in less than 5 years.

Ground Source Heat Pumps: GIS mapping revealed that the sites of the Ashbourne Industrial Estate are suitable for locating either vertical (limestone bedrock) or horizontal ground collectors for Ground Source Heat Pumps (GSHP). The financial viability and CO_2 emission reductions of a GSHP are greatest when providing low-temperature heat (less than 50ºC). As approximately 75% of the heat demand from these sites is likely to be related to industrial processes (thereby requiring a heat above 50ºC), GSHP in these sites would be most suitable for supplying the space and domestic hot water fraction of the heat demand and pre-heating a proportion of the water intended for industrial processes. The remainder of the heat could then be produced with a secondary heating system (e.g. biomass or natural gas).

The costs of the appropriate systems with horizontal collectors are as presented in the following table (**Table 4**).

Site Ref.	Site Name	GSHP System Installed Capacity (kWp)	System Cost (£)
NLP142	Tongue Lane, Buxton	60	20,000
NLP143	Tongue Lane, Buxton	100	30,000
NLP144	Tongue Lane, Buxton	120	40,000
	3 Sites Cumulative including District Heating Network	280	125,000

Table 4: GSHP Costs

These GSHP systems could be expected to payback within 5 -7 years. The economy of scale does not apply to GSHP to the same degree as with the Biomass systems because there are many costs associated with GSHP that are fixed to a degree irrespective of the system size (e.g. digging trenches, drilling boreholes etc.).

A further installed capacity of 100, 150 and 200 kW_p would be required to meet peak demands in each site respectively.

Solar Thermal: The levels of solar irradiation received by the site would be suitable for harnessing solar energy. Solar Thermal could be applied to the site with the minimum of visual impacts as the technologies, once considered early in the design phase of the buildings, can be neatly integrated into the building fabric and as modern materials should not appear obtrusive due to the industrial modern nature of the buildings. Furthermore, the presence of a roof with a southern aspect is likely, provided that solar passive design and therefore good architectural practice is employed.

As with the GSHP, most solar thermal systems in the UK generate heat that is not suitable for some industrial processes (less than 80ºC). This is entirely dependant on the industry in question and therefore so too is the potential contribution of Solar Thermal.

Were a Solar Thermal System to contribute toward the heat demand of the domestic hot water supply and toward preheating of industrial processes, $40m^2$ of solar thermal collectors could reduce CO_2 emissions by less than 1%. If integrated into the building fabric during construction, the design and installation of these systems would be expected to cost in the region of £30,000 per site (£750 per kW_p). As previously mentioned, this is entirely dependant on the nature of the industrial processes.

The contribution of Solar Thermal to the overall heat demands on each of the sites is not likely to be financially competitive with that of Biomass or GSHP unless a significant grant were made available for the Solar Thermal system.

District-Heating: As mains natural gas would be available to NLP 142, 143 and 144, and as the sites would be likely to maintain a constant demand for heat, natural gas fuelled Combined Heat and Power (CHP) in conjunction with district heating could be very suitable for these sites

When the natural gas system warrants decommissioning, biomass fuelled CHP could then be installed in conjunction with the district-heating network when Biomass CHP becomes viable in the UK.

The CO_2 emission reductions from district-heating, CHP cannot be quantified without detailed specification of the system. However it could be expected that a natural gas fuelled district heating CHP scheme on the sites could deliver CO_2 emission reductions of over 60 % and Biomass fuelled district heating scheme of over 80%.

A natural gas CHP system and district heating network connecting the three sites with an installed capacity of 750 kW_{th} and 300 MW_e could cost in the region of £200,000. Much of the electricity generated from this plant could be exported to the local residential areas.

Wind Energy Conversion: Wind generation is not suitable for these sites as their optimal location toward the south-east of the sites (due to the prevailing wind) is precisely where the residential developments are causing decreased wind speeds, turbulent flows and lower thresholds for visual and aural impacts.

Solar Photovoltaics: Solar PV, for the same reasons as for Solar Thermal, could easily be applied to the site. An 8 kW array ($50m^2$) would provide CO_2 emission reductions of less than 1% of each of the sites (see Table 2).

The design and installation of such building integrated systems could be expected to cost in the region of £40,000 per site. As with Solar Thermal, Solar PV is not likely to payback within its lifetime unless the installation is subsidised.

Summary: Due to the large electricity demands of the three sites at Tongue Lane Industrial Estate and to the inability to generate significant quantities of electricity on-site; the major source of CO_2 emission reductions must come from low/zero carbon heat generation.

Both Solar Thermal and Solar Photovoltaics could contribute to CO_2 emission reductions but are unlikely to contribute to significant reductions cost-effectively in the absence of external grant funding.

It is for these reasons that for any CO_2 emission reduction in excess of 25 % to occur in a cost-effective manner, only natural gas fuelled CHP (and/or district heating) could be applied.

A significant opportunity for financial investment exists here for an Energy Services Company (ESCo) as if the heat demand of each site is combined, there is likely to be sufficient heat and electricity demands from the industries and electricity demands from the residences to sustain large CHP generation.

Based on the assumptions made, a Biomass system would be the most appropriate renewable technology for achieving in excess of a 10% reduction on a site-by-site basis. A summary of the reductions provided by each technology is as presented in the following table (**Table 5**).

Site Ref.	Site Name	% Potential Reduction Biomass	% Potential Reduction GSHP	% Potential Reduction Solar Thermal ($40m^2$ Collectors)	% Potential Reduction Solar PV (8 kW, 50 m^2)	% Potential Reduction Natural Gas CHP and District Heating
NLP142	Tongue Lane, Buxton	15 - 20	5 - 10	0 - 5	0 - 5	>60
NLP143	Tongue Lane, Buxton	15 - 20	5 - 10	0 - 5	0 - 5	>60
NLP144	Tongue Lane, Buxton	15 - 20	5 - 10	0 - 5	0 - 5	>60
	3 Sites Cumulative	15 - 20	5 - 10	0 - 5	0 - 5	>60

Table 5: Renewable energy CO_2 emission reductions for the Tongue Lane Industrial Estate Developments (NLP 142, 143 and 144)

Case Study 2: Ashbourne Industrial Estate, Bradwell

Site Name: Ashbourne Industrial Estate, Bradwell
Site Ref NLP 016
Planning Authority: Derbyshire Dales Planning Authority

With a gross area of almost 7 hectares (net size 5.5 ha), NLP 016 in the Ashbourne Industrial Estate has been allocated for redevelopment under the Local Plan. The site is situated to the South East of Ashbourne on the Derby Road (A52) and is presented in the following map (**Figure 2**).

Figure 2: Ashbourne Industrial Estate (NLP 016) and access

Assuming a mixed end-use of industry, storage, distribution and administration, and compliance with post 2010 regulations, the anticipated heat and electricity demands are as presented in the following table (**Table 6**). Approximately 60% of the total heat demand from the site is likely to be attributable to industrial processes and 40% for space and domestic water heating.

Site Ref.	Site Name	Low Grade Heat (MWh/year)	High Grade Heat (MWh/year)	Total Heat (MWh/year)	Tonnes CO_2 (Heat)	Elec. (MWh/year)	Tonnes CO_2 (Elec.)	Total Heat and Elec. (GWh/year)	Total CO_2 (Tonnes)
NLP 016	Ashbourne Industrial Estate	0.9	1.3	2.1	492	2.8	1,524	5.0	2,016

Table 6: Anticipated Heat and Electricity Demands for developments at Ashbourne Industrial Estate (NLP 106)

Biomass: As with **Case Study 1**, a Biomass system could be sized to deliver 90% of the annual heat demand of NLP 016. Deliveries from four 40-tonne Lorries of wood chips or one 40-tonne lorry of wood pellets would be required to meet the demand. This level of delivery could easily be sustained by the site especially if a second point of access to the A52 were created for the site.

Were a biomass system to provide 90% of the heat demand of these sites, an 18% reduction in total CO_2 emissions could be realised.

Guideline costs for systems in this size region can be expected to cost in the region of £175,000 (700 kW_p) for boiler, installation and basic pipe work.

Ground Source Heat Pumps: As with case study 1, in NLP 016, GSHP would be suitable to supply the space and domestic hot water fraction of the heat demand and pre-heating a proportion of the water intended for industrial processes. Both vertical (siltstone and sandstone bedrock) and horizontal ground collectors would be suitable.

CO_2 emission reductions of approximately 7% could be delivered by a GSHP in this manner. Each tonne of CO_2 reduced by this GSHP system over its lifetime would cost approximately £64. The cost of a 300 kW GSHP with horizontal collectors would cost in the region of £100,000.

This cost could be significantly reduced if combined with the necessary upgrading of the water supply, foul drainage infrastructure and surface water drainage both on- and off-site.

A further 400 kW_p of capacity would be required in addition to the GSHP to meet peak loads.

Solar Technologies: Due to the surrounding topography, the Solar Technologies may not be viable for Ashbourne Industrial Estate. GIS mapping has shown that the site lies on the boundary of an opportunity zone and of a constraint zone for solar energy generation. Levels of solar irradiance in the UK can cause energy generated by Solar Thermal and Solar Photovoltaics to be of a high expense and therefore, small reductions in exposure to insulation can rapidly reduce the viability of a solar energy generation.

As Ashbourne Industrial Estate is located on the outskirts of the settlement, and as the structures located on the site are likely to be of a modern appearance, both Solar Thermal and Solar Photovoltaics could be integrated into the building fabric without causing a significant visual impact.

The north-west/south east orientation of the site may lend the new structures to achieve a high solar gain in the morning. This would be particularly suitable for Solar Thermal.

Detailed analyses would have to be undertaken to investigate the viability of solar technologies for this site.

CHP: Providing the presence of a constant heat demand year round, natural gas fuelled CHP could be very suitable for this site. CHP must run for at least 4,000 hours per year to ensure viability.

Wind Energy Conversion: Wind generation could possibly be suitable for these sites as the GIS mapping revealed that wind speeds may be sufficient, the south-east of the site is open to the prevailing wind and as visual and aural impacts are not likely to be an issue as the nearest residences are 0.75 km away. A site specific investigation would have to be carried out to quantify the exact order of CO_2 emissions that wind generation would provide on this site. However, one or two 50 kW horizontal axis turbines with a 15m rotor diameter generating 230 MWh per year a piece could contribute to CO_2 emissions reductions in the order of 6 or 12% respectively. Larger turbines are not likely to be suitable for the locale.

Summary: As with the Tongue Lane Industrial Estate, significant CO_2 emission reductions must come from low/zero carbon heat generation in order for them to be cost-effective. The surrounding topography may mean that both solar thermal and solar photovoltaics are not viable options for the site. As before, they could contribute to CO_2 emission reductions but are unlikely to contribute to significant reductions cost-effectively in the absence of grant funding. The scale of wind generation suitable for the site could result in significant CO_2 emission reductions.

It is for these reasons that for any CO_2 emission reduction in excess of 25 % to occur Natural gas fuelled CHP would have to be employed. The proximity of Ashbourne would provide a demand for exported electricity. As other sites within the Industrial Estate may accommodate further future developments, any development in this area should be mindful of the possibility for further energy import and export. CO_2 emission reduction in excess of 20 % could be achieved by a Biomass system. Neither CHP nor Biomass would have a negative visual impact.

Table 7: Renewable energy CO_2 emission reductions for the Ashbourne Industrial Estate (NLP 016)

Site Ref.	Site Name	% Potential Reduction Biomass	% Potential Reduction GSHP	% Potential Reduction Wind (1 x 50 kW)	% Potential Reduction Wind (2 x 50 kW)
NLP 016	Ashbourne Industrial Estate	15 - 20	5 - 10	5 - 10	10 - 15

Case Study 3: Hall Farm, Hathersage

Site Name: Hall Farm, Hathersage
Site Ref NLP 063
Planning Authority: Peak District National Park Planning Authority

Hall Farm is situated in a conservation area in the North West of Hathersage, Hope Valley. The site has an area of 0.26 ha. The development is for commercial and office use and involves the conversion of dilapidated farm buildings. In addition to the site being in a conservation area, the development is sensitive due to the presence of listed buildings.

The site is near the A6187 (Main Road) but at present access is restricted. Although situated on the edge of the settlement, its environs are predominantly built-up. The site is presented in the following map (Figure 3).

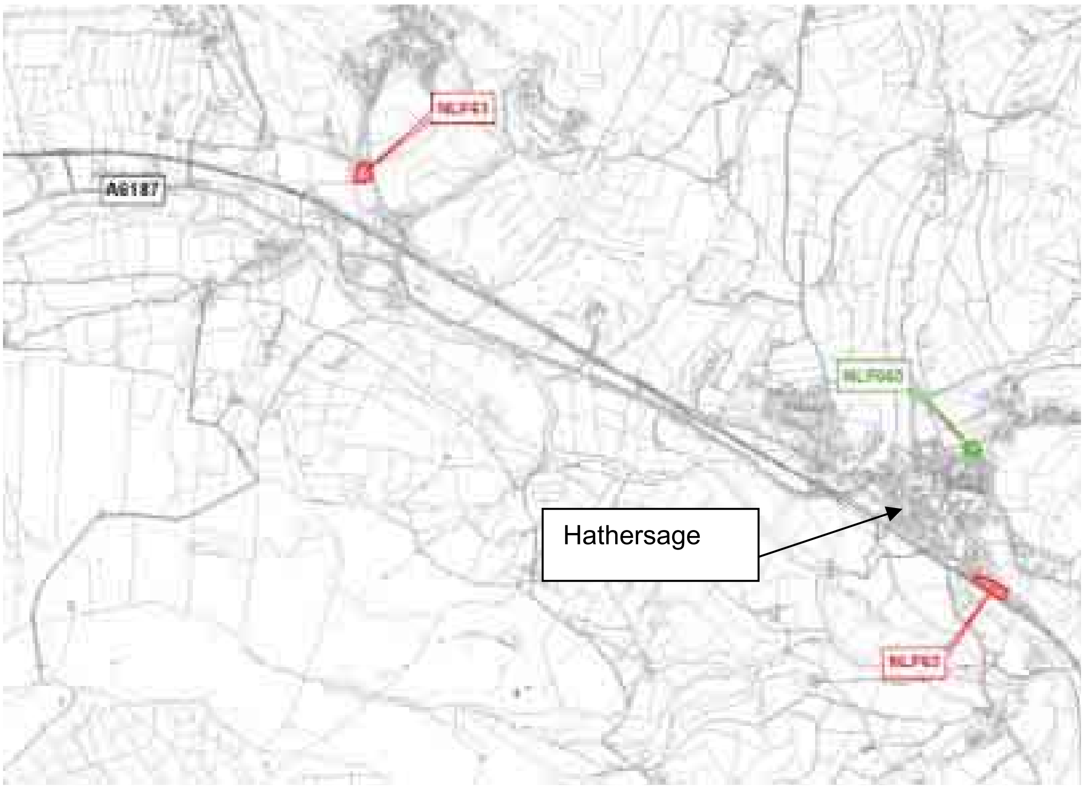


Figure 3: Hall Farm Hathersage (NLP 063) and access

Assuming the mixed end-uses of predominantly office-based industry and compliance with post-2010 regulations; the anticipated heat and electricity demands are as presented in the following table (**Table 8**).

Site Ref.	Site Name	Total Heat (MWh/year)	Tonnes CO_2 (Heat)	Elec. (MWh/year)	Tonnes CO_2 (Elec.)	Total Heat and Elec. (MWh/year)	Total CO_2 (Tonnes)
NLP 063	Hall Farm, Hathersage	102	23	135	73	237	96

Table 8: Anticipated Heat and Electricity Demands for developments at Hall Farm, Hathersage (NLP 063)

Biomass: The development at Hall Farm is likely to result in significantly lower energy intensity (both heat and electricity) than the preceding case studies (Tongue Lane Industrial Estate and Ashbourne Industrial Estate). This is due to the fact that only a light industry could operate from a site in such proximity to residences.

Therefore, the quantity of biomass required to satisfy the heat demand is considerably less: 22 deliveries of wood chips or 6 deliveries of wood pellets from an 18 tonne lorry per year.

As mentioned previously, as a result of their higher energy density, wood pellets can be a more suitable fuel in areas where access may be an issue.

A Biomass system sized to deliver 90% of the annual heat demand of this site would provide a CO_2 emission reduction of 19%. Such a system would have an installed capacity of 60 kW and is likely to cost in the region of £25,000 for all plant, basic pipe-work and installation. A further installed capacity of over 10 kW would be required to cover peak loads.

Ground Source Heat Pumps: In contrast to the preceding case studies, the majority of the heat required in Hall Farm is likely to be of a low temperature. As the site has sufficient space to locate horizontal collectors GSHP would be ideal for this site. (Vertical collectors would also be suitable as bedrock is sandstone).

CO_2 emission reductions of approximately 8% could be delivered by a GSHP for this site. A 60 kW GSHP with horizontal collectors would cost in the region of £40,000 provided that its installation occurred during construction (thereby reducing installation costs).

Solar Technologies: The application of 12 m^2 of Solar Thermal collectors to this site (costing £10,000) to generate heat for domestic hot water could produce a 1% CO_2 emission reduction. A 2 kW photovoltaic array (also costing in the region of £10,000) could provide CO_2 emission reductions of less than 1% of the site.

As this site is in a conservation area, and as the southern face of the site is that which faces the settlement, the integration of these technologies into the building façade would require extreme sensitivity. Ground frame-mounted collectors and arrays may be a potentially more discrete method of employing said technologies.

District Heating: As the site is surrounded by existing domestic buildings, exporting heat may not be appropriate.

Wind Energy Conversion: Wind generation is not appropriate for this site as it is located in a conservation area.

Summary: Once again it can be seen that the most significant CO_2 emission reductions can be obtained by reducing the carbon intensity of the provision of heating. The technologies by which these reductions are achieved (Biomass and GSHP) are also the most discrete as their operation does not necessarily affect the character of the structure in which they are housed.
As the development of this site requires significant investment in the dilapidated farm buildings to be brought into employment use, the lower capital cost, significant CO_2 reductions and lower running costs would quite possibly make a Biomass system the preferred renewable technology for this site.

Site Ref.	Site Name	% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal ($8m^2$ of Evacuated Tube Collectors)	% Reduction from Solar PV (2 kW, 15 m^2)
NLP 063	Hall Farm, Hathersage	15 - 25	5 - 15	< 5	1

Table 9: Renewable energy CO_2 emission reductions for the Hall Farm, Hathersage (NLP 063

Achieving a 20% CO_2 reduction would be possible with a biomass system and minor fabric improvements. An improvement of 10% on CO_2 emissions could be achieved with a GSHP and fabric improvements.

Summary of Findings: Renewable Energy in Non Domestic Developments

The following bar chart (**Figure 4**) displays the average cost related to the reduction of one tonne of CO_2 for each of the renewable technologies in question over its lifetime in the instances presented in **Case studies 1, 2 and 3**. The calculation of these values takes into account the capital and maintenance costs and the inflation of fuel costs (3% per annum).

Wind energy conversion has not been included in as it is unlikely to contribute significantly to CO_2 reductions in non-domestic developments in any of the three regions at present.

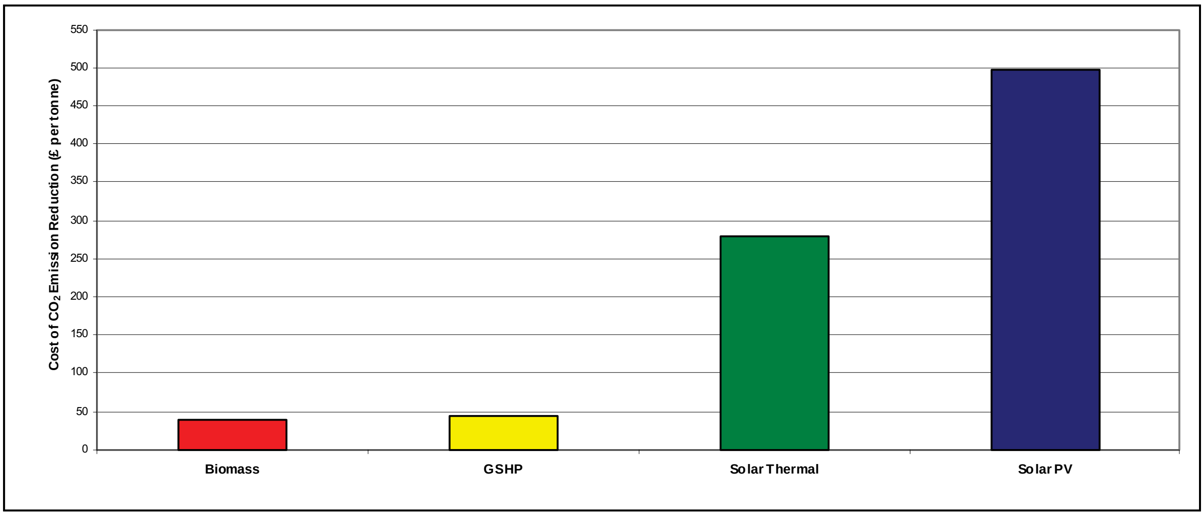


Figure 4: Costs related to the reduction of 1 tonne of CO_2 emissions

As can be seen, the expense of CO_2 emission reductions from both Biomass and GSHP are a factor of 5 and 10 less than that for Solar Thermal and Solar Photovoltaics respectively. This demonstrates that the most cost-effective CO_2 emission reductions for non-domestic sites such as these will come from reducing the carbon intensity of heat provision.

For this purpose, in each of the regions in question, Biomass is by far the most promising technology for reducing the carbon intensity of future non-domestic developments for the following reasons:

- Biomass can provide high temperature heat with a low carbon intensity;
- Although capital costs are significantly higher than for conventional systems, Biomass systems will payback in their lifetime as the cost of fossil fuel energy consumption increases (due to both fuel cost and carbon market measures e.g. the Carbon Reduction Commitment, Climate Change Levy etc.). Grants for Biomass systems can further improve their economic viability (e.g. Bio-energy Capital Grants Scheme);
- The creation of a Biomass demand can stimulate local Biomass supply thereby adding economic growth and employment to the region (in addition to reducing waste sent to land fill if fuel from waste streams is employed); and
- Biomass systems will not negatively impact on the character of the location in which they are located as they are almost entirely internal. The visual impact of extremities of such systems (e.g. flu) can be reduced when designed to be discrete.

Ground Source Heat Pumps also have great potential to reduce CO_2 emission in new non-domestic developments in the region. Their viability does however depend on the nature of the heat demand in question. Drying, washing, space-heating and pre-heating are examples of industrial processes where GSHP could perform well. However, sterilising, pasteurising and chemical processes are examples of industrial processes to which GSHP would only be suitable for pre-heating. As with Biomass, GSHP are unlikely to cause any negative visual impact during operation as they are entirely internal or subterranean.

Solar thermal heat production is mostly less than 80ºC. For this reason, as was the case with GSHP, Solar Thermal's suitability to industrial processes is case dependant. Building integrated Solar Thermal collectors need not cause a visual impact if designed appropriately. Frame mounted ground systems may be viable in locations where modifications to the integrity of materials from which a building is composed are sensitive.

Of the technologies examined, solar photovoltaic generation is presently the most expensive method of energy generation. As with solar thermal, it need not be visually obtrusive if designed appropriately and frame mounted ground systems may be viable in sensitive locations.

Electricity generation from wind power is unlikely to contribute to significant CO_2 emission reductions in any of the three regions. Certain instances may present themselves where a site could accommodate a productive turbine. Careful consideration should be given to whether the visual impact merits the relatively small level of energy generation.

RENEWABLE ENERGY FEASIBILITY CASE STUDY - DOMESTIC DEVELOPMENT

Case Study 1: Bakewell Road, Matlock

Site Name: Bakewell Road, Matlock
Site Ref W2936
Planning Authority: Derbyshire Dales Planning Authority

A site at Bakewell Road, Matlock (W2396) with a gross area of almost 0.95 hectares, is to be the site of 58 new units of social housing. The site is situated to the North West of Matlock on the Bakewell Road and is presented in the following map labelled DD822 (**Figure 5**).

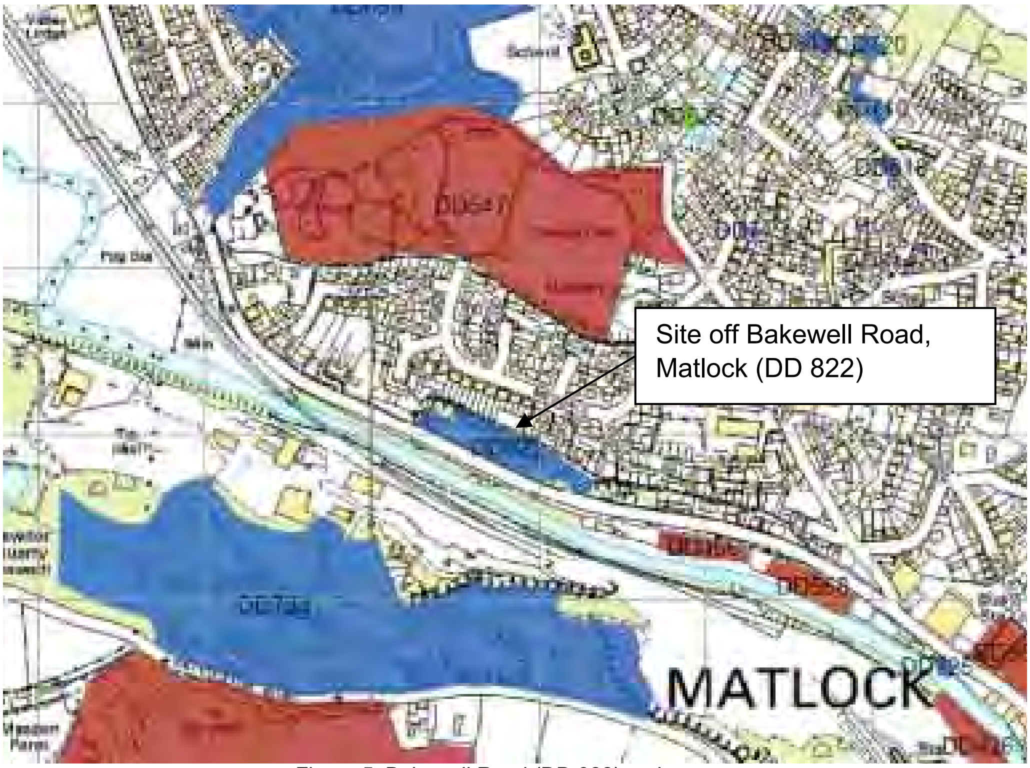


Figure 5: Bakewell Road (DD 822) and access

In line with current policy, all of the houses in this development will achieve the Code for Sustainable Homes level 3. For the purpose of this case study, it was assumed that this development would be comprised of a mix of twenty 2-, twenty 3- and eighteen 4-bedroom semi-detached homes of 90, 110 and 140 sq metres floor area respectively. The anticipated heat and electricity demands are as presented in the following table (**Table 10**).

Site Ref.	Site Name		Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
W2396	Bakewell Road, Matlock	20 x 90 m^2 property	61	14	52	28	113	42
		20 x 110 m^2 property	74	17	63	34	138	51
		18 x 140 m^2 property	85	19	72	39	158	58
	Cumulative (58 units)		221	50	188	101	408	151

Table 10: Anticipated Heat and Electricity Demands for residential development at Bakewell Road (W2396)

Biomass: A wood chip or wood pellet boiler that provides the entire space and water heating demand in one of the houses would lead to a 27% reduction in CO_2 emissions. A 6 kW wood pellet boiler would cost approximately £6,000 per unit (installation of ten or more is likely to reduce cost by up to 20%).

The installation of wood chip or wood pellet boilers in all of the 4-bedroom homes (18 homes) and 4 of the 3-bedroom homes (at a cost of £110,000) would reduce the CO_2 emissions of the entire development by 10%. Investment in a centralised biomass boiler and district heating network for all of the houses would be a solution with a shorter pay-back period and with higher returns on the initial investment.

The installation of 3 x 100 kW biomass boilers and district-heating network to each of the 58 homes, at a cost of £170,000 (£50,000 for district-heating network), would reduce the CO_2 emissions from the entire development by over 30% over the lifetime of the biomass boiler.

The district-heating network would be functional for in excess of 50 years thereby enabling further CO_2 emission reductions once the initial boiler is decommissioned and replaced.

Capital costs would be recoverable through management of the system and charging heating bills (e.g. an ESCo). A major advantage of this system would be that low-carbon heat could be supplied at a high efficiency and at a lower cost than if provided by conventional means.

Ground Source Heat Pumps: Due to the density of this development, there would not be enough ground space (>10m long, 1.5m deep trench per kW_p) for each home to have a horizontal trench to accommodate the ground coils associated with GSHP. This site has bedrock geology of limestone which is suitable for vertical boreholes. If a combination of vertical and horizontal coils (20m depth per kW_p) were applied, GSHP could easily be applied to all houses.

In order to maintain suitable ground temperatures for horizontal trenches, no more than 1 MW_p of collectors should be installed per hectare (trenches 5m apart with ground heat content of 50 W per m^2).

The cost of installing a single 8 kW GSHP in a new-build home ranges from £8,000 to £12,000 depending on whether horizontal or vertical collectors are used (horizontal drilling increases installation costs greatly). However, mass installations (>10 units) during construction can decrease installation costs by over half as machinery is available on-site and as the installation can be planned to be integrated with the construction of the site.

A GSHP installed in each home could deliver a CO_2 emission reduction of over 10% of the total development but would cost in the region of £250,000.

As with Biomass, a viable opportunity for district heating exists on this site. 3 x 100 kW GSHP providing the entire heat demand of every house in this development could reduce total CO_2 emissions by 15%. Such a system would cost in excess of £150,000 (including district heating). Capital costs could once again be recovered via an ESCo contract.

Natural Gas CHP: The CO_2 emission reductions from district heating CHP cannot be quantified without detailed specification of the system. However it could be expected that a natural gas fuelled CHP district heating scheme on this site could deliver CO_2 emission reductions of over 40 % and would be likely to start to turn a profit well within its lifetime.

Solar Thermal: Domestic applications are by far the largest application for Solar Thermal systems in the UK. Solar thermal can reduce the energy required by a household for domestic hot water by up to 50% and can thereby reduce CO_2 emissions by 4%.

Individual Solar Thermal systems can cost up to £4,000 per unit. However, if the design and installation of the systems occurs during construction the cost is likely to be less than half this figure. Furthermore, installations can be designed to be fully integrated into a roof thereby minimising any visual impact and reducing the costs of conventional building materials.

At a cost of £3,000, each Solar Thermal system would have a payback of less than fifteen years. In the absence of district-heating, Solar Thermal is highly recommended for all new domestic developments.

Wind Energy Conversion: Wind generation is not suitable for this site as it is located in a densely populated area and as local wind speeds were shown to be inadequate.

Solar Photovoltaics: As with Solar Thermal, Solar PV could easily be applied to the site without causing a visual impact. There are many innovative methods for integrating solar photovoltaics into new developments (e.g. solar PV roof tiles).

A 1 kW array per house could provide CO_2 emission reductions of between 12 and 18% of each of the houses. Costs could range from £3,000 to £5,000 per kW_p depending on the extent to which the PV is integrated into the dwellings and on the number of arrays installed. The payback period for such an array has been calculated to be in the region of 30 years. As a result, without grants, Solar PV is not likely to be cost effective. A 1 kW Solar PV array on each roof would cost more and reduce emissions by over ten times less than both the Biomass and the GSHP district heating schemes.

Summary: As with the non-domestic sites, significant CO_2 reductions from the provision of heating could be expected to be more achievable in a cost-effective manner than from renewable electricity generation. This is the case both practically (limited roof space to accommodate collectors and arrays) and economically (energy from solar technologies is considerably more expensive than from Biomass and GSHP).

As a result, excellent opportunities exist in new housing developments (especially Social Housing) for heat distribution via a district heating network from a centralised boiler (or GSHP). As the domestic hot water demand in a home makes up a higher proportion of the overall heat demand than is the case in most non-domestic situations, solar thermal systems are viable for domestic installations.

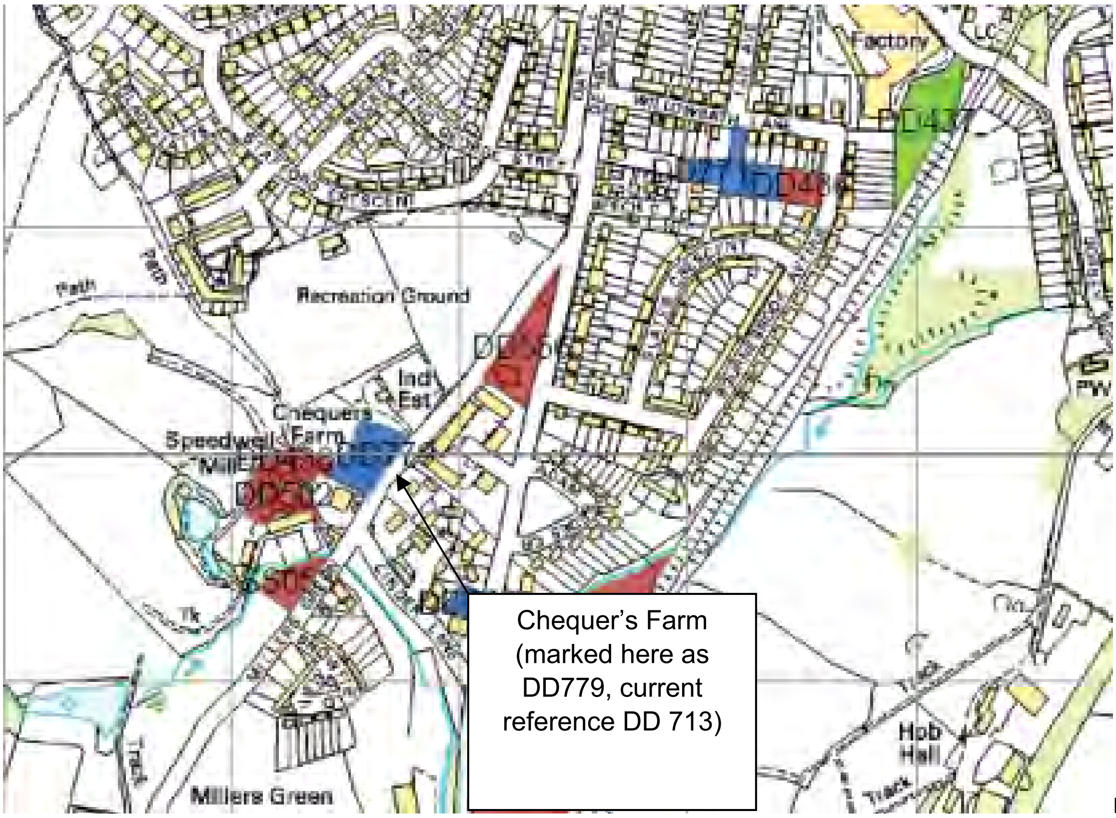
Site Ref.	Site Name	Property Type	% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal (4m^2 of Evacuated Tube Collectors)	% Reduction from Solar PV (1 kW, 6 m^2)
W2396	Bakewell Road, Matlock	Dwelling	25 - 30	10 - 15	< 10	12 - 18

Table 11: Renewable energy CO_2 emission reductions for the Bakewell Road, Matlock (W2396)

Case Study 2: Chequer's Farm, Millers Green

Site Name: Chequer's Farm, Millers Green
Site Ref DD 713
Planning Authority: Derbyshire Dales Planning Authority

A development on the Chequers Farm site at Millers Green (0.25 ha) of five apartments and five houses is due to occur within the next five years. The site is situated in the South of Wirksworth at Millers Green and is presented in the following map (**Figure 6**).



Image

Figure 6: Chequers Farm, Millers Green (DD 713) and access

It was assumed that this development would be built to meet but not exceed the current building regulations in terms of energy conservation. The resultant anticipated heat and electricity demands are presented in the following table (**Table 12**).

Site Ref.	Site Name	Dwelling (type and number)	Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
DD 713	Chequer's Farm, Millers Green	80 m^2 apartments 5 x 80 m^2 apartments	11 54	2 10	4 21	2 11	15 75	4 21
		120 m^2 house 5 x 120 m^2 houses	16 81	3 15	6 31	3 17	22 112	6 32
	Entire Development	(5 apartments, 5 houses)	135	26	52	28	187	53

Table 12: Anticipated Heat and Electricity Demands for residential development at Chequers Farm (DD 713)

Biomass: The heat demand of each of the apartments would be too low to warrant the installation of a Biomass boiler in each unit (and the cost involved would be unjustifiable). A centralised Biomass boiler system and buffer tank supplying heat for all of these apartments would however be a viable option.

For this purpose, 2 x 30 kW Biomass wood chip boilers could meet the demand. The total cost of these systems would be in the region of £35,000. As these systems would require periodic maintenance and management, labour costs could make a scheme of this size unviable. In the absence of maintenance costs, a payback period of 8 years would be anticipated with capital and fuel costs recovered through heating bills.

A wood chip or wood pellet boiler system could provide a 26% reduction in CO_2 emissions for each house. A 12 kW wood pellet boiler would cost approximately £8,000 per unit (installation of five is likely to reduce costs by up to 20%). However, a centralised Biomass boiler supplying the five apartments and the five houses would not only be a suitable option for reducing CO_2 emissions but also for reducing the expense of the development. It would also be an attractive investment for an ESCo.

2 x 60 kW Biomass boiler systems supplying each of the houses and the apartments would cost in the region of £60,000 would pay back in less than 7 years and would achieve CO_2 reductions of over 35%.

The volume of deliveries from this installation (6 wood chip or 3 wood pellet monthly deliveries from 18-tonne Lorries) could easily by handled by the present access to the site.

Ground Source Heat Pumps: As was the case with Biomass, a GSHP for each apartment would not be suitable. As GSHP require little maintenance they would be extremely suitable for supplying the heat demand of the 5 apartments. 2 x 30 kW GSHP installed with horizontal trenches would cost in the region of £20,000, would reduce CO_2 emissions by over 15% of the apartments (7% of the entire development) and would payback in less than 5 years.

The cost of installing a single 12 kW GSHP in a new-build home ranges from £8,000 to £12,000 depending on whether horizontal or vertical collectors are used. However, mass installations (>10 units) during construction can decrease installation costs by over half as machinery is available on-site and as the installation can be planned to be integrated in construction on site. Such systems would reduce the CO_2 emissions from each house by approximately 11% and would payback in less than 7 years.

GSHP supplying the entire heat demand of the site would once again be more efficient and cost-effective. 2 x 40 kW GSHP and district heating network costing in the region of £75,000 could reduce the total CO_2 emissions of the site by 18% and would have a payback of less than 9 years.

Solar Thermal: As was previously mentioned, domestic applications are by far the largest application for Solar Thermal systems in the UK.

In general, the area of roof per apartment will be less than the area of roof area per house and the occupancy density of an apartment will be higher than that of a house. These two factors lead to the contribution of solar energy being less per dwelling in an apartment than in a house. 4 m^2 of solar thermal collectors could reduce the energy required by each of the houses for domestic hot water by up to 50% and could thereby reduce CO_2 emissions by 4%. If each house was fitted with 4m^2 of collectors, the total cost would be likely to be in the region of £12,000 and at this price the collectors would payback within 16 years.

10m^2 of solar thermal collectors on the roof of the apartments (2 m^2 per apartment) could reduce the energy required for domestic hot water by 30 – 40% and thereby reduce CO_2 emissions by approximately 6%. As previously mentioned, in the absence of district-heating, Solar Thermal is highly recommended for all new domestic developments.

Natural Gas CHP and District Heating: Once again, natural gas CHP and district heating would be a viable option for this site. The industrial estates nearby could provide an excellent demand to export heat to improve the viability of the scheme.

Wind Energy Conversion: Wind generation is not suitable for this site as it is located in a densely populated area and as wind speeds are too low.

Solar Photovoltaics: As with Solar Thermal, Solar PV could be applied to the dwellings of the site. A 1 kW array (6 m^2) per house could provide CO_2 emission reductions of an average of 8% per house. As previously mentioned, there are many innovative methods for integrating solar photovoltaics into new developments (e.g. solar PV roof tiles) and financial savings can be thereby made. Costs could range from £2,500 to £5,000 per kW_p depending on the extent to which the PV is integrated into the dwellings and on the number of arrays installed.

Site Ref.	Site Name		% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal ($4m^2$ of Evacuated Tube Collectors)	% Reduction from Solar PV (1 kW, 6 m^2)
DD 713	Chequer's Farm, Millers Green	80 m^2 apartments	40 - 50	15 - 25	5 - 10	10
		5 x 80 m^2 apartments	40 - 50	15 - 25	5 - 10	10
		120 m^2 house	40 - 50	15 - 25	5 - 10	7
		5 x 120 m^2 houses	40 - 50	15 - 25	5 - 10	7
	Entire Development	(5 apartments, 5 houses)	25 - 35	10 - 15	5 - 10	8

Table 13: Renewable energy CO_2 emission reductions for the Bakewell Road, Matlock (W2396)

Summary: As all of these homes will be built to Level 3 of the Code for Sustainable Homes, their energy demands are at minimum 25% lower than those experienced by homes built to 2006 standards. From 2010 on, all social housing will be required to meet Level 4 of the Code for Sustainable Homes. Level 4 represents a minimum of a 44% reduction of expected energy use in comparison to a home built to the 2006 standards.

These ever-heightening standards have two major effects on the provision of renewable energy:

- As heat becomes a lower proportion of the total energy demand due to superior insulation and air-tightness, the contribution from the generation of renewable electricity toward total CO_2 emission becomes greater;
- The cost per dwelling rises in response to increases in the expense of materials and workmanship.

As a result of these factors and in the absence of wind energy conversion, preference for capital expenditure in multiple-dwelling developments should be in favour of the instatement of district heating networks and their corresponding controls, even if fuelled by natural gas. This is true both in terms of CO_2 emission reductions and economics.

District heating networks will endure in excess of 50 years. Should available funds prohibit the installation of Biomass, GSHP or CHP, natural gas district heating replaced with renewable energy systems after the initial boilers are decommissioned would ensure significantly lower lifetime emissions from the development.

Case Study 3: Main Street, Kniveton

Site Name: Main Street, Kniveton
Site Ref DD694
Planning Authority: Derbyshire Dales Planning Authority

With a gross area of 0.14 hectares, DD 694 is to be the site of a single residence.

The site is situated on Main Street, Kniveton 3km to the North East of Ashbourne.

The site is presented in the following map (**Figure 7**).

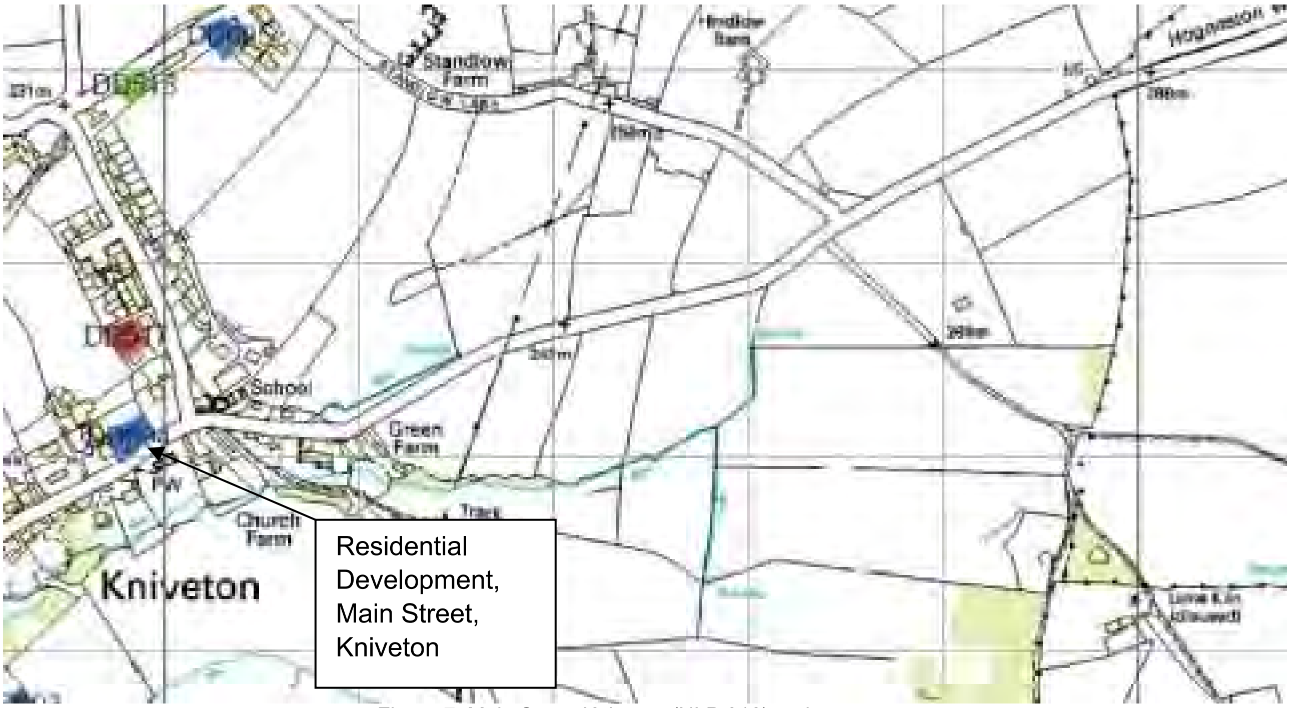


Figure 7: Main Street Kniveton (NLP 016) and access

In the absence of finalised plans, the new house was assumed to have a floor area of 150m^2 and be compliant with Level 4 of the Code for Sustainable Homes. The anticipated heat and electricity demands are presented in the following table (**Table 14**).

Site Ref.	Site Name		Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
DD694	Main Street, Kniveton	Single 150 m^2 residence	5	1.2	4	2.3	9	3.5

Table 14: Anticipated Heat and Electricity Demands for developments at Main Street, Kniveton (NLP 016)

Biomass: A 12 kW wood chip or wood pellet boiler would reduce the CO_2 emissions of this residence by 27%. Such a system would be likely to cost £8,000 and would cost no more than a natural gas boiler system over its lifetime (at current costs).

Ground Source Heat Pumps: With bedrock geology of limestone and mudstone and suitable area for digging horizontal trenches, GSHP would be suitable for this site.

A 12 kW GSHP system with horizontal trenches would also cost in the region of £8,000, reduce CO_2 emissions by 11% and would payback within the lifetime of the system.

Solar Thermal: 4 m^2 of evacuated tube collectors could provide up to 50% of the heat demand for domestic hot water thereby reducing CO_2 emissions by 4%. Such a system would cost £4,000 and would payback within 16 years.

Solar Thermal is highly recommended for all new single residence domestic developments.

Wind Energy Conversion: Wind generation is not suitable for this site as it is located in a residential area and as local wind speeds are not sufficient.

Solar Photovoltaics: As with Solar Thermal, Solar PV could easily be applied to the site. A 1 kW array could provide CO_2 emission reductions of around 12% for this site.

Site Ref.	Site Name		% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal	% Reduction from Solar PV (1 kW_p)
DD694	Main Street, Kniveton	Single 150 m^2 residence	20 - 30	10 - 15	<10	12

Table 15: Renewable energy CO_2 emission reductions for the Tongue Lane Industrial Estate Developments (NLP 142, 143 and 144)

Summary: Cost-effective CO_2 emission reductions are readily achievable on this site without impinging on the character of the village through employment of Biomass or GSHP. As was previously mentioned, both Biomass and GSHP would do so without incurring significant cost over the lifetime of the technologies. Grants from the Low Carbon Building Programme could make an investment in one of these technologies very attractive.

Solar thermal could contribute to CO_2 emission reductions in a cost-effective manner.

Case Study 4: St Georges Road, New Mills

Site Name: St Georges Road, New Mills
Site Ref HP179
Planning Authority: High Peak Planning Authority

A single house is to be built on a site off St Georges Road, New Mills (central region of the High Peak). The site is presented in the following map marked HP179 (**Figure 8**).

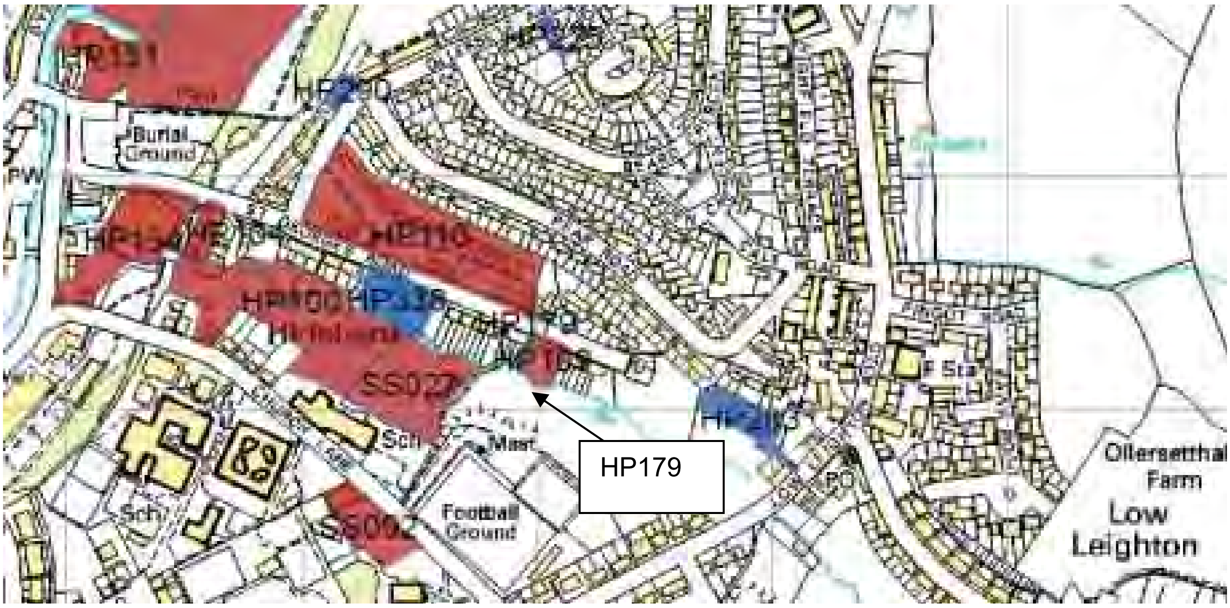


Figure 8: Site off St Georges Road, New Mills (NLP 079)

For the purpose of energy demand quantification, it was assumed that the new house would have a floor area of 200 m^2 and would achieve Level 4 of the Code for Sustainable Homes. The resultant energy demands and corresponding CO_2 emissions are as presented in the following table (**Table 16**).

Site Ref.	Site Name		Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
HP 179	St Georges Road New Mills	Single 200 m^2 residence	7	1.6	6	1.6	13	3.1

Table 16: Anticipated Heat and Electricity Demands for residential development at St Georges Road, New Mills (DD179)

The guidance from **Case Study 3.3** is identically applicable to this case study due to the fact that both homes would be built to the same standard and are of a similar size. In summary, Solar Thermal and either GSHP or Biomass would provide cost-effective CO_2 emissions for this house.

Site Ref.	Site Name		% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal	% Reduction from Solar PV (1 kWp)
HP 179	St Georges Road New Mills	Single 200 m^2 residence	20 - 30	10 - 15	<10	<10

Table 17: Renewable energy CO_2 emission reductions for St Georges Road New Mills (HP 179)

Case Study 5: Glossop Road, Charlesworth

Site Name: Glossop Road, Charlesworth
Site Ref HP844
Planning Authority: High Peak Planning Authority

A site off Glossop Road, Charlesworth is to be developed to accommodate 11 new houses. For the purpose of this study it was assumed that they will be built to the standard of level 4 of the Code for Sustainable Homes and that each will have a floor area of 120 m^2.

Figure 9: Site off Glossop Road, Charlesworth (NLP 844)

To quantify the forecasted energy demands associated with this development, it was assumed that the new house would have a floor area of 120 m^2 and would achieve Level 4 of the Code for Sustainable Homes. The resultant energy demands and corresponding CO_2 emissions are as presented in the following table (**Table 18**).

Site Ref.	Site Name		Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
HP844	Glossop Road Charlesworth	1 x 120 m^2 house	4	0.9	2	1.9	6	2.8
		11 x 120 m^2 house	44	10	21	20.7	65	30.7

Table 18: Anticipated Heat and Electricity Demands for residential development in Site off Glossop Road, **Charlesworth** (NLP 844)

The guidance and recommendations from **Case studies 3 and 4** are applicable to each of the houses within this development if each is treated as an individual case, the guidance from 1 and 2 if treated as a whole.

In summation, the most cost-effective means of reducing CO_2 emissions and lifetime energy costs is to include a centralised boiler and district-heating network. In the absence of a district heating network Biomass and GSHP could reduce CO_2 emissions by 27 and 11% respectively. In the absence of district heating, Solar Thermal is highly recommendable.

Site Ref.	Site Name		% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal	% Reduction from Solar PV (1 kW_p)
HP844	Glossop Road Charlesworth	1 x 120 m^2 house	20 - 30	10 - 15	<10	14

Table 19: Renewable energy CO_2 emission reductions for Glossop Road Charlesworth (HP 844)

Case Study 6: Brown Edge Road, Buxton

Site Name: Brown Edge Road, Buxton
Site Ref HP160
Planning Authority: High Peak Planning Authority

A residential development consisting of 30 units is to be permitted on a site off Brown Edge Road, Buxton. The site is presented in the following map (**Figure 10**).

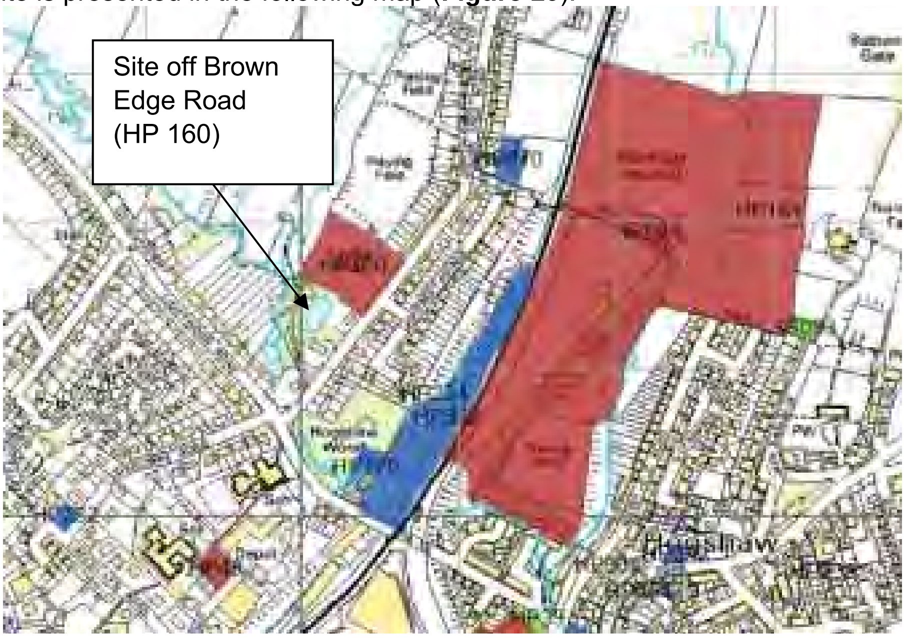


Figure 10: Site off Brown Edge Road, **Buxton** (HP160)

In order to forecast the energy demands attributable to this development, it was assumed that 15 of the houses would be 2-bedroom with a floor area of 120 m^2 and that 15 would be 3 bedroom with a floor area of 150 m^2.

Site Ref.	Site Name		Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
HP 160	Brown Edge Road Buxton	Single 120 m^2 residence	4	0.9	3.5	1.9	8	2.8
		15 x 120 m^2 residence	60	13.7	52.5	28.2	113	41.9
		Single 150 m^2 residence	5	1.1	4.3	2.3	9.3	3.4
		15 x 150 m^2 residence	75	17.1	64.5	34.6	139.5	51.7
		30 Properties Cumulatively	135	30.8	117	62.8	252	93.6

Table 20: Anticipated Heat and Electricity Demands for residential development in Site off Brown Edge Road, Buxton (HP160)

The recommendations and guidance for this development are identical to those for **Case study 1**. In summary, district heating from a centralised boiler (biomass or natural gas) or from a GSHP would be the most cost-effective way in which to reduce CO_2 emissions from the development. In the absence of district heating, solar thermal and biomass or GSHP would reduce CO_2 emissions by over 30% and over 15% respectively.

Site Ref.	Site Name		% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal	% Reduction from Solar PV (1 kWp)
HP 160	Brown Edge Road Buxton	Single 200 m^2 residence	20 - 30	10 - 15	<10	14

Table 21: Renewable energy CO_2 emission reductions for Brown Edge Road Buxton (HP 160)

Case Study 7: Highfield Road, Bakewell

Site Name: Highfield Road, Bakewell
Site Ref (NP/DDD/0401/163 15th July 2002)
Planning Authority: Peak District National Park Planning Authority

In 2002, a residential development of 8 shared ownership (4 two- and three-bed) and 28 rented (19 two-bed and 9 three-bed) properties was built on a site on Highfield Road to the standard of Level 3 of the Code for Sustainable Homes. Each two-bed property has a floor area of 66 m^2. Each three-bed property has a floor area of 76 m^2.

In order for the homes to be in keeping with the character of the local area, all pipe-work other than that associated with rainwater was completely internal to each building whilst the exterior of each house was constructed of the following materials:

Natural Blue slate or Harrow old stone tiles;

- Natural limestone walls in random rubble with natural Gritstone lintels ,cills and quoins;

Figures 11: Highfield Road, Bakewell (HP160)

All developments in the National Park region are subject to stringent assessment to ensure that their presence will not negatively impact the character of the region. It is for this reason that renewable energy technologies and CO_2 emission reduction targets have in the past and continue to cause contention in many such areas.

The following analyses investigate the degree to which CO_2 emission reductions could be achieved with renewable energy technologies were the development to re-occur post-2010.

As the notional homes are to be built post-2010, they would be built to the standard of Level 4 of the Code for Sustainable Homes. The following table presents the resultant energy demands and associated CO_2 emissions.

Site Ref.	Site Name		Heat (MWh)	Tonnes CO_2 (Heat)	Elec. (MWh)	Tonnes CO_2 (Elec)	Total Heat and Elec. (MWh)	Total CO_2 (Tonnes)
NP/DDD/0401/163 15th July 2002	Highfield Road, Bakewell	Single 66 m^2 residence	2	0.6	2	1.1	5	1.7
		23 x 66 m^2 residence	46	13.8	46	25.3	115	39.1
		Single 76 m^2 residence	3	0.7	2	1.3	5	2.0
		13 x 76 m^2 residence	37	8.5	31	16.9	69	25.4
		36 Properties Cumulatively	83	22.3	77	42.2	184	64.5

Table 22: Site off Highfield Road, Bakewell (NP/DDD/0401/163 15th July 2002)

As with case studies 1, 2, 5, and 6, a district heating network and centralised boiler (or GSHP) would lead to the highest and most cost-effective CO_2 reductions.

In comparison to each home having an individual natural gas condensing boiler, CO_2 emissions reductions of 10, 13 and 30% could be achieved on total energy use with Natural Gas, GSHP and Biomass fuelled district heating.

The district heating system would require 3 x 75 kW boilers (or pumps in the case of GSHP) and would cost as follows:

- £95,000 for Natural Gas condensing boilers;
- £130,000 for GSHP with horizontal trenches; and
- £150,000 for wood chip or wood pellet boilers.

Each system cost includes the £50,000 cost for the district heating system which is inherent to each. There would be some cost savings as the properties wouldn't need to be individually connected to the gas network. In comparison, the installation of 36 x 10 kW condensing boilers would be likely to cost in excess of £20,000.

Due to the local topography, solar energy generation or wind energy conversion is not viable for Bakewell.

As with **Case studies 1, 2, 5, and 6**, individual installations of renewable technologies in each house would be possible. However, the preferable economics of the district heating systems negates the validity of doing so.

CHP may be suitable for this site. Further investigation would be required in order for this to be validated.

The following table presents the CO_2 emission reductions achievable by each of the relevant technologies if applied on a house by house basis.

Site Ref.	Site Name		% Potential Reduction Biomass	% Potential Reduction GSHP	% Reduction Solar Thermal	% Reduction from Solar PV (1 kW_p)
NP/DDD/0401/163 15th July 2002	Highfield Road, Bakewell	Dwelling	20 - 30	10 - 15	<5	20 - 25

Table 23: Renewable energy CO_2 emission reductions for Highfield Road, Bakewell (NP/DDD/0401/163 15th July 2002)

Summary of Findings: Renewable Energy in Domestic Developments.

As district heating is unlikely to be retrofitted, the opportunity for the installation of a district-heating network can be lost if not included during a development's construction.

District-heating can have enormous financial and environmental benefits whether fuelled with natural gas or a renewable energy source over the entire lifetime of each building it serves. This is especially the case if combined with electricity generation (CHP).

The advantages of installing and managing a district heating network over the installation of individual boilers are:

- Possibility of reduced capital costs;
- Financial return on capital investment;
- Potentially lower energy costs for consumers;
- Reduced CO_2 emissions.

As the district heating pipe-work will last in excess of 50 years, successive centralised heating systems can use the network whilst reflecting technological developments and the relevant 'energy climate'.

For this reason, the feasibility of district heating should be carried out for all new domestic developments consisting of multiple dwellings. Each new domestic development of multiple homes presents a possibly lucrative opportunity for an ESCo.

In the event that district heating is not appropriate for a given development, there are many cost-effective ways to reduce the CO_2 emissions of new residences.

Solar thermal collectors can be integrated into the building fabric of most new homes without causing a visual impact. Such systems can significantly contribute to the heat demand of a home in a cost-effective manner. Provided that a home is designed for a high solar gain and that the collectors are suitably integrated into the roof, there is no reason why Solar Thermal should not be included in a new home.

Individual Biomass boilers and GSHP can reduce the CO_2 emissions from a new home by over 25% and over 10% respectively. Both systems are likely to have reduced running costs in comparison to conventional systems and to payback within their lifetimes.

APPENDIX 3. CARBON CAPTURE

Moorlands and peat covered areas are usually considered as a natural carbon sink as they can actively sequester (or fix) carbon. As the peat forms it locks in carbon, contained in plant matter and prevents it from being released into the atmosphere, thus could have a direct and positive effect through reducing and capturing CO_2 and storing it. Conversely, it has been estimated that drying peat releases as much carbon into the atmosphere each year as the entire transportation system of the UK.

On the other hand, it is evident that there is severe erosion in the peat blanket in those areas, e.g. the Upper North Grain (UNG) is one of the heavily eroding blanket peat catchment in the Peak District. Serious environmental consequences can be expected from the drying and erosion of those areas:

Release of carbon and GHG emissions into the atmosphere thus accelerating the climate change effects. A paper published recently in *Nature* estimated that **80%** of all Carbon losses from the UK soils are derived from moorland peat soils.

The erosion also releases the heavy metals and toxins that were stored in the peat for the last two hundred years due to the industrial revolution industry in the surrounding urban settlements such as Sheffield and Manchester.

An increase in environmental hazards, e.g. fires due to dry conditions; reduced capacity to moderate flooding; loss of biodiversity and a poor countryside access experience. Fires can also be set deliberately on blanket bog as a tool to increase growth in edible plants for livestock or game birds such as grouse.

The study addressed the impact of this issue on the Peaks sub-region and considered a scenario of complete restoration of the moorland for carbon capture, using:

- Re-vegetation of bare peat areas, leading to **40-70%** vegetation within two years and as such stabilising the carbon.
- Grip Blocking, Grips are used to describe the moorland drainage ditches.

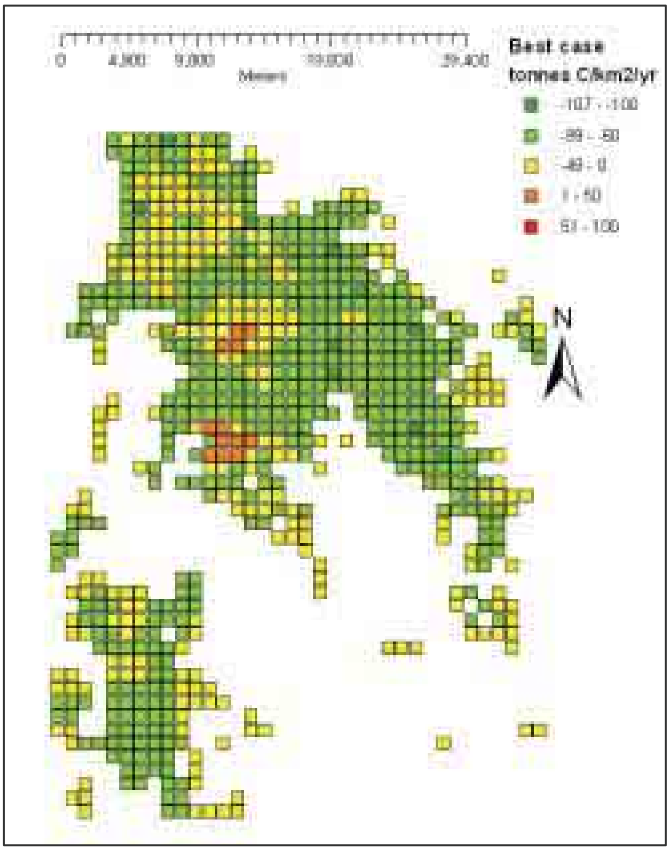


Figure 1 Scenario taken by University of Durham and level of carbon capture[37]

[37] University of Durham- Dept of Earth Science, carbon storage in the peatland presentation

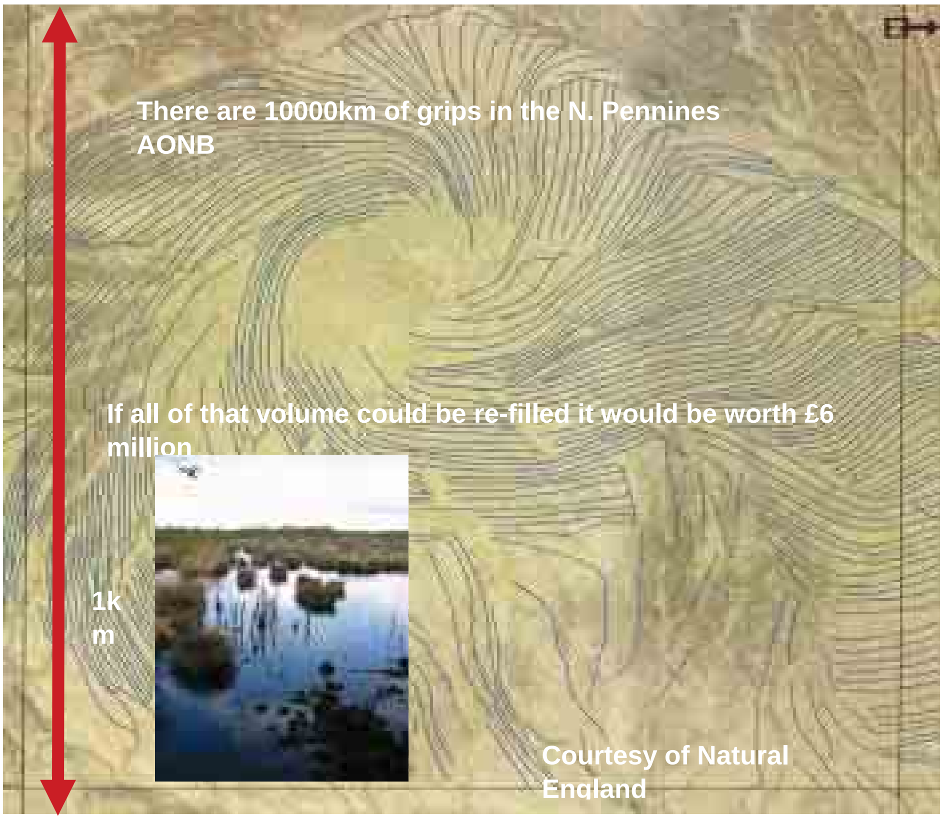


Figure 2 Using existing grips as source base for peat "*re-building* "

Restoration of the Moorland, use of peat in carbon capture:

For this scenario, we used tested modelling method, developed by University of Durham, to estimate the level of carbon capture that a target of **725km^2** of the Peak District National Park could harvest, i.e. after restoration and expansion, taking it up from the current collective coverage area of **462.22 km^2**; see **Figure 5.1**.

Area Authority	Current area of Moorland[38] (Km^2)
Peak District National Park Authority	444.61
High Peak Borough Planning Area	17.44
Derbyshire Dales District Planning Area	Nil

The calculation was forecast for up to 10 years to see the effect the restoration process will have on minimising the level of carbon dioxide emissions in the atmosphere. The total carbon saving of restoration would be **-609 to -1128** tonnes of equivalent CO_2/km^2/yr. This figure is equivalent to taking 240 cars off the roads or generating renewable energy from a 1MW wind turbine for each square kilometre. An added benefit for the planning authority would be to use the process to claim Carbon Credits, as part of the Carbon Reduction Commitment CRC, which currently equals to £25/tonne of equivalent CO_2, compared to £10/tonne of equivalent CO_2 from woodland restoration.

APPENDIX 4. THE RENEWABLES OBLIGATION

The Renewables Obligation (RO) is a Government initiative to encourage more renewable electricity generation. A certificate, known as a **Renewable Obligation Certificate (ROC)**, is issued for each megawatt hour (MWh) of renewable electricity generated. Electricity suppliers need these certificates as they have an obligation to source a specific and annually increasing percentage of the electricity they supply from renewable sources. The current level is 9.1% for 2008/09 rising to 15.4% by 2015/16.

ROCs can be issued on a monthly or yearly basis. The threshold for claiming 1 ROC is 0.5MWh. The renewables obligation is primarily aimed at large scale generation although micro-generators can participate. For example, a 1kW wind turbine may only generate enough electricity to claim 1 or 2 ROCs a year which could be valued as much as £40 or as little £15 per ROC depending on market price. The Government allows micro-generators to participate through an agent who can amalgamate the output of several micro-generators making it more worthwhile for micro-generators to get involved. Renewable energy sources eligible under the Obligation are outlined below.

Eligibility of energy derived from waste

Electricity generating stations that use biomass, energy crops, agricultural waste and forestry material to generate electricity are eligible to claim ROCs. Source: Department for Business Enterprise & Regulatory Reform (BERR) 2008

Sources	Eligibility
Landfill gas	Yes
Sewage gas	Yes
Hydro exceeding 20 MW declared net capacity (dnc)	Only stations commissioned after 1st April 2002
Hydro 20 megawatts or less dnc	Yes
Onshore wind Yes	Yes
Offshore wind Yes	Yes
Co-firing of biomass	Yes. (There are no restrictions on the amount of co-firing a generator can undertake. However, suppliers can only meet 10% of their obligation from co-fired ROCs.)
Other biomass	Yes
Geothermal power Yes	Yes
Tidal and tidal stream power Yes	Yes
Wave power Yes	Yes
Photovoltaics Yes	Yes
Energy crops Yes	Yes

[http://www.berr.gov.uk/whatwedo/energy/sources/renewables/policy/renewables-obligation/what-is-renewables-obligation/page15633.html]

APPENDIX 5. ENERGY STATEMENT

The Energy Statement is to set out the predicted CO_2 emissions of developments and best practice arrangements showing how these can be reduced by at least 10%, through the on-site generation of renewable energy[39]. The energy statement is not meant to provide a comprehensive design analysis on the energy performance of the building, but rather to show the project's compliance to statutory regulation and/or regional or planning authority guideline.

It is for the planning applicant to demonstrate the effectiveness of different renewable technologies to be implemented. Figures should not be presented without context. In order to adequately assess the feasibility of renewable technologies and their contribution to reducing carbon emissions a design process should have been followed.

The Energy Statement should include the following information:

i The energy efficiency of the building
ii The feasibility of CHP and or community heating
iii A list of renewable technologies considered
iv The baseline annual predicted energy demand of the development
v The baseline annual predicted carbon emissions of the development
vi The contribution of each proposed renewable energy technology
vii Cost information of technically feasible renewable technologies
viii A summary of the benefits of renewable energy technologies included
ix The reduction in the development's baseline carbon emissions.

Planning Authorities differ in the way they implement the process, i.e. relevant to the size and complexity of development suggested. The parameters of compliance are also influenced by other relevant issues within the planning authority local development framework and guideline, e.g.

- Relevance to threshold emissions level, when applicable, if building in areas assigned as, e.g. low emission zones, contaminated or strategic air quality areas.
- Code of sustainable homes, in case of residential developments.
- BREEAM standard
- Regional and/or local guideline.
- Planning Authority's guideline of level of contribution from renewable energy to the site's energy demand (in %).

Details of the process can also differ, so where some authorities would require a Provisional or scoping Energy statement when advising on a *potential* large development, before pledging a full energy statement accompanying the complete design and analysis ; this to minimise costs on the developer and allow for changes in the design approach if necessary. Others would only require a one stage Energy statement.

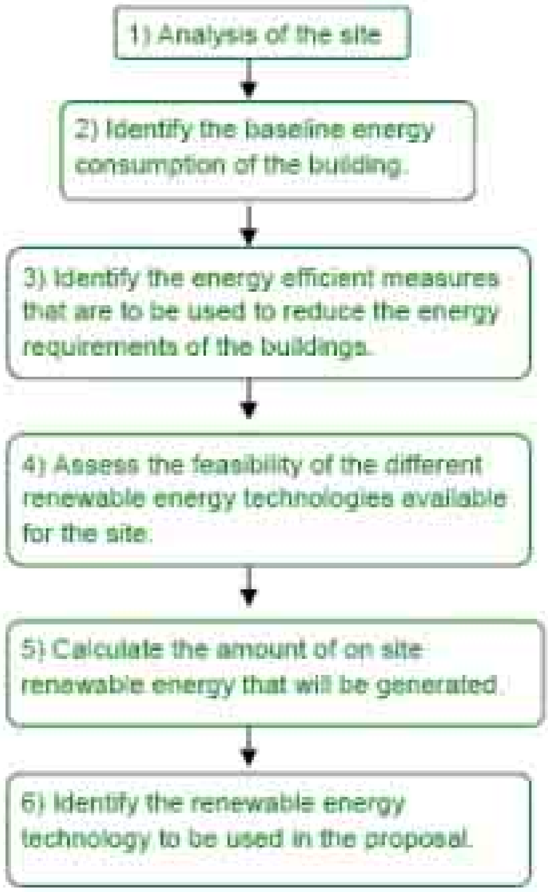
With strategic projects, e.g. Power and Waste management plants, authorities might require a comprehensive energy statement with brief payback analysis for relevant renewable technologies, usually followed by a Post construction Review (PCR) of the development after commissioning, to verify level of compliance to the statement's pledge.

The latter process mirrors the same process followed in BREEAM standards. It also has to account for the threshold requirement for Renewable Energy Contribution and from what source (if there is a list of prioritised technologies), relevant to the specific guideline of the planning Authority's Energy Supplementary Planning Document.

The flow diagram on the following page highlights the key steps in producing an Energy Statement.

[39] This is detailed in the supplement to PPS1 (Delivering Sustainable Development), PPS 22 (Renewable Energy)

Key steps in producing an Energy Statement



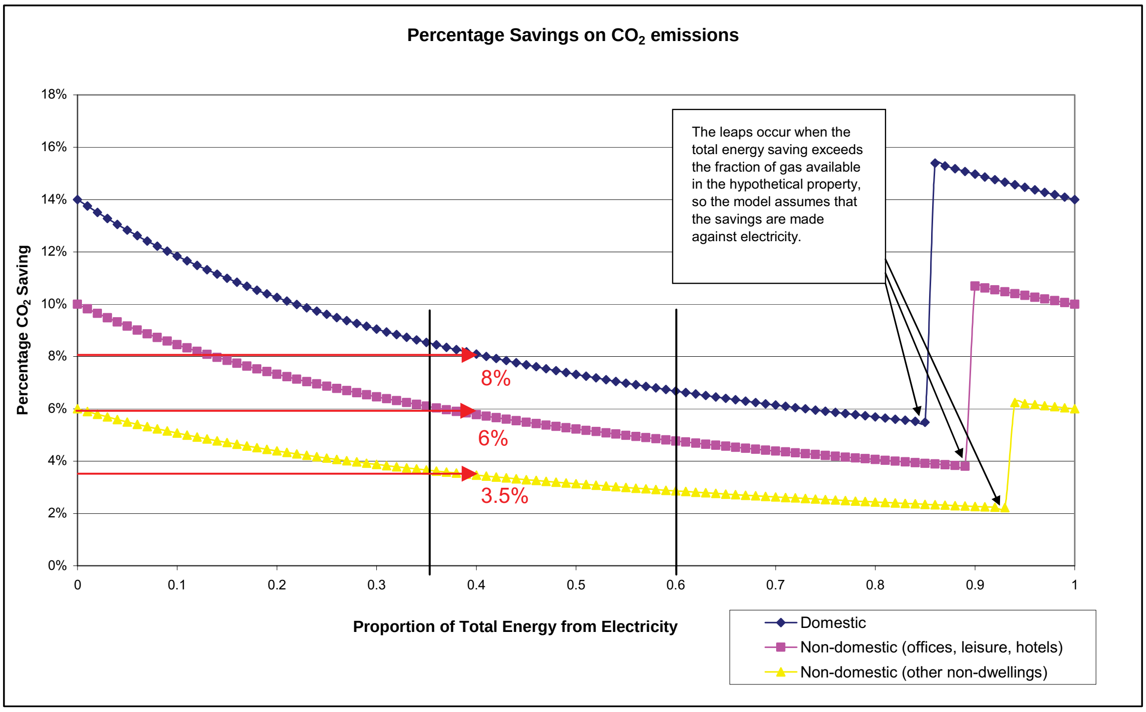
APPENDIX 6. EXISTING RE INSTALLATIONS AND CO_2 TARGETS

The table below shows existing and proposed renewable energy installations in the sub-region.

	Planning_Ref	X_Coord	Y_Coord	Post_code	Technology	Category	Ar	SystemSiz	Energy_k	Status
DDDC	07/00327/FUL	425944	362565	DE4 2LN	Solar thermal	Farm	4	3	1200	
DDDC	06/00943/FUL	428655	359705	DE4 2PA	Wind	Holiday cottage		0.4	185	
DDDC	07/00339/FUL	430476	360130	DE4 3EN	Solar thermal	Residential	##	2.0	782	
DDDC	04/08/0692	429398	357816	DE4 3PW	Solar thermal	Residential	4	3.2	1275	
DDDC	06/00517/FUL	430111	356604	DE4 3RJ	Solar thermal	Residential	3	2.6	1033	
DDDC	07/00772/FUL	428915	361038	DE4 3SE	Solar thermal	Residential	4	3.2	1275	
DDDC	06/00059/FUL	428731	353888	DE4 4DQ	Solar PV	Residential		15.4	1500	
DDDC	06/00059/FUL	428731	353888	DE4 4DQ	Solar thermal	Residential	8	5.8	2310	
DDDC	08/00132/FUL	428492	353952	DE4 4EG	solar thermal	Residential & commercial				
DDDC	06/00427/FUL	432268	360102	DE4 5FJ	Solar thermal	Residential	4	3.2	1275	
DDDC	04/08/0725	431218	361043	DE4 5LB	Solar thermal	Residential	4	3.2	1275	
DDDC	08/00042/FUL	418376	345474	DE6 1HR	Solar thermal	Residential	##	3.7	1461	
DDDC	06/00985/FUL	420404	351056	DE6 1JG	Wind	Farm		5	8040	
DDDC	02/03/0168	420850	350740	DE6 1JL	Wind	Farm		5	7216	
DDDC	06/00568/FUL	418030	345687	DE6 1LH	Solar thermal	Residential	4	3.2	1275	
DDDC	06/00657/FUL	423292	350703	DE6 1PR	Solar thermal	Residential	4	3.2	1275	
DDDC	08/00171/FUL	416631	344727	DE6 2GL	Solar thermal	Residential				
DDDC	07/00599/FUL	421578	340925	DE6 3AR	GSHP	Residential				
DDDC	07/00599/FUL	421578	340925	DE6 3AR	Solar thermal	Residential	4	3.0	1200	
DDDC	07/00419/FUL	421853	341496	DE6 3AW	Solar thermal	Residential	##	3.0	1200	
DDDC	08/00336/FUL	426400	349550	DE6 3JT	Wind	Farm		2	3500	
DDDC	06/00995/FUL	426847	350065	DE6 3JW	Solar thermal	Residential		0.0	1600	
DDDC	07/00346/FUL	426683	350055	DE6 3LH		Residential	4	3.0	1200	
PDNP	NP/SM/1108/0	12906	52536		Biomass	Farm				
PDNP	NP/SM/1108/0	12906	52536		Anaerobic	Farm				
PDNP	NP/SM/1108/0	12906	52536		Solar thermal	Farm				
PDNP		415345	383829	S33 8WB	Biomass - woo	Commercial		50		Operational
PDNP	NP/DDD/0807/(	420107	359316	DE4 2PG	Biomass - woo	Residential				
PDNP		412296	385629	S33 7ZA	GSHP	Commercial		30		Operational
PDNP		414739	363626	SK17 0DG	GSHP	Commercial		15		Operational
PDNP	NP/DDD/1107/'	414658	360194	SK17 0AY	GSHP	Farm		8		Operational
PDNP		414620	378500	SK17 8JE	GSHP	Farm		12		Operational
PDNP	NP/SM/0307/02	410680	359650	SK17	GSHP	Residential		?		Operational
PDNP	NP/DDD/0207/(	421104	361461	DE45 1LN	GSHP	Residential		8		Operational
PDNP - Lady Bower		420050	385450		Hydro	Commercial		200		Operational
PDNP - Hartington Mill		412050	359850		Hydro	commercial		2.5		Operational
PDNP	HPK1098154	402200	397200	SK13 1JT	Hydro	Commercial		150	919800	Operational
PDNP -		405550	398450		Hydro	Commercial		240	1471680	Operational
PDNP - Rhodeswood,Tintwistle,		404250	398150		Hydro	Commercial		240	1471680	Operational
	Outside Natior	441550	334150		Hydro	Commercial		170	1042440	Operational
PDNP - Chatsworth Hse		426030	370174	DE45 1PP	hydro	Commercial		100	288000	Operational
PDNP - Longnor		408760	364675		Hydro	Commercial				Operational
	Outside Natior	434150	352350	DE56 2HE	Hydro	Commercial		240		Operational
PDNP -		401650	375950		Hydro	Commercial		150		Operational
DDDC -		429450	357350	DE4 3PY	Hydro	Commercial		240		Operational
PDNP - Caudwe	NP/DDD/0708/(	423477	366340	DE45 1LA	Hydro	Residential		30	200,000	Proposed
DDDC	DDD0797309	418570	350318	DE6 1LF	Solar PV	Residential		2	1500	
PDNP	NP/SM/0505/05	403622	367902	SK17 0SQ	Solar thermal	Farm		4	1600	
DDDC	DDD0601293	424133	360436	DE4 2DT	Solar thermal	Residential		4	1600	
PDNP	NP/M/0607/049	396517	378042	SK10 5UU	Solar thermal	Residential	5	3.6	1449	
PDNP	NP/DDD/0507/(	424983	372683	DE45 1RR	Solar thermal	Residential	4	3.2	1275	
PDNP	NP/DDD/0307/(	422080	376514	S32 5RG	Solar thermal	Residential	4	3.0	1200	
PDNP	NP/DDD/0407/(	425205	372757	DE45 1ST	Solar thermal	Residential	5	3.6	1449	
PDNP	NP/DDD/1206/'	424999	373529	S32 3XF	Solar thermal	Residential	3	2.2	867	
PDNP	NP/DDD/0107/(	424410	360745	DE4 2DU	Solar thermal	Residential	##	2.3	935	
PDNP	NP/HPK/0107/(	403983	378227	SK23 9UZ	Solar thermal	Residential	4	3.2	1275	
PDNP	NP/HPK/0506/(	418555	383189	S33 6RB	Solar thermal	Residential	6	4.3	1734	
PDNP	NP/DDD/0205/(	409019	367188	SK17 0BS	Solar thermal	Residential		4.0	1600	
PDNP	NP/B/1204/136	415615	402424	S36 4TF	Solar thermal	Residential		4.0	1600	
PDNP	NP/DDD/1204/'	418616	354445	DE6 1QJ	Solar thermal	Residential		4.0	1600	
DDDC	DDD0403159	417531	380833	S33 9GZ	Solar thermal	Residential	4	3.0	1200	
PDNP	NP/DDD/0607/(	424358	374420	S32 3XB	Solar thermal	Residential	6	4.5	1800	
PDNP	NP/DDD/0707/(	416419	375245	SK17 8QU	Solar thermal	Residential	3	2.2	867	
PDNP	NP/DDD/0408/(	421796	376357	S32 5QH	Solar thermal	Residential	3	2.2	867	
PDNP	NP/DDD/0906/(	418889	354443	DE6 1QG	Solar???	Residential			1600	
PDNP	NP/DDD/0705/(	425149	372895	DE45 1SJ	Solar???	Residential			1600	
DDDC	07/00083/FUL	424715	354420	DE4 4HF	Wind	Commercial		10,000	########	Proposed
PDNP	NP/DDD/1205/'	414620	378500	SK17 8JE	Wind	Farm		6	18180	
PDNP	NP/M/0804/086	395085	365887	SK11 0QG	Wind	Farm		5	4100	
PDNP	NP/K/0106/006	408531	409628	HD9 4HW	Wind	Farm		6	8760	
PDNP	NP/DDD/0308/(	418081	362235	DE45 1LY	Wind	Farm		20	30000	
PDNP		414620	378500	SK17 8JE	Wind	Farm		6	12000	
PDNP	NP/HPK/1206/'	413608	385581	S33 7ZE	Wind	Residential		1.5	550	
PDNP	NP/M/0606/058	398827	379697	SK23 7QU	Wind	Residential		1.5	920	
PDNP		415322	375853	SK17 8NE	Wind	School				Proposed
PDNP	NP/S/1004/112	426521	385867	S10 4QZ	Wind			1.5	1930	
PDNP	NP/DDD/0204/(	421925	368955	DE45 1AA	Solar???	Residential				
HP	HPK/2001/0243	404622	393429	SK13 8SH	Solar thermal	Residential		3	1200	Operational
HP	HPK/2006/0944	404070	381156	SK23 9RS	Wind	Farm		6	7960	Operational
HP	HPK/2006/0229	404462	372846	SK17 9AB	Wind	Residential		1.5	620	Operational
HP	HPK/2005/0891	406886	380298		Wind	Residential		1.5	310	Operational
HP	HPK/2008/0527	400093	385236		Hydro	Commercial		70	260000	Installation
HP	HPK/2008/0523	404121	381185	SK23 9RS	Solar thermal	Farm		4	1600	Operational
HP	HPK/2007/0829	404664	375014	SK17 6SS	Wind	Farm		6	16100	Operational

The chart below summarises the findings from the following table which calculates the percentage of CO_2 emissions reductions according to the target of renewable energy recommended by end use.

It is assumed that the fuel being displaced is gas. There is a leap in the chart when the heat:electricity ratio is so low that the model assumes that the energy displaced is electricity.



This chart results directly from the findings of the case studies analysed within this project and shouldn't therefore be used in isolation.

Calculation of CO_2 Emissions Reduction

Elec:Heat Ratio	Heat:Elec Ratio	CO_2 emissions at 100%	CO_2 Saving			CO_2 when Demand at:			CO_2 saving		
X axis			RE @ 14%	RE @ 10%	RE @ 6%	86%	90%	94%	86%	90%	94%
1	0	0.537	0.075	0.054	0.032	0.462	0.483	0.505	14%	10%	6%
0.99	0.01	0.534	0.075	0.054	0.032	0.458	0.480	0.501	14%	10%	6%
0.98	0.02	0.530	0.075	0.054	0.032	0.455	0.476	0.498	14%	10%	6%
0.97	0.03	0.527	0.075	0.054	0.032	0.451	0.473	0.494	14%	10%	6%
0.96	0.04	0.523	0.075	0.054	0.032	0.448	0.469	0.491	14%	10%	6%
0.95	0.05	0.520	0.075	0.054	0.032	0.444	0.466	0.487	14%	10%	6%
0.94	0.06	0.516	0.075	0.054	0.032	0.441	0.462	0.484	15%	10%	6%
0.93	0.07	0.513	0.075	0.054	0.011	0.438	0.459	0.501	15%	10%	2%
0.92	0.08	0.509	0.075	0.054	0.011	0.434	0.456	0.498	15%	11%	2%
0.91	0.09	0.506	0.075	0.054	0.011	0.431	0.452	0.494	15%	11%	2%
0.9	0.1	0.502	0.075	0.054	0.011	0.427	0.449	0.491	15%	11%	2%
0.89	0.11	0.499	0.075	0.019	0.011	0.424	0.480	0.487	15%	4%	2%
0.88	0.12	0.495	0.075	0.019	0.011	0.420	0.476	0.484	15%	4%	2%
0.87	0.13	0.492	0.075	0.019	0.011	0.417	0.473	0.480	15%	4%	2%
0.86	0.14	0.488	0.075	0.019	0.011	0.413	0.469	0.477	15%	4%	2%
0.85	0.15	0.485	0.027	0.019	0.011	0.458	0.466	0.474	5%	4%	2%
0.84	0.16	0.481	0.027	0.019	0.011	0.455	0.462	0.470	6%	4%	2%
0.83	0.17	0.478	0.027	0.019	0.011	0.451	0.459	0.467	6%	4%	2%
0.82	0.18	0.475	0.027	0.019	0.011	0.448	0.456	0.463	6%	4%	2%
0.81	0.19	0.471	0.027	0.019	0.011	0.444	0.452	0.460	6%	4%	2%
0.8	0.2	0.468	0.027	0.019	0.011	0.441	0.449	0.456	6%	4%	2%
0.79	0.21	0.464	0.027	0.019	0.011	0.438	0.445	0.453	6%	4%	2%
0.78	0.22	0.461	0.027	0.019	0.011	0.434	0.442	0.449	6%	4%	2%
0.77	0.23	0.457	0.027	0.019	0.011	0.431	0.438	0.446	6%	4%	2%
0.76	0.24	0.454	0.027	0.019	0.011	0.427	0.435	0.442	6%	4%	3%
0.75	0.25	0.450	0.027	0.019	0.011	0.424	0.431	0.439	6%	4%	3%
0.74	0.26	0.447	0.027	0.019	0.011	0.420	0.428	0.435	6%	4%	3%
0.73	0.27	0.443	0.027	0.019	0.011	0.417	0.424	0.432	6%	4%	3%
0.72	0.28	0.440	0.027	0.019	0.011	0.413	0.421	0.428	6%	4%	3%
0.71	0.29	0.436	0.027	0.019	0.011	0.410	0.417	0.425	6%	4%	3%
0.7	0.3	0.433	0.027	0.019	0.011	0.406	0.414	0.422	6%	4%	3%
0.69	0.31	0.429	0.027	0.019	0.011	0.403	0.410	0.418	6%	4%	3%
0.68	0.32	0.426	0.027	0.019	0.011	0.399	0.407	0.415	6%	4%	3%
0.67	0.33	0.422	0.027	0.019	0.011	0.396	0.403	0.411	6%	4%	3%
0.66	0.34	0.419	0.027	0.019	0.011	0.392	0.400	0.408	6%	5%	3%
0.65	0.35	0.416	0.027	0.019	0.011	0.389	0.397	0.404	6%	5%	3%
0.64	0.36	0.412	0.027	0.019	0.011	0.385	0.393	0.401	6%	5%	3%
0.63	0.37	0.409	0.027	0.019	0.011	0.382	0.390	0.397	7%	5%	3%
0.62	0.38	0.405	0.027	0.019	0.011	0.379	0.386	0.394	7%	5%	3%
0.61	0.39	0.402	0.027	0.019	0.011	0.375	0.383	0.390	7%	5%	3%
0.6	0.4	0.398	0.027	0.019	0.011	0.372	0.379	0.387	7%	5%	3%
0.59	0.41	0.395	0.027	0.019	0.011	0.368	0.376	0.383	7%	5%	3%
0.58	0.42	0.391	0.027	0.019	0.011	0.365	0.372	0.380	7%	5%	3%
0.57	0.43	0.388	0.027	0.019	0.011	0.361	0.369	0.376	7%	5%	3%
0.56	0.44	0.384	0.027	0.019	0.011	0.358	0.365	0.373	7%	5%	3%
0.55	0.45	0.381	0.027	0.019	0.011	0.354	0.362	0.369	7%	5%	3%
0.54	0.46	0.377	0.027	0.019	0.011	0.351	0.358	0.366	7%	5%	3%
0.53	0.47	0.374	0.027	0.019	0.011	0.347	0.355	0.363	7%	5%	3%
0.52	0.48	0.370	0.027	0.019	0.011	0.344	0.351	0.359	7%	5%	3%
0.51	0.49	0.367	0.027	0.019	0.011	0.340	0.348	0.356	7%	5%	3%
0.5	0.5	0.364	0.027	0.019	0.011	0.337	0.345	0.352	7%	5%	3%
0.49	0.51	0.360	0.027	0.019	0.011	0.333	0.341	0.349	7%	5%	3%
0.48	0.52	0.357	0.027	0.019	0.011	0.330	0.338	0.345	7%	5%	3%
0.47	0.53	0.353	0.027	0.019	0.011	0.326	0.334	0.342	8%	5%	3%
0.46	0.54	0.350	0.027	0.019	0.011	0.323	0.331	0.338	8%	5%	3%
0.45	0.55	0.346	0.027	0.019	0.011	0.320	0.327	0.335	8%	5%	3%
0.44	0.56	0.343	0.027	0.019	0.011	0.316	0.324	0.331	8%	6%	3%
0.43	0.57	0.339	0.027	0.019	0.011	0.313	0.320	0.328	8%	6%	3%
0.42	0.58	0.336	0.027	0.019	0.011	0.309	0.317	0.324	8%	6%	3%
0.41	0.59	0.332	0.027	0.019	0.011	0.306	0.313	0.321	8%	6%	3%
0.4	0.6	0.329	0.027	0.019	0.011	0.302	0.310	0.317	8%	6%	3%
0.39	0.61	0.325	0.027	0.019	0.011	0.299	0.306	0.314	8%	6%	4%
0.38	0.62	0.322	0.027	0.019	0.011	0.295	0.303	0.310	8%	6%	4%
0.37	0.63	0.318	0.027	0.019	0.011	0.292	0.299	0.307	8%	6%	4%
0.36	0.64	0.315	0.027	0.019	0.011	0.288	0.296	0.304	8%	6%	4%
0.35	0.65	0.311	0.027	0.019	0.011	0.285	0.292	0.300	9%	6%	4%
0.34	0.66	0.308	0.027	0.019	0.011	0.281	0.289	0.297	9%	6%	4%
0.33	0.67	0.305	0.027	0.019	0.011	0.278	0.286	0.293	9%	6%	4%
0.32	0.68	0.301	0.027	0.019	0.011	0.274	0.282	0.290	9%	6%	4%
0.31	0.69	0.298	0.027	0.019	0.011	0.271	0.279	0.286	9%	6%	4%
0.3	0.7	0.294	0.027	0.019	0.011	0.268	0.275	0.283	9%	6%	4%
0.29	0.71	0.291	0.027	0.019	0.011	0.264	0.272	0.279	9%	7%	4%
0.28	0.72	0.287	0.027	0.019	0.011	0.261	0.268	0.276	9%	7%	4%
0.27	0.73	0.284	0.027	0.019	0.011	0.257	0.265	0.272	9%	7%	4%
0.26	0.74	0.280	0.027	0.019	0.011	0.254	0.261	0.269	9%	7%	4%
0.25	0.75	0.277	0.027	0.019	0.011	0.250	0.258	0.265	10%	7%	4%
0.24	0.76	0.273	0.027	0.019	0.011	0.247	0.254	0.262	10%	7%	4%
0.23	0.77	0.270	0.027	0.019	0.011	0.243	0.251	0.258	10%	7%	4%
0.22	0.78	0.266	0.027	0.019	0.011	0.240	0.247	0.255	10%	7%	4%
0.21	0.79	0.263	0.027	0.019	0.011	0.236	0.244	0.251	10%	7%	4%
0.2	0.8	0.259	0.027	0.019	0.011	0.233	0.240	0.248	10%	7%	4%
0.19	0.81	0.256	0.027	0.019	0.011	0.229	0.237	0.245	10%	7%	4%
0.18	0.82	0.252	0.027	0.019	0.011	0.226	0.233	0.241	11%	8%	5%
0.17	0.83	0.249	0.027	0.019	0.011	0.222	0.230	0.238	11%	8%	5%
0.16	0.84	0.246	0.027	0.019	0.011	0.219	0.227	0.234	11%	8%	5%
0.15	0.85	0.242	0.027	0.019	0.011	0.215	0.223	0.231	11%	8%	5%
0.14	0.86	0.239	0.027	0.019	0.011	0.212	0.220	0.227	11%	8%	5%
0.13	0.87	0.235	0.027	0.019	0.011	0.209	0.216	0.224	11%	8%	5%
0.12	0.88	0.232	0.027	0.019	0.011	0.205	0.213	0.220	11%	8%	5%
0.11	0.89	0.228	0.027	0.019	0.011	0.202	0.209	0.217	12%	8%	5%
0.1	0.9	0.225	0.027	0.019	0.011	0.198	0.206	0.213	12%	8%	5%
0.09	0.91	0.221	0.027	0.019	0.011	0.195	0.202	0.210	12%	9%	5%
0.08	0.92	0.218	0.027	0.019	0.011	0.191	0.199	0.206	12%	9%	5%
0.07	0.93	0.214	0.027	0.019	0.011	0.188	0.195	0.203	12%	9%	5%
0.06	0.94	0.211	0.027	0.019	0.011	0.184	0.192	0.199	13%	9%	5%
0.05	0.95	0.207	0.027	0.019	0.011	0.181	0.188	0.196	13%	9%	5%
0.04	0.96	0.204	0.027	0.019	0.011	0.177	0.185	0.192	13%	9%	6%
0.03	0.97	0.200	0.027	0.019	0.011	0.174	0.181	0.189	13%	9%	6%
0.02	0.98	0.197	0.027	0.019	0.011	0.170	0.178	0.186	14%	10%	6%
0.01	0.99	0.193	0.027	0.019	0.011	0.167	0.174	0.182	14%	10%	6%
0	1	0.190	0.027	0.019	0.011	0.163	0.171	0.179	14%	10%	6%

Assumes gas being displaced (yellow)

Assumes electricity being displaced (purple)