High Weald Area of Outstanding Natural Beauty

Energy Use & Generation Audit

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TV Energy

HIGH WEALD JOINT ADVISORY COMMITTEE

HIGH WEALD AREA of OUTSTANDING NATURAL BEAUTY

This report has been prepared by TV Energy Ltd for the High Weald Area of Outstanding Natural Beauty Unit. Report reference TVR186.

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EXECUTIVE SUMMARY

This report has been commissioned by the High Weald AONB Unit and its purpose is to understand energy generation & consumption in relation to achieving a low carbon economy within the designated area of the High Weald AONB.

An explanation and comparison of energy terminology and units has been provided, along with a comparison of various renewable and low carbon energy technologies with conventional power generation in terms of output capacity and annual generation. Tables of figures, graphs and explanatory notes can be found in sections 2.1 and 2.2 of the main report.

Applying the methodology contained within the report 'Review of Renewable and Decentralised Energy Potential in SE England' commissioned by the Southeast England Partnership Board in 2009 to the designated area, and including information contained within the report 'Wind Energy Regional Assessment' commissioned by the High Weald AONB Unit in 2009 along with a number of example interpretations, the following table provides a quantified assessment of the potential for renewable energy capacity and annual generation within the High Weald AONB.

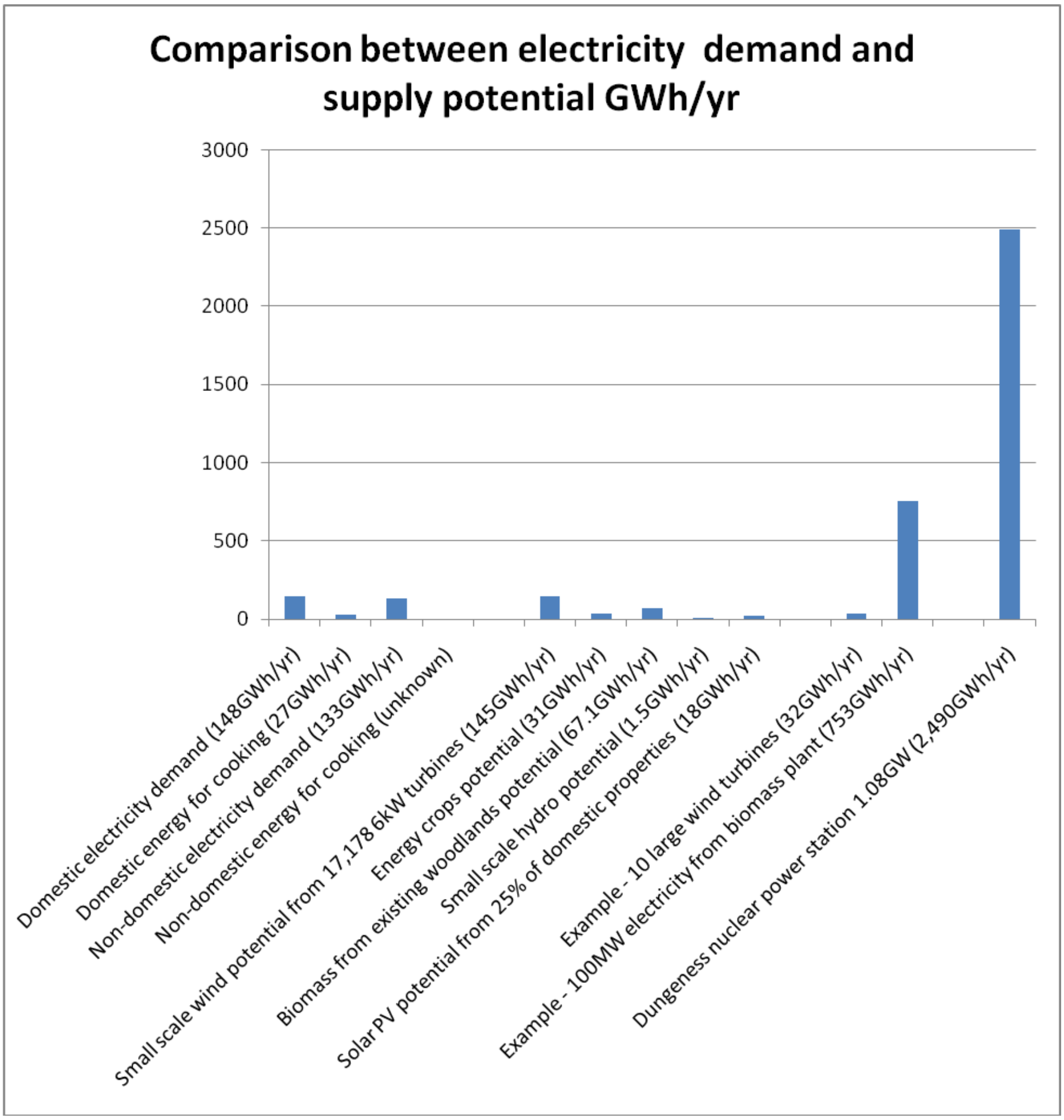
	Electricity		Heat		
Renewable & low carbon energy technology	Energy plant capacity	Annual energy generated	Energy plant capacity	Annual energy generated	Notes
	MW	GWh/yr	MW	GWh/yr	
Wind power					
Large scale	unknown	unknown			Not quantified within the HW AONB 'Wind Energy Regional Assessment' report
Small scale	103.1	144.5			Application to the domestic sector only, 17,178 6kW turbines
Example of large scale wind turbine deployment	20	32			10 large wind turbines @2MW each
Biomass					
Energy crops	4.2	31.4	54.2	95.0	Based on potential resource within HW AONB. Electricity and heat figures as alternatives
Existing woodland	8.9	67.1	125.4	219.8	Based on potential resource within HW AONB. Electricity and heat figures as alternatives
Example of large scale electricity generation	100	753.4			100MW plant would require approx 900,000tonnes/yr of woodchip @30%MC
Example of non-domestic heat application			4.5	8.0	Using estimated heat demand for the 100 schools within the HW AONB
Hydro	0.3	1.5			Environment Agency methodology
Solar					
PV	22.9	18.1			Application to the domestic sector only, 25% of total properties
Thermal			22.9	10.1	Application to the domestic sector only, 25% of total properties
Heat pumps			unknown	unknown	Methodology not defined

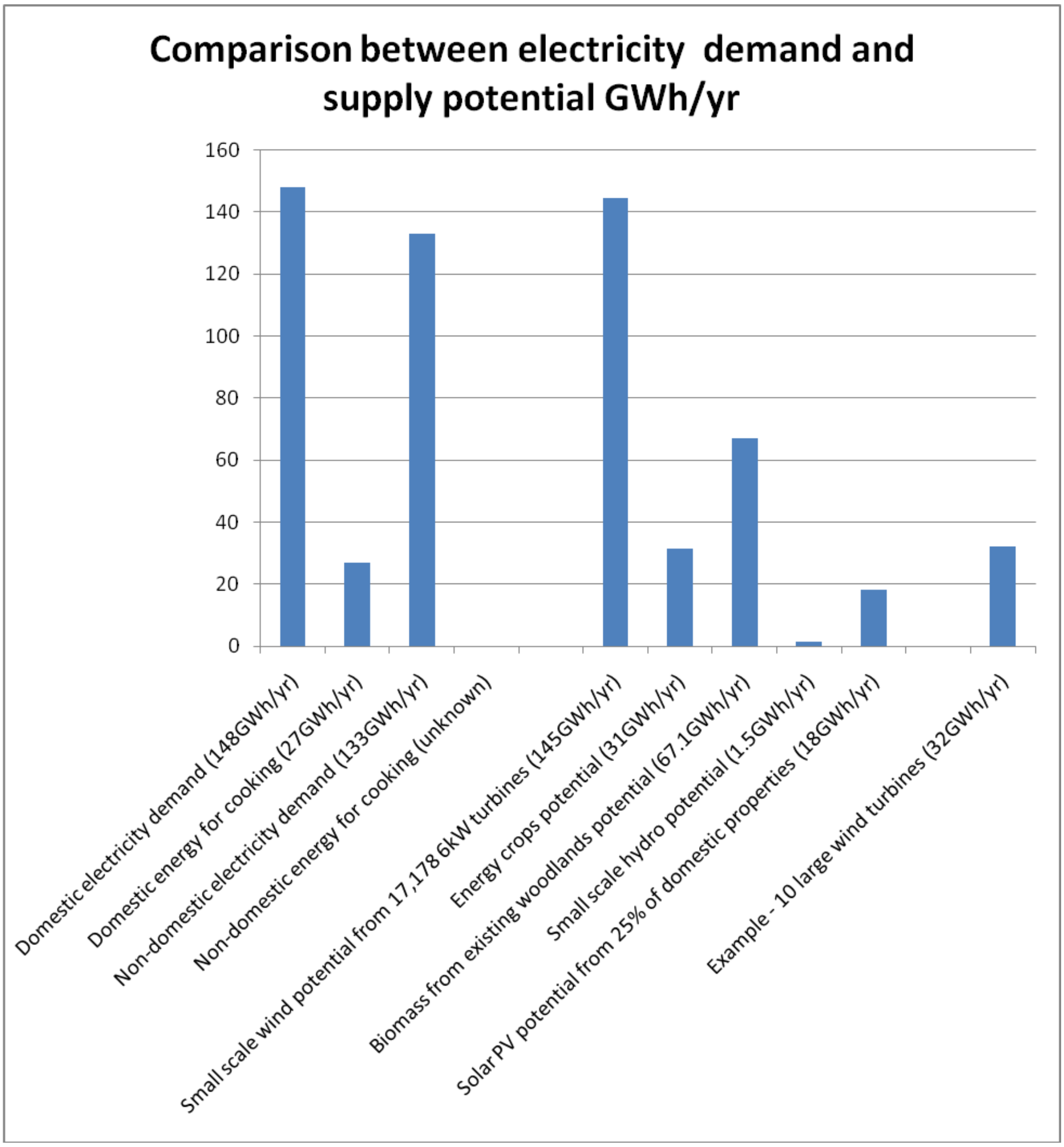
The results of the assessment of renewable energy potential represent the 'accessible resource' i.e. the total amount of potential that is theoretically available. They do not represent what could be practically achieved and delivered within designated area. Further assumptions and scenario testing would need to be undertaken to refine the results i.e. considering deployment, supply chain and planning constraints and opportunities.

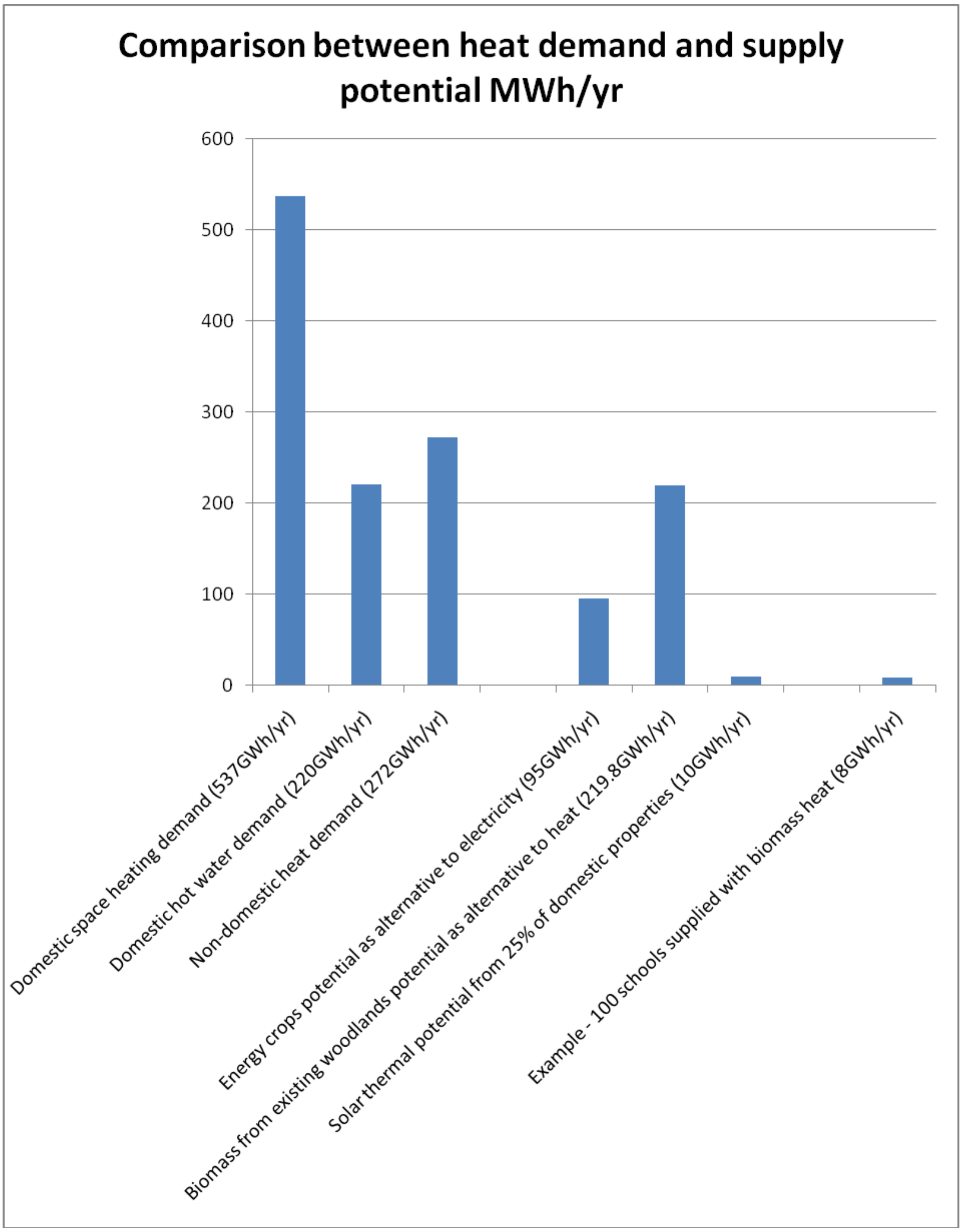
An assessment of energy consumption within the High Weald AONB in relation to the built environment using publically available energy statistics is shown below.

	Electricity	Space heating	Hot water	Cooking/ catering	Notes
	GWh/yr	GWh/yr	GWh/yr	GWh/yr	
Domestic energy consumption	148	537	220	27	As applied to the 45,888 dwellings within the HW AONB
Non-domestic energy consumption	133	272		unknown	Interpreting MSOA data
Totals	**281**	**1029**		unknown	

Graphs showing comparisons between energy supply and demand figures are as follows.




Comparison between electricity demand and supply potential GWh/yr
160
140
120
100
80
60
40
20
0
Domestic electricity demand (148GWh/yr)
Domestic energy for cooking (27GWh/yr)
Non-domestic electricity demand (133GWh/yr)
Non-domestic energy for cooking (unknown)
Small scale wind potential from 17,178 6kW turbines (145GWh/yr)
Energy crops potential (31GWh/yr)
Biomass from existing woodlands potential (67.1GWh/yr)
Small scale hydro potential (1.5GWh/yr)
Solar PV potential from 25% of domestic properties (18GWh/yr)
Example - 10 large wind turbines (32GWh/yr)



The potential electricity generation from small scale wind turbines within the domestic sector is very similar to domestic electricity consumption, and is around 4 times the potential electricity generated by solar PV systems. There is uncertainty over the practical potential for small scale wind, when considering planning, local available wind resource and long term operation of the technology. In the case of solar hot water, energy consumption is over 20 times the potential generation for this technology. It should be noted that the DECC methodology is likely to underestimate the total potential from solar thermal, given that this technology typically provides 50% of annual hot water needs, in this translating to a figure of 12.5% of total demand, given that the potential is based upon 25% of the housing stock providing suitable roof orientation.

The potential for large scale wind turbines is unknown, however given the summary statement within the Wind Energy Regional Assessment the likelihood of there being more than a handful of single turbines hosted by non-domestic energy consumers, or clusters of turbines, is considered to be small. To allow a comparison to be made and as an example, 10 large turbines of 2MW capacity each would generate the equivalent of around 20% of domestic electricity consumption, or 10% of total electricity consumption per year.

In the case of energy crops and biomass from existing woodlands, the potential for heat generation is nearly 40 times the estimated energy demand from the 100 schools within the area.

A 100MW electricity generating plant would have an annual output of 5 times domestic electricity consumption and would require around 900,000tonnes of woody biomass at 30% moisture content per year. This compares with the potential annual available tonnage from energy crops from available land in the High Weald AONB of 25,000odt (35,500tonnes @30%MC) and 50% of the potential annual timber resource from existing woodlands which might be directed towards energy production of around 53,000odt (75,500tonnes @30%MC).

Combining the potential for domestic small scale wind turbines, domestic solar PV systems, hydro schemes and the allowing for 10 large wind turbines the total electricity generation potential is 195.6GWh/yr. This does not include any potential for additional small scale wind turbines outside of the domestic sector, solar PV systems installed on non-domestic buildings or solar PV farms. The potential for electricity generation from biomass is not included for reasons of inefficiency of resource use, uncertainty of the technology as CHP at small (building integrated) scale and the requirement for significant import quantities at large scale. Locally available biomass is more likely to be used (and used more efficiently) in heat applications within areas off the mains gas grid. The total electricity consumption associated with domestic and non domestic buildings is 281GWh/yr. Based on these figures the potential for renewable electricity generation is 69.6% of total annual electricity consumption. The assessment of potential assumes sufficient capacity could be made available through reinforcement at the local distribution grid level to enable generators to connect and feed power to local loads as well as the wider network safely and efficiently.

The potential for renewable and low carbon heat includes contributions from biomass, solar thermal systems and heat pumps. Quantifying the application of biomass based on resources present within the designated area is uncertain due to the difficulties of disaggregation of data within designated areas, and in any case the potential at small scale will be determined in practice by local heat demand. Including the figures for heat available from the combustion of biomass as energy crops and timber from existing woodland, combined with hot water from domestic solar thermal systems the total heat generation potential is 324.9GWh/yr. This does not include any contributions from heat pumps, this is likely to be small due to limitations in application and in any case has limited carbon saving potential. The total heat consumption associated with domestic and non domestic buildings is 1,029GWh/yr. Based on these figures the potential for renewable heat generation is 31.6% of total annual heat consumption. Clearly a significant shortfall in renewable heat supply exists, an intensive programme of energy efficiency measures implemented within the existing building stock would help in providing a closer balance between supply and demand.

It is clear that there is a significant potential for the generation of renewable energy as electricity and heat within the High Weald AONB. This can be achieved by using a range of technologies appropriate to the characteristics of the landscape and buildings within the area, although it is appreciated that in practice some may be more challenging to implement at scale than others. The highest potential for roll-out of renewable energy technologies at a local building-integrated level is likely to be roof mounted solar PV and solar thermal systems, and biomass boilers/ stoves. A high deployment of small scale wind turbines can in theory provide a significant contribution to total electricity demand, large wind turbines have greater potential energy output however opportunities for deployment are likely to be more limited. The potential for electricity generated from hydro sites in the area is small. Additionally there is likely to be potential for electricity generated by large scale solar PV farms although this has not been specifically assessed within the report.

The following recommendations are put forward in order to further develop the picture of renewable energy generation and energy consumption within the High Weald AONB:

1. Quantify the potential for commercial scale wind turbines through further development of the methodology used within the existing Wind Energy Regional Assessment report
2. Carry out an assessment of capacity of the local electricity distribution grid at one or a number of potential points of interest within the area in order to understand the potential implications of grid connection of renewable energy generation above building integrated scale (eg. large wind turbines, solar PV farms)
3. Provide more accurate estimates of energy consumption for the non-domestic sector through interpretation of OS Address Layer 2 and other searches
4. Provide an assessment of solar thermal, solar PV and small wind turbine potential within the non-domestic sector based on searches carried out in 3 above
5. Provide a more accurate assessment of domestic solar thermal and PV potential based on desktop searches of the area
6. Provide an assessment of potential for heat pump technology using a methodology appropriate to the area
7. Assess the potential for local supply of existing woody biomass resources into the area with particular reference to the potential use for heat for schools and other public sector buildings in order to stimulate uptake
8. Quantify the potential heat demand from non-domestic buildings which could be supplied from woody biomass sources, and compare with the total available local resource
9. Quantify current levels of renewable energy capacity and generation through the use of SEE-Stats and other searches

1 INTRODUCTION

This report has been commissioned by the High Weald Area of Outstanding Natural Beauty (AONB) Unit. The purpose is to understand energy generation & consumption in relation to achieving a low carbon economy within the High Weald AONB. Specifically this includes an explanation and comparison of energy terminology and units, a comparison of various renewable and low carbon energy technologies with conventional power generation in terms of output capacity and generation, an assessment of renewable energy potential and an assessment of energy consumption within the area in relation to the built environment.

The EU Renewable Energy Directive obliges the UK to provide 15% of overall energy consumption from renewable sources by 2020. The Government's Renewable Energy Strategy published in July 2009 envisages that this target should be implemented through 30% of electricity, 12% of heat and 10% of transport energy coming from renewable sources.

The Climate Change Act 2008 requires the UK to achieve at least an 80% cut in greenhouse gas emissions by 2050 and a 34% reduction by 2020 (26% reduction in CO_2 emissions), against a 1990 baseline.

These national targets help provide the context for renewable energy generation and greenhouse gas emissions reductions for a subdivided area such as the High Weald AONB and can assist with future planning and policy in these areas.

2 TECHNICAL ANALYSIS

2.1 *Energy Units of Measurement*

2.1.1 Energy in SI Units at Various Scales

The following table provides factors to compare energy figures as standard SI units at various scales, with reference to energy plant capacity and energy generated or consumed.

Table to compare energy plant capacity with energy generation at small, medium and large scale

	Small scale	Medium scale	Large scale
Energy plant capacity (rate of generation)	To convert from kW (kiloWatts) to:	MW (MegaWatts)	GW (GigaWatts)
		Multiply by 1,000	Multiply by 1,000,000
Energy generated or consumed (quantity over a period)	To convert from kWh (kiloWatt-hours) to:	MWh (MegaWatt-hours)	GWh (GigaWatt-hours)
		Multiply by 1,000	Multiply by 1,000,000
Example: A 1.0MW capacity energy plant operating at its maximum rated output for 2000hours will generate 2000MWh			

The capacity of energy generating plant installed as building integrated systems is usually measured in kW (kiloWatts). Larger systems which supply a number of buildings or are connected to the electricity distribution grid in the case of wind or solar farms have output capacity typically measured in MW (MegaWatts). Very large capacity central power stations supplying electricity to the transmission network at 275 or 400kV are measured in GW (GigaWatts).

2.1.2 Conversion from Imperial and Non-SI Units to SI Units

The following table provides factors to convert from imperial units typically encountered quantifying energy plant capacity into standard SI (Systeme International) units.

Table to convert units typically encountered into SI units

Energy plant capacity	Apply the factor below to convert to SI units		
Energy unit	Function	Factor	SI units
Btu/hr (heat flow rate)	divide by	3,412	kW
	divide by	3,412,000	MW
	divide by	3,412,000,000	GW
Horsepower	divide by	1.341	kW
	divide by	1,341	MW
	divide by	1,341,000	GW
Tons (heat flow rate, refrigeration)	divide by	0.317	kW
	divide by	317	MW
	divide by	317,000	GW

Oil fired boilers, for example are often still classed in Btu/hr.

The following table provides factors to enable conversion from imperial and metric units typically encountered quantifying energy generated or consumed into standard SI units.

Table to convert units typically encountered into SI units			
Energy generated or consumed	Apply the factor below to convert to SI units		
Energy unit	Function	Factor	SI units
Btu	divide by	3,412	kWh
	divide by	3,412,000	MWh
	divide by	3,412,000,000	GWh
Therm	divide by	0.03412	kWh
	divide by	34.12	MWh
	divide by	34,120	GWh
Tonnes of oil equivalent (toe)	multiply by	11,630	kWh
	multiply by	11.63	MWh
	multiply by	0.01163	GWh
MJ (MegaJoules)	divide by	3.6	kWh
	divide by	3,600	MWh
	divide by	3,600,000	GWh
GJ (GigaJoules)	divide by	0.0036	kWh
	divide by	3.6	MWh
	divide by	3,600	GWh

2.2 *Energy Plant Capacity & Annual Generation – Technology Comparisons*

The following table provides a comparison of energy plant capacity and typical annual energy generation for various renewable, low carbon and conventional energy technologies.

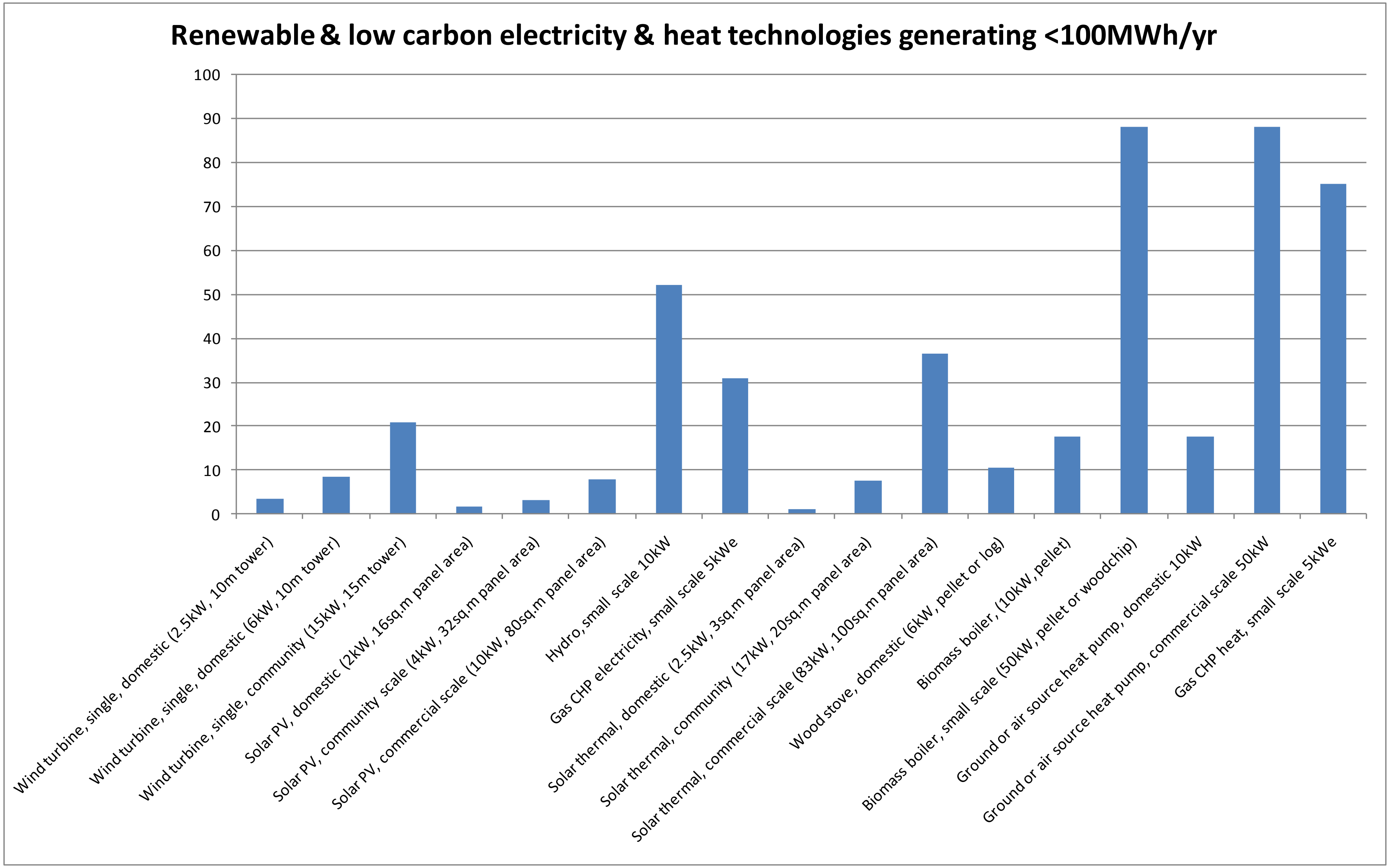
Table to compare renewable & low carbon energy technologies with conventional technologies at various scales

Energy generating technology	Energy plant capacity				Typical annual energy generated					
	Electricity		Heat		Electricity			Heat		
	kW	MW	kW	MW	kWh/yr	MWh/yr	GWh/yr	kWh/yr	MWh/yr	GWh/yr
RENEWABLE ENERGY										
Wind turbines										
Domestic microgeneration, single (10m tower)	2.5				3,500					
Domestic microgeneration, single (10m tower)	6				8,500					
Community scale, single (20m tower)	15				21,000	21				
Commercial scale, single (80m tower)		2				3,200	3.2			
Wind cluster (5 turbines)		10				16,000	16			
Small wind farm (10 turbines)		20				31,500	31.5			
Large wind farm (25 turbines)		50				79,000	79			
Solar photovoltaics (PV)										
Domestic microgeneration (16sq.m panel area)	2				1,600					
Community scale (32sq.m panel area)	4				3,200	3.2				
Commercial scale (80sq.m panel area)	10				8,000	8.0				
Solar farm, freestanding (16000sq.m panel area)		2				1,600	1.6			
Solar thermal (hot water)										
Domestic microgeneration (3sq.m panel area)			2.5					1,100	1.1	
Community scale (20sq.m panel area)			17					7,500	7.5	
Commercial scale (100sq.m panel area)			83					36,500	36.5	
Biomass (woody, clean)										
Stove, domestic microgeneration (pellet or log)			6					10,500	10.5	
Boiler, domestic microgeneration (pellet)			10					17,500	17.5	
Boiler, small scale (pellet or woodchip)			50					88,000	88	
Boiler, medium scale (pellet or woodchip)			500						880	
Boiler, large scale (woodchip)			2,000	2					3,500	3.5
CHP, small scale (woodchip)	25		75		123,000	123			370	
CHP, medium scale (woodchip)	500		1,500			2,500	2.5		7,500	7.5
CHP, large scale (woodchip)		5		15		25,000	25		75,000	75
Electricity only, medium scale (woodchip)		50					375			
Electricity only, large scale (woodchip)		100					750			
Co-firing, typical 5% (ground)		50				210,000	210			
Biomass (waste)										
Landfill gas, typical		2				11,400	11.4			
Biogas/ sewage gas	500	1				1,900	1.9			
Energy from Waste (MSW)		10		11		38,500	38.5		42,500	42.5
Hydro										
Small scale, microgeneration	10				52,000	52				
Medium scale	200					1,000	1			
LOW CARBON ENERGY										
Heat pumps										
Air source, domestic microgeneration			10					17,500	17.5	
Ground source, domestic microgeneration			10					17,500	17.5	
Air source, commercial scale			50					88,000	88	
Ground source, commercial scale			50					88,000	88	
Gas CHP										
Small scale, microgeneration	5		12		31,000			75,000		
Medium scale	250		350			1,600	2		2,200	2.2
Large scale		5		7		31,000	31		43,400	43.4
CONVENTIONAL ENERGY										
Power Stations										
Dungeness nuclear power station		1,080					2,490			
Kingsnorth coal fired power station		1,940					7,232			
Damhead Creek gas fired (CCGT) power station		792					5,889			

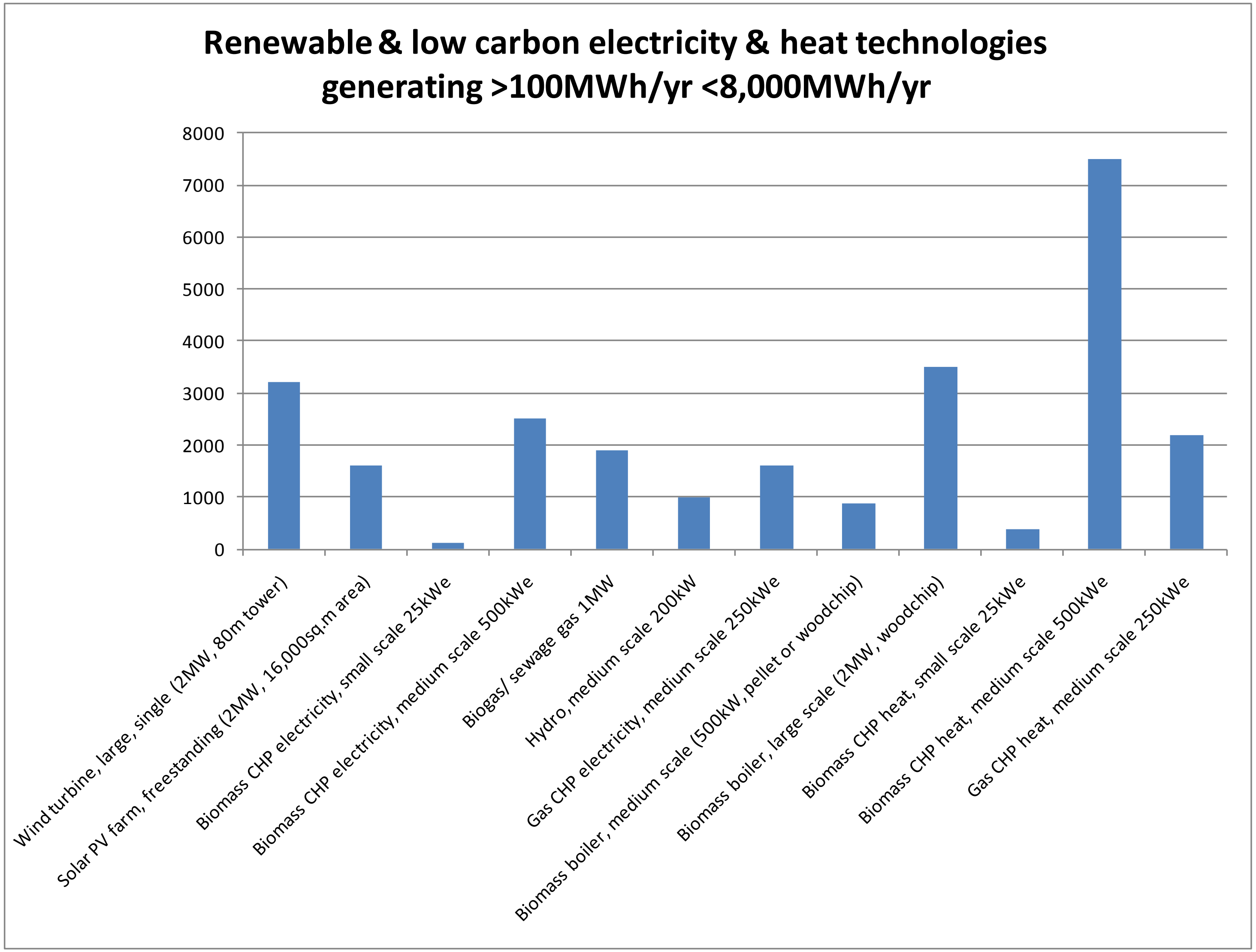
CHP = combined heat & power
MSW = municipal solid waste
CCGT = combined cycle gas turbine

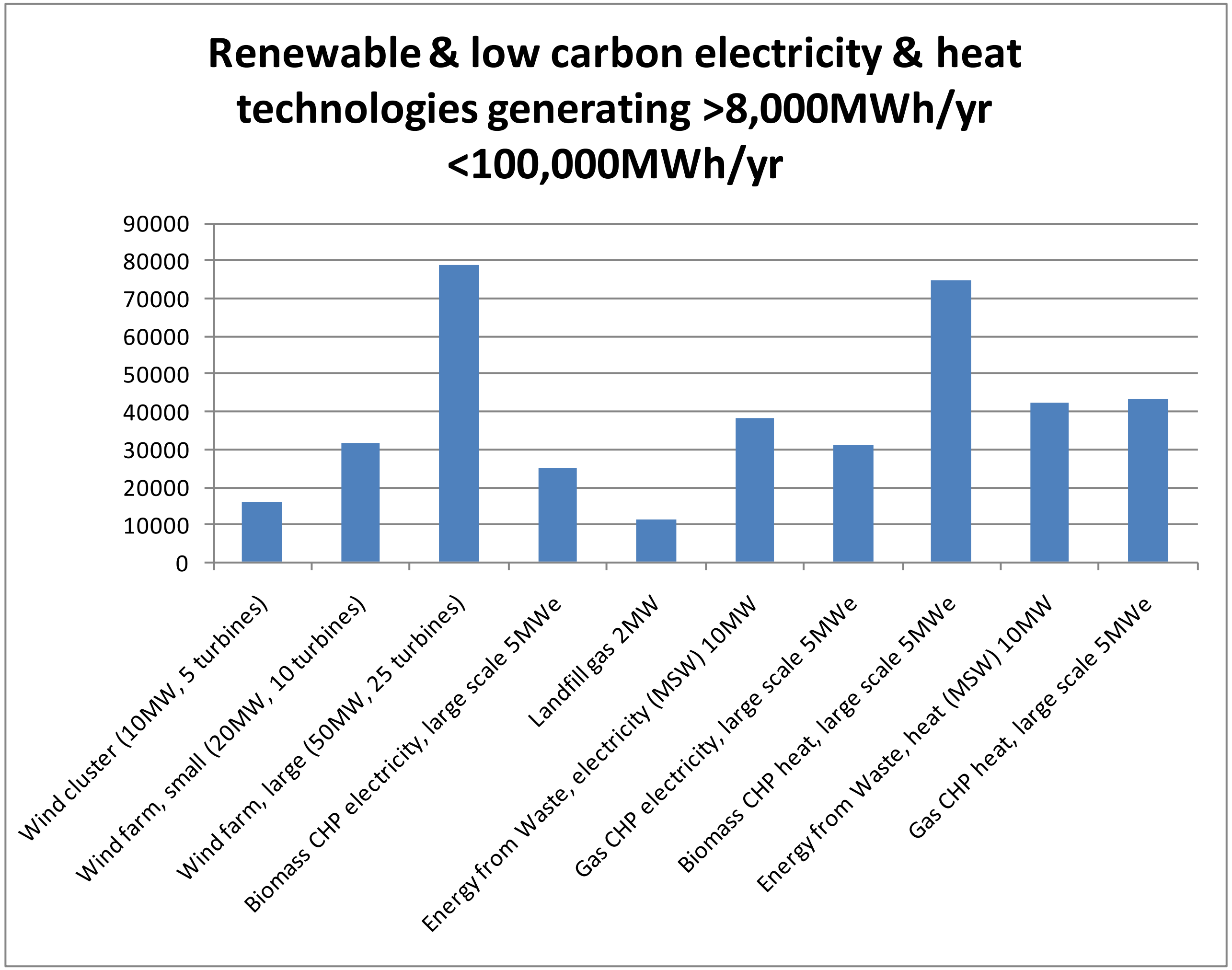
The table includes various onshore-based technologies at various scales, including power stations of relevance to the High Weald AONB.

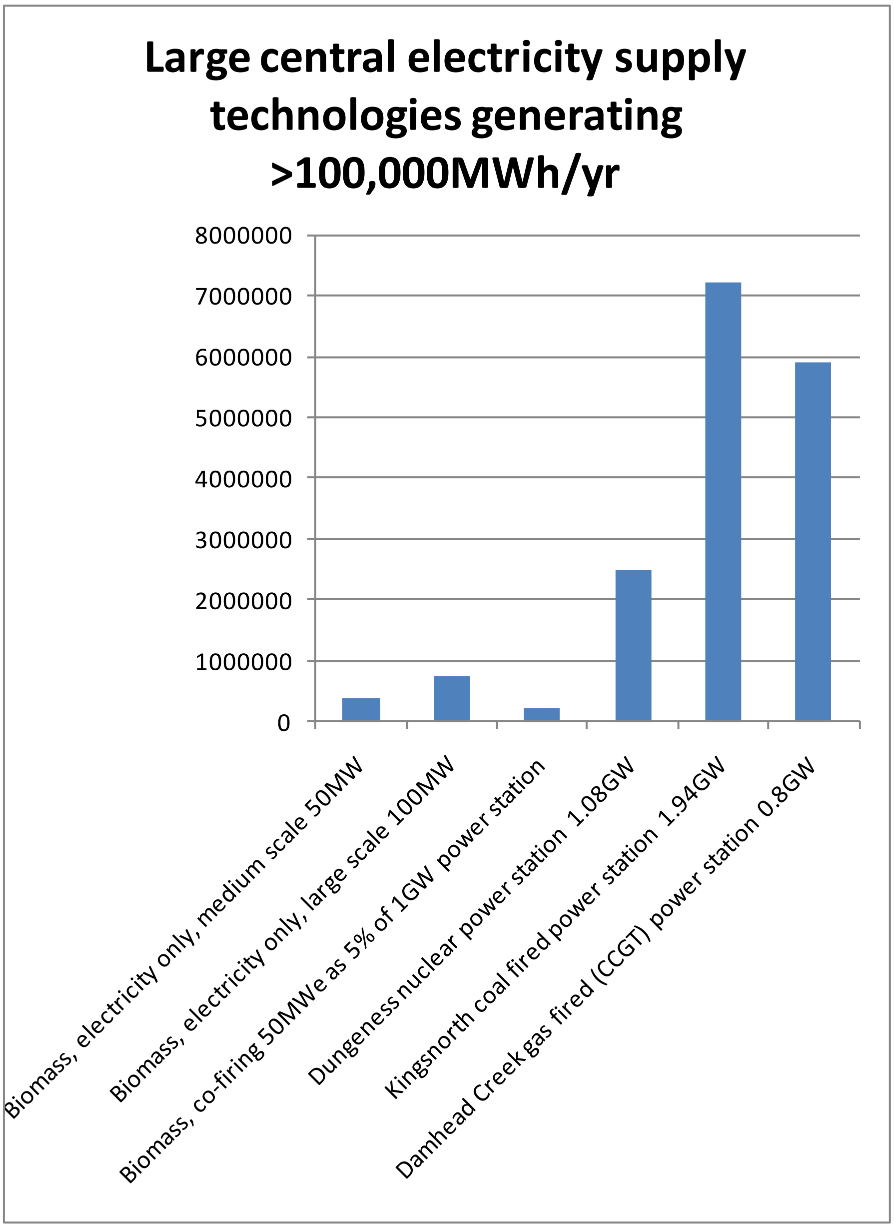
The following graphs provide a simple comparison of annual energy output between individual technologies, split between scales of output.



Renewable & low carbon electricity & heat technologies generating <100MWh/yr
100
90
80
70
60
50
40
30
20
10
0
Wind turbine, single, domestic (2.5kW, 10m tower)
Wind turbine, single, domestic (6kW, 10m tower)
Wind turbine, single, community (15kW, 15m tower)
Solar PV, domestic (2kW, 16sq.m panel area)
Solar PV, community scale (4kW, 32sq.m panel area)
Solar PV, commercial scale (10kW, 80sq.m panel area)
Hydro, small scale 10kW
Gas CHP electricity, small scale 5kWe
Solar thermal, domestic (2.5kW, 3sq.m panel area)
Solar thermal, community (17kW, 20sq.m panel area)
Solar thermal, commercial scale (83kW, 100sq.m panel area)
Wood stove, domestic (6kW, pellet or log)
Biomass boiler, (10kW, pellet)
Biomass boiler, small scale (50kW, pellet or woodchip)
Ground or air source heat pump, domestic 10kW
Ground or air source heat pump, commercial scale 50kW
Gas CHP heat, small scale 5kWe


Renewable & low carbon electricity & heat technologies generating >100MWh/yr <8,000MWh/yr
8000
7000
6000
5000
4000
3000
2000
1000
0
Wind turbine, large, single (2MW, 80m tower)
Solar PV farm, freestanding (2MW, 16,000sq.m area)
Biomass CHP electricity, small scale 25kWe
Biomass CHP electricity, medium scale 500kWe
Biogas/ sewage gas 1MW
Hydro, medium scale 200kW
Gas CHP electricity, medium scale 250kWe
Biomass boiler, medium scale (500kW, pellet or woodchip)
Biomass boiler, large scale (2MW, woodchip)
Biomass CHP heat, small scale 25kWe
Biomass CHP heat, medium scale 500kWe
Gas CHP heat, medium scale 250kWe


Renewable & low carbon electricity & heat technologies generating >8,000MWh/yr <100,000MWh/yr
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Wind cluster (10MW, 5 turbines)
Wind farm, small (20MW, 10 turbines)
Wind farm, large (50MW, 25 turbines)
Biomass CHP electricity, large scale 5MWe
Landfill gas 2MW
Energy from Waste, electricity (MSW) 10MW
Gas CHP electricity, large scale 5MWe
Biomass CHP heat, large scale 5MWe
Energy from Waste, heat (MSW) 10MW
Gas CHP heat, large scale 5MWe



For renewable and low carbon energy technologies, comparisons can be made based on the size and energy output appropriate for domestic properties, as well as for larger non-domestic buildings and groups of buildings in the case of larger biomass boilers and CHP applications.

It should be noted that for each technology, the energy output figures are typical and are a function of the number of hours of operation of the generator per year at equivalent maximum output. This is determined by the capacity factor, dependent upon:

- Local availability of energy resource for the generator in question, for example average windspeed, solar irradiation, average rainfall within the catchment, tonnage of waste
- Local heat demand in the case of boilers, solar thermal systems, heat pumps and CHP (Combined Heat & Power) plants
- Electricity demand in the case of central power stations

- Economic factors in relation to the UK electricity market

The relationship between energy plant capacity and annual energy generated is defined as follows:

Annual energy generated = **energy plant capacity** x **capacity factor** x **8766hrs/yr**

The energy output figures shown in the above table are based on the capacity factors used in the report 'Review of Renewable and Decentralised Energy Potential in SE England' commissioned by the Southeast England Partnership Board. This is the most recent report providing an assessment of renewable energy resource and potential within the southeast region, based on the Department for Energy & Climate Change (DECC) methodology (Renewable and Low Carbon Capacity Assessment Methodology: the English Regions 2010) and for the most part will be used as the baseline to determine renewable energy resource for the High Weald AONB. In the case of renewable and low carbon technologies the capacity factor for each technology used is an average figure and may not be representative of any particular application within the High Weald. The annual electricity outputs of the three centralised power stations shown are actual figures for 2009.

2.3 *Renewable Energy Potential within the High Weald AONB*

The following section provides a broad quantitative assessment of the potential for renewable energy uptake within the High Weald AONB. This assessment has been based on a review of data and results contained within the Review of Renewable and Decentralised Energy Potential Within Southeast England report commissioned by the Southeast England Partnership Board and jointly provided by Land Use Consultants and TV Energy in August 2010. Also included are the findings of the Wind Energy Regional Assessment report commissioned by the High Weald Joint Advisory Committee and provided by the Digital Landscape Co-operative in May 2009.

The Review of Renewable and Decentralised Energy Potential Within Southeast England report is a resource based assessment based on DECC methodology (Renewable and Low Carbon Capacity Assessment Methodology: the English Regions 2010). Within designated areas the DECC methodology requires that separate assessments should be undertaken of the potential for renewable energy deployment. Natural England state that designated areas such as AONBs should be included in the overall renewable energy assessment, and the study considered this where possible and appropriate. It was considered that the development of commercial & small scale wind turbines and energy crops were most likely to affect the purposes and special qualities of designated areas, and that revised assumptions agreed with Natural England were applied as separate assessments. The methodology within the report provided technology specific resource data for wind turbines, energy crops and hydropower within designated areas. For other technologies it was not possible to disaggregate the data between designated and undesignated areas and therefore the potential for the High Weald AONB is incomplete in this respect. The exception to this is in respect of solar technologies and biomass resources available from existing woodland. The DECC methodology for solar technologies can be applied to the domestic sector where the total number of residential properties located within the High Weald is known, as is in this case. The High Weald Woodlands Carbon Report commissioned by the High Weald Joint Advisory Committee in 2010 provides figures for current and future sustainable timber production volumes for the High Weald AONB and these have been used as the basis for quantifying potential electricity and heat capacity and energy generation from biomass from existing woodland. The DECC methodology has been applied to these annual volumes to determine the figures for electricity and heat capacity and annual energy generation.

It should be noted that the results of the assessment of renewable energy potential represent the 'accessible resource' i.e. the total amount of potential that is theoretically available. They do not represent what could be practically achieved and delivered within any given sub-region or other defined area. Further assumptions and scenario testing would need to be undertaken to refine the results i.e. considering deployment, supply chain and planning constraints and opportunities.

The number, type, output capacity and annual energy generation of renewable energy technologies currently deployed within the High Weald AONB is not known however it is expected to be small. SEE-Stats (www.see-stats.org) provides a database of renewable energy installations within SE England and this information can be interpreted to enable those installations operating within the boundary of the designated area to be identified and their output capacity and annual generation quantified.

2.3.1 Wind Turbines

The GIS modelling techniques used within the Wind Energy Regional Assessment report found that a large number of measured constraints significantly affected the available land area and therefore potential for commercial scale wind turbines within the High Weald AONB. The average annual windspeed considered to offer commercial viability for wind turbine projects was considered to be >6.5m/s at 100m above ground level. The report found that single turbines or small clusters of up to 3 turbines in the 0.75 – 2.0MW range were the only types of development likely to be brought forward, and that site selection and layout would make projects difficult to develop due to local sensitivities. The report only considered the potential for large scale wind turbines; small domestic scale turbines were not assessed.

It is noted in the report that no interpolation of the GIS results was made which would quantify the number of potential commercial scale wind turbines and hence total output capacity that could be sited when considering the required minimum average windspeed figure in areas not affected by the constraints. It is recommended therefore that the data is re-examined in order to quantify the commercial scale resource in these areas if possible.

As part of the Review of Renewable and Decentralised Energy Potential Within Southeast England it was agreed at the stakeholder workshops carried out as part of the work that the following assumptions should be used for the purpose of the regional study:

- There is no capacity for commercial wind energy developments within designated landscapes but that further local level assessments should be undertaken

- There is no capacity for wind turbines within a buffer of 2km adjacent to designated landscapes to reflect the importance of the setting of these areas.

It was concluded that separate studies should be undertaken as part of individual Managements Plans. This has already been done in this case through the Wind Energy Regional Assessment report.

For small wind turbines (defined as below 100kW capacity) the assessment methodology within the Renewables Review states that 50% of the potential resource as defined within the DECC methodology would be theoretically achievable within designated areas. The assessment methodology for small scale wind energy was undertaken by identifying the number of residential and non residential properties within an area and assuming that a 6kW machine would be installed on all sites which have a wind speed greater than 4.5m/s @10m above ground level. A wind speed scaling factor was then applied to take account of the potential for obstructions in built up areas to reduce the average wind speeds and therefore the number of suitable properties. Wind turbine capacity and annual energy output figures for each local authority area and as a total for the High Weald are shown below. The potential for small wind turbines where a local authority area includes other designated areas besides the High Weald AONB has been based on a simple assessment of land area ratios; this assumes that the density of buildings which have a wind speed greater than 4.5m/s @10m above ground level within designated areas is identical - in reality this is unlikely to be the case.

	50%				
Local authority	Residential potential (MW)	Non-residential potential (MW)	Total potential (50% scenario) (MW)	Total potential (50% scenario) (GWh/yr)	% of total designated areas estimated as High Weald
Rother within HW AONB	33.6	1.5	**35.17**	**49.29**	
Wealden within designated areas	33.2	1.9	35.08	49.17	
Wealden within HW AONB			**31.57**	**44.25**	90%
Ashford within designated areas	8.7	0.5	9.16	12.83	
Ashford within HW AONB			**3.66**	**5.13**	40%
Sevenoaks within designated areas	13.6	0.7	14.32	20.07	
Sevenoaks within HW AONB			**3.58**	**5.02**	25%
Tunbridge Wells within HW AONB	15.9	0.9	**16.78**	**23.52**	
Tandridge within designated areas	0.3	0.0	0.32	0.45	
Tandridge within HW AONB			**0.08**	**0.11**	25%
Horsham within designated areas	2.5	0.3	2.83	3.97	
Horsham within HW AONB			**0.93**	**1.31**	33%
Mid Sussex within designated areas	13.4	0.7	14.12	19.79	
Mid Sussex within HW AONB			**11.30**	**15.83**	80%
TOTALS			**103.07**	**144.47**	

A total wind turbine capacity of 103.07MW would require 17,178 6kW wind turbines.

2.3.2 Biomass

The SE Renewables Review considered four main types of clean biomass resource:

- Managed woodland
- Dedicated energy crops
- Industrial woody waste
- Agricultural arisings (straw)

Arboricultural arisings from the pruning of trees are a potential fifth source of plant biomass which were not directly covered by the methodology but were included in the study under managed woodland.

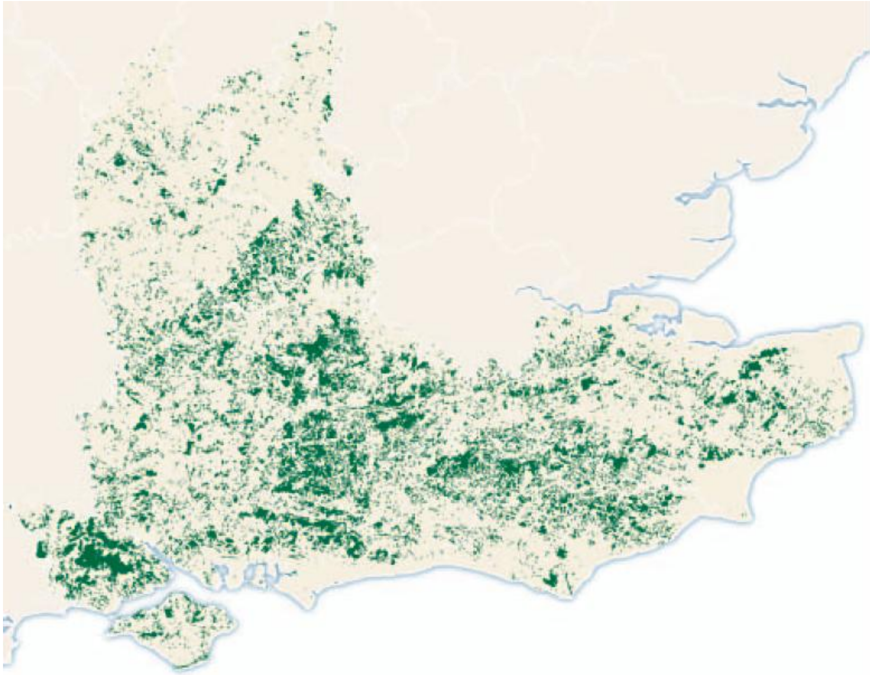
In assessing and quantifying the available resource the SE Renewables Review considered that the total resource associated with each type of biomass could be used to generate electricity, or alternatively heat. CHP was not considered. The resulting totals shown in the tables below define the resource in these terms.

Within the SE Renewables Review no assessment was undertaken to determine the potential managed woodland resource within designated areas as the Forest Research Tool as used was not able to spatially disaggregate the data according to designated area boundaries.

The South East is the most wooded region of England, with 15% of its area as woodland. The Forestry Commission[1] estimate that there would be approximately 500,000 tonnes per year of woodfuel potentially available from the existing woodlands in the South East of England if just 50% of the woodlands sustainable annual yield is used. Less than 10% of that potential is currently being used.

The diagram below shows the location of the existing woodland in South East England. It can be seen that a significant area of the High Weald AONB lies within the more densely wooded areas of northeast West Sussex, northern East Sussex and southwest Kent.

[1] http://www.forestry.gov.uk/website/forestry.nsf/byunique/infd-7s3fqn



The total area of woodland within the High Weald AONB is 37,070hectares, adjusted to include estimates for woodland under 2ha. The Forestry Commission suggest that the current total annual harvest might be in the order of 20,000cu.m of conifers and 12,000cu.m of broadleaves, as very rough estimates. The total potential sustainable production of combined broadleaved and conifer (70% of MAI - mean annual increment) is 214,200cu.m/yr. It is worth noting that where woodlands are currently undermanaged MAI has been stored for many years so there is likely to be a large amount of biomass available in the first cut.

The table below provides an assessment of biomass electricity plant capacity and annual energy generated based on 50% of the theoretical sustainable production yield from the High Weald being available for this purpose. Figures for heat plant capacity and annual energy generated are provided as alternatives. These figures have been calculated using the DECC methodology as applied to woody biomass resources in general.

Area	Current annual harvest (cu.m)		Estimated sustainable timber production (cu.m/yr)		50% of sustainable production yield (odt/yr)	Electricity plant capacity (MW)	Electricity generation (GWh/yr)	Heat plant capacity (alternative) (MW)	Heat generation (alternative) (GWh/yr)
	conifers	broadleaves	conifers	broadleaves					
High Weald	20,000	12,000	78,400	135,800	53,417	**8.9**	**67.1**	**125.4**	**219.8**

Natural England advised that the estimates for energy crops within designated areas should be constrained to the extent as defined by the 'medium scenario' within the methodology – this assumed that all abandoned land and pasture will be planted with energy crops. The details of the definition of the medium scenario contained within the SE Renewables Review report are as follows:

Assessment approach:

Assumed that energy crops are planted only on land no longer needed for food production (all abandoned land and pasture).

Data source used:
DEFRA Agricultural and Horticultural Survey 2008 GAEC12 land (not available as mapped data).

Coverage/ scale:
Region/ County/ LA (estimated based on 2007 Local Authority contributions).

Further comments/ divergence from DECC methodology:
Mapped data for abandoned land and pasture was not available for this study. GAEC12 land was seen as a reasonable alternative dataset. Data at Local Authority level are not available post 2007. The proportional breakdown between Local Authorities in 2007 was used to estimate the Local Authority breakdown in 2008.

The assessment of energy crops potential within the High Weald AONB based on land availability is shown below.

Local authority	Miscanthus (ha)	SRC (ha)	Yield (odt/yr)	Electricity plant capacity (MW)	Electricity generation (GWh/yr)	Heat plant capacity (alternative) (MW)	Heat generation (alternative) (GWh/yr)	% of total designated areas estimated as High Weald
Hastings total	1.6	0.2	29	0.005	0.036	0.063	0.110	
Hastings within HW AONB	0.3	0.0	**5**	**0.001**	**0.006**	**0.011**	**0.020**	
Rother total	431.1	47.9	7,664	1.277	9.623	16.608	29.098	
Rother within HW AONB	356.2	39.6	**6,332**	**1.055**	**7.950**	**13.721**	**24.040**	
Wealden total	767.0	85.2	13,636	2.273	17.121	29.551	51.773	
Wealden within HW AONB	418.6	46.5	**7,442**	**1.240**	**9.345**	**16.129**	**28.257**	90%
Ashford total	1,006.3	111.8	17,890	2.982	22.462	38.769	67.924	
Ashford within HW AONB	143.7	16.0	**2,555**	**0.426**	**3.208**	**5.538**	**9.702**	40%
Sevenoaks total	343.9	38.2	6,114	1.019	7.676	13.249	23.213	
Sevenoaks within HW AONB	52.3	5.8	**931**	**0.155**	**1.169**	**2.017**	**3.533**	25%
Tunbridge Wells total	378.0	42.0	6,719	1.120	8.437	14.561	25.511	
Tunbridge Wells within HW AONB	260.4	28.9	**4,629**	**0.772**	**5.812**	**10.032**	**17.576**	
Tandridge total	118.1	13.1	2,099	0.350	2.636	4.549	7.970	
Tandridge within HW AONB	4.8	0.5	**85**	**0.014**	**0.107**	**0.184**	**0.322**	25%
Horsham total	825.9	91.8	14,683	2.447	18.436	31.820	55.748	
Horsham within HW AONB	66.9	7.4	**1,189**	**0.198**	**1.493**	**2.577**	**4.514**	33%
Mid Sussex total	217.0	24.1	3,858	0.643	4.844	8.361	14.648	
Mid Sussex within AONB	104.4	11.6	**1,856**	**0.309**	**2.331**	**4.023**	**7.049**	80%
TOTALS			**25,024**	**4.17**	**31.42**	**54.23**	**95.01**	

SRC = short rotation coppice (willow)
odt = oven dried tonnes

As for the assessment of small wind turbines, the potential land area available for energy crops where a local authority area includes other designated areas besides the High Weald AONB has been based on a simple assessment of land area ratios - the relative density of available land area is assumed to be the same for each separate designated area, this is unlikely to be the case in practice.

For industrial woody waste and agricultural arisings there is no separated data available for designated areas.

It is important to note that the DECC methodology does not take account of imported sources of biomass which in reality are likely to make up a significant proportion of the biomass resource used in the South East and indeed any sub-divided area within the region. Any multi-MW scale electricity generating plant for example would require large quantities of biomass in 1000s of tonnes per year to be imported from other regions and potentially from overseas.

The potential for the use of biomass in boilers and combined heat & power (CHP) plant at small (sub-MW) scale will be determined in practice by local opportunities based on individual building heat load, heat load density and type of end user rather than locally available resource. An additional important consideration given the area being assessed is the limited availability of the mains gas network within rural locations and the impact that biomass can make as an alternative to the use of higher cost fossil fuels for heating (heating oil, LPG, solid fuel and electricity). Schools for example have traditionally offered good potential for stimulating the uptake of biomass-fuelled heating systems locally within rural areas. There are around 100 schools within the High Weald AONB plus an additional 35 schools within the area but outside of the designation (within urban areas, for example Tunbridge Wells) and a further 50 schools in close proximity to the boundary within neighbouring urban areas.

Considering the schools located within the High Weald AONB, and assuming each school on average has an annual heat demand of 80MWh/yr, if supplied from biomass this would require a boiler capacity of around 45kW using the capacity factor for biomass boilers within the table under section 2.2. Each boiler would consume around 30tonnes of woodchip @30% moisture content or 20tonnes of wood pellets per year. For 100 schools this translates to 4.5MW of boiler capacity, 3,000tonnes of woodchip @30% MC or 2,000tonnes of wood pellets per year.

For non-woody biomass resources, the following is noted:

- Poultry Litter – no separated data is available within designated areas
- Biogas from wet organic waste – no separated data is available within designated areas
- Co-firing – there are no power stations located within the High Weald AONB
- MSW - no separated data is available within designated areas, the resource is based on collated forecasts of MSW arisings for waste planning authorities or individual local authorities. There are no known planned Energy from Waste facilities located within the High Weald AONB
- C&I waste - estimates of arisings from the South East waste model of forecast arisings and capacity therefore no separated data is available within designated areas
- Landfill gas (LFG) – there are no LFG stations within the High Weald AONB
- Sewage gas – there are a number of sewage waste treatment stations administered by Southern Water and located within the High Weald AONB however their potential capacity for energy generation via the anaerobic digestion of sewage waste is not known

2.3.3 Hydro

The potential for hydropower capacity and annual electricity generation is quantified by ‘win-win’ sites as defined by the Environment Agency study within the SE Renewables Review. The standard DECC methodology was used, the impact of deployment of hydro schemes was not considered to affect the purposes/ special qualities of designated areas. The data describing the potential hydro resource falling within designated areas for each local authority was used, based on the locations of individual sites, discounting those sites falling within other designated areas besides the High Weald AONB. The resulting hydropower turbine capacity and annual electricity generation figures are shown in the table below.

Local authority	Win-wins in designated areas (kW)	Win-wins in designated areas (MW)	Win-wins in designated areas (GWh/yr)
Rother total and within HW AONB	**182.3**	**0.18**	**0.94**
Wealden total	56.2	0.06	0.29
Wealden within HW AONB	**15.0**	**0.02**	**0.08**
Sevenoaks total	155.5	0.16	0.80
Sevenoaks within HW AONB	**15.0**	**0.02**	**0.08**
Tunbridge Wells total and within HW AONB	**72.6**	**0.07**	**0.38**
TOTALS		**0.28**	**1.47**

2.3.4 Solar

Within the SE Renewables Review the assessment of potential for solar energy (PV and thermal) was based on an estimation of the total number of roofs available for solar panels. Assumptions were applied relating to the percentage of residential, commercial and industrial properties that may be suitable for the installation of solar panels, essentially based on an approximate southerly roof orientation or horizontal, these are 25% for domestic, 40% for commercial and 80% for industrial buildings. For solar installations as part of new housing, allocations as set by regional bodies are now uncertain due to the revoked Regional Spatial Strategies (RSS), with central government seeking to return decision making powers on planning to local councils.

The High Weald AONB Management Plan states that there are 45,888 houses within the boundary. There are 103 villages and 2 towns. There is no information describing commercial properties and industrial buildings within the High Weald.

Solar PV and solar thermal capacity and annual output figures based on uptake within residential properties are shown in the table below.

Area	Residential properties	25% of residential properties	Solar PV (MW)	Solar thermal (MW)	Solar PV (GWh/yr)	Solar thermal (GWh/yr)
High Weald	45,888	11,472	**22.9**	**22.9**	**18.1**	**10.1**

2.3.5 Heat Pumps

The SE Renewables Review applied a methodology to determine heat pump capacity and annual output based on a range of percentage figures applied to the total number of different types of residential property (detached, semi-detached, terraced, flats) within each local authority area and whether mains gas was available or not. A similar process was applied to commercial properties.

Within the High Weald only the total number of residential properties is known, therefore this methodology cannot be applied as it stands. Assumptions could be made however on the percentage of residential properties within the High Weald which could be supplied with heat from heat pumps, although this would be a purely arbitrary figure. It is important to note that the efficient use of heat pump technology requires the application of low temperature heat suitable for use with underfloor heating systems or oversized radiators ideally serving thermally tight buildings generally associated with modern construction methods. The number of properties within the High Weald which could provide these conditions is estimated to be a small percentage of the total, assuming that the vast majority of the existing housing stock was built prior to 2000.

2.3.6 Electricity Grid Connection

The electricity transmission network in England and Wales is owned and operated by National Grid Electricity Transmission (NGET) and supplies electricity at 400 and 275kV. Electricity is supplied into the High Weald AONB from Dungeness, Kingsnorth and Damhead Creek power stations, as well as an interconnector from continental Europe at Folkestone.

Most renewable electricity generators by their nature are small, numerous and distributed and are connected at the distribution network at lower voltages. This is called embedded, distributed or dispersed generation. Small generators cannot be connected to the transmission network because of the cost of high voltage transformers and switchgear, and the transmission network is likely to be a long way from the generator as its location is usually predetermined. The distribution network operates at 132, 33 and 11kV, and eventually at 400V 3phase and 230V single phase. The District Network Operator (DNO) covering the southeast region at the distribution level which includes the High Weald AONB is UK Power Networks.

The appropriate voltage level at which to connect a generator is largely dependent on its output capacity. Attempting to connect at too low a voltage for reasons of convenience and cost will have too great an effect on network voltages and fault levels and cannot therefore be permitted. This can lead to a common situation in the case of larger renewable energy systems such as wind farms, wind clusters and large single turbines (and now solar PV farms) where the proposer of a generator wants to connect at one voltage level, while the DNO suggests connection at the next level up. An increasing amount of distributed generation is connecting to the local distribution network as the uptake of renewable and low carbon electricity technologies gathers pace.

Larger scale renewable electricity generation such as wind farms are connected to the network at 132 or 33kV. Little Cheyne Court, a 26 turbine wind farm development with a total generating capacity of 60MW located just outside of the High Weald AONB boundary near Rye is connected via underground cables to the 132kV network. The proposed single wind turbine at Glyndbourne near Lewis has a capacity of 850kW and is located outside of the High Weald AONB boundary but within the South Downs AONB. The turbine is proposed to be connected to the 11kV network via underground cables to an existing substation. It is not known in either case the extent of additional grid strengthening equipment required to accommodate these installations.

Smaller capacity renewable electricity generators at the building integrated scale such as roof mounted solar PV systems, small wind turbines or CHP plant as micro-generators would be connected at 400/230V at the incomer. The majority of these types of installations would each supply a few kW to local loads and the immediate grid, and in isolation their effect would not be noticeable.

The impact on operation of the grid of connecting either a MW-scale generator or number of generators to the higher voltage distribution network or a large number of small generators supplying power into the local grid at lower voltages is uncertain and can only be determined based on assessment at specific locations through a technique known as load flow analysis. The analysis of the potential uptake of individual technologies within the High Weald AONB would suggest that the majority of renewable electricity in terms of output capacity is likely to be micro-generation (building integrated systems connected at lower voltages). The amount of grid strengthening required to facilitate this generation capacity is unknown and can only be quantified through detailed analysis.

UK Power Networks have produced a Long Term Development Statement (LTDS) for the southeast distribution network. The introduction, network summary and network area map can be downloaded from their website at http://www.ukpowernetworks.co.uk/products-services/networks/knowledge-centre/long-term-development-statement.shtml. These documents provide a useful summary of the distribution network and the issues affecting current and long term operation. Detailed network data and development proposals can additionally be requested from UK Power Networks. The LTDS provides project developers with sufficient network data, forecasts and commentary to carry out initial assessments of project feasibility.

Senergy Econnect offers grid connection assessment services including site connection scoping, high level grid integration assessments and detailed grid integration studies for individual site locations in exchange for a fee, based on information contained in the LTDS and outputs from liaison with the DNO.

2.4 *Energy Consumption within the High Weald AONB*

2.4.1 Background to Statistical Data

The following section provides an assessment of buildings energy consumption within the High Weald AONB, using publically available statistics.

The Department of Energy and Climate Change (DECC) administers information processed by the UK Statistics Authority as the Digest of UK Energy Statistics (DUKES), contained within these statistics are the latest energy production and consumption figures for 2009. These national figures can be applied to the domestic building stock located within the High Weald AONB.

Energy consumption statistics subdivided into defined regions in the UK are also supplied by DECC. Geographical areas are divided into Middle Super Output Area (MSOA) boundaries and further subdivided into Lower Super Output Area (LSOA) boundaries. Annual consumption data are available at MSOA level, and at LSOA level currently for 6 local authorities in England and Wales as a pilot study. Energy consumption data is divided into natural gas supplied through the national gas network and electricity, split between the total number of domestic and commercial/ industrial consumers falling within each MSOA and LSOA. Gas consumption information can be used as a proxy for heat demand, however this takes no account of buildings heated using other fuels and it is thought likely that a significant percentage of the area of the High Weald AONB is not connected to the national gas network given its predominantly rural nature.

DECC use the gas industry standard cut-off of 73,200kWh whereby any gas meters with consumption greater than or equal to 73,200kWh/yr are classified as commercial/ industrial, whereas those with less are classified as domestic.

2.4.2 Domestic Properties

The following table provides an assessment of energy consumption as space heating, hot water, cooking/ catering and electricity associated with domestic properties. The energy totals relating to the domestic sector within the UK is shown as per household figures, based on the total number of households in the UK in 2008 being 26,334,000. These per household figures have then been applied to the total number of households within the High Weald AONB as 45,888 (taken from the 2009 Management Plan).

	UK, 2008	45,888 dwellings within High Weald AONB
Energy demand per end use	Domestic energy, UK average, per dwelling	UK figures applied to all dwellings within High Weald
	kWh/yr	GWh/yr
Space heating	11,713	537
Hot water	4,792	220
Total heat demand	**16,505**	**757**
Cooking/ Catering	580	27
Electricity (lighting/ appliances)	**3,231**	**148**
TOTALS	**20,316**	**932**

The energy demand numbers for the High Weald are the result of applying national average figures. It should be noted that there are limitations on their accuracy, the actual figures will be determined by a large number of factors including the degree days for the region, size of dwellings, thermal quality of the buildings, occupancy and behaviour of individual residents.

2.4.3 Non-Domestic Properties

LSOA and MSOA boundaries overlap the High Weald AONB boundary as well as the internal boundaries surrounding Tunbridge Wells, Crowborough and Heathfield. For this reason it is not possible to use this data to determine energy consumption within the High Weald AONB. LSOA areas being smaller (minimum population 1000) are more likely to be able to be approximately interpreted through visual inspection as applicable to the High Weald, assuming this data will become available in the future for the High Weald, however energy consumption relating to commercial/industrial consumers is not included in the DECC figures due to data disclosure restrictions.

Ordnance Survey provides data relating to commercial premises, known as Address Layer 2, this lists types and locations of each premises. This could be used along with a data search of public sector buildings to build up a list of non-domestic properties which could be assessed for energy demand using a range of benchmarks and assumptions.

Further analysis through GIS mapping would needed to identify the non-domestic premises within the area, this information could then be used to provide estimates of electricity and heat demand.

As an example to give some idea of the magnitude of heat demand for a portion of non-domestic properties supplied by gas, using MSOA data for 2007 and selecting an MSOA which falls entirely within the High Weald AONB and could therefore be considered representative of the designated area as a whole:

MSOA Code:	E02004407
MSOA Name:	Wealden 005
Population:	7506
Land area:	75.06sq.km
Industrial/ commercial gas:	9,185MWh/yr

In addition, data describing electricity consumption for the industrial/ commercial sector within the same MSOA is as follows:

Industrial/ commercial electricity:	6,844MWh/yr

Assuming that 95% of industrial/ commercial gas consumption is associated with providing heat and that heat is delivered through boilers with an average seasonal efficiency of 80% the annual heat demand is calculated as 6,981MWh/yr or 7GWh/yr.

The total area of the High Weald AONB is 1,461sq.km (taken from the 2009 Management Plan). Making the assumption that Wealden 005 is representative of the entire designated area in terms of gas and electricity consumption for the industrial/ commercial sector, scaling up results in the following figures:

Industrial/ commercial gas:	178,781MWh/yr
Industrial/ commercial heat:	135,881MWh/yr
Industrial/ commercial electricity:	133,215MWh/yr

Note that the above heat demand figure does not take account of heat provided by fuel other than mains gas, and likely to be a significant amount in the case of predominantly rural locations, such as heating oil, LPG and electricity. Assuming that the gas-supplied heat consumption represents 50% of the total heat demand for non-domestic properties, the total industrial/ commercial heat demand is 271,762MWh/yr or 271.8GWh/yr.

By way of comparison, for the same MSOA the domestic gas consumption figure is 56,239MWh/yr. Using the same assumptions as for non-domestic data, this translates to a heat demand of 42,742MWh/yr or 42.7GWh/yr, just under 6% of the total heat demand for the entire domestic sector for the High Weald AONB. MSOA data also provides domestic electricity consumption as Economy 7 (night rate), the vast majority of which will be supplying storage heaters. For Wealden 005 this is 10,756MWh/yr, adding to the estimated gas consumption-derived heat demand figure above.

3 ANALYSIS OF RESULTS

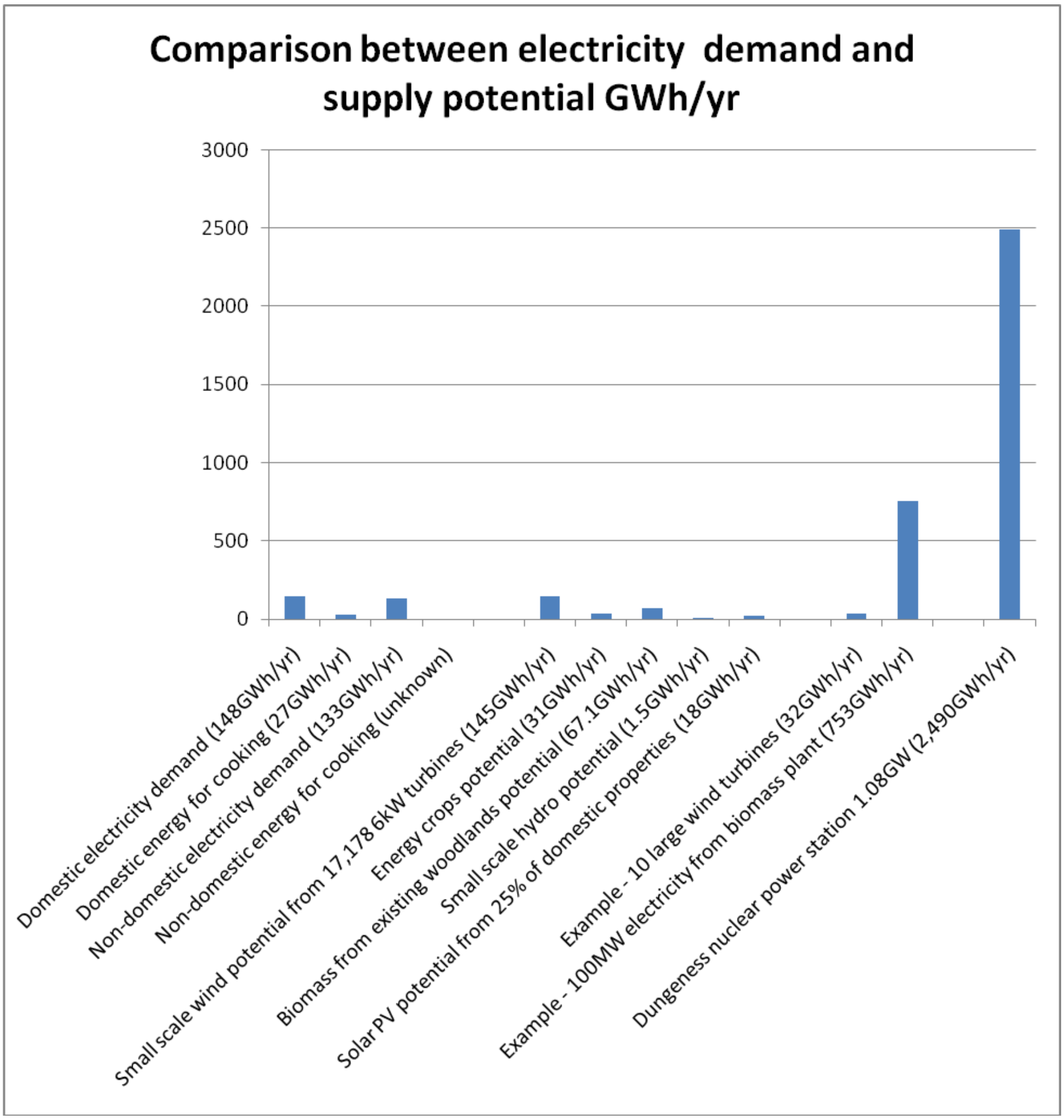
Using the figures resulting from the analysis in the previous section a summary table of renewable and low carbon energy plant capacity and energy generation potential for the High Weald AONB is shown below.

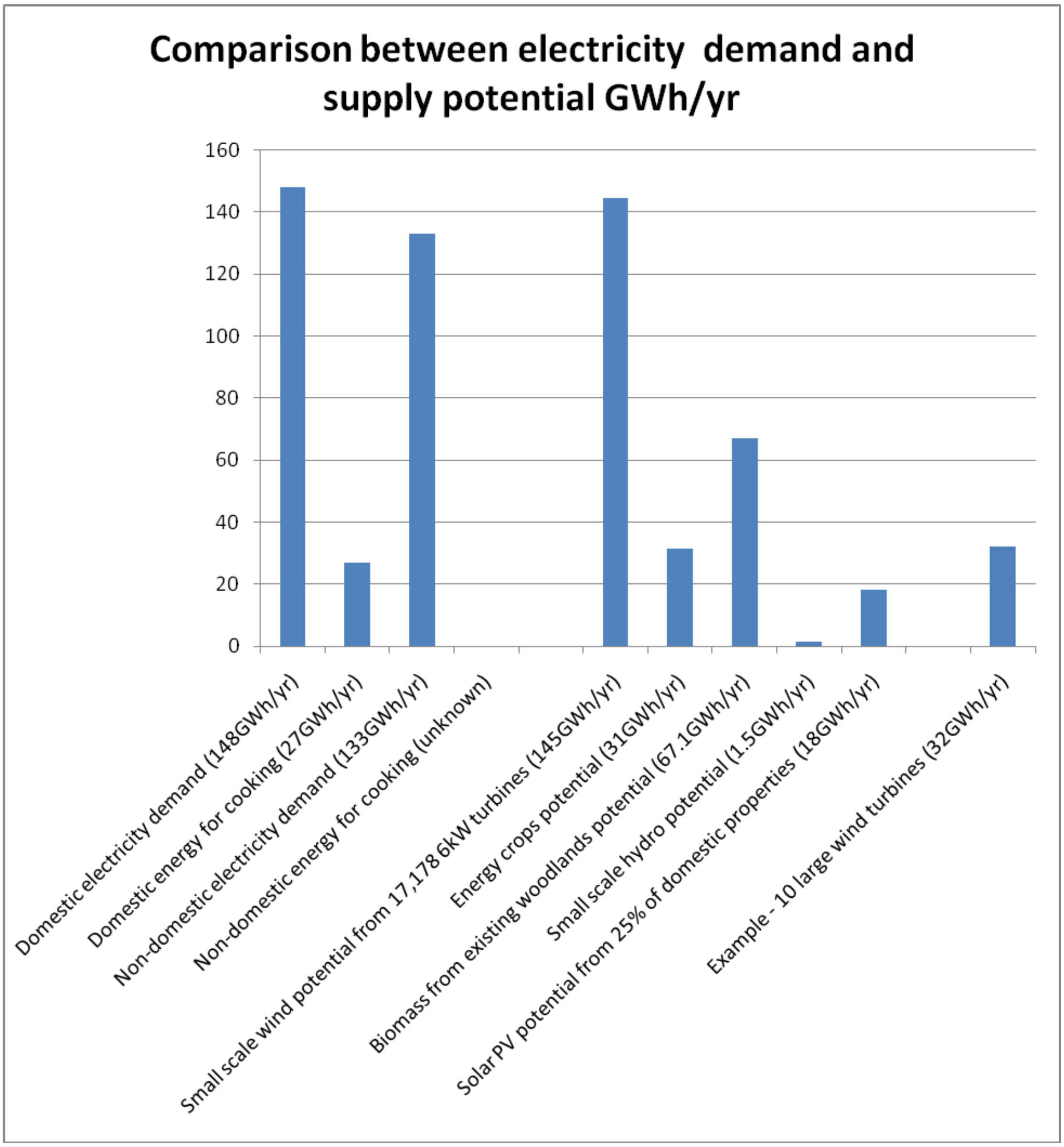
	Electricity		Heat		
Renewable & low carbon energy technology	Energy plant capacity	Annual energy generated	Energy plant capacity	Annual energy generated	Notes
	MW	GWh/yr	MW	GWh/yr	
Wind power					
Large scale	unknown	unknown			Not quantified within the HW AONB 'Wind Energy Regional Assessment' report
Small scale	103.1	144.5			Application to the domestic sector only, 17,178 6kW turbines
Example of large scale wind turbine deployment	20	32			10 large wind turbines @2MW each
Biomass					
Energy crops	4.2	31.4	54.2	95.0	Based on potential resource within HW AONB. Electricity and heat figures as alternatives
Existing woodland	8.9	67.1	125.4	219.8	Based on potential resource within HW AONB. Electricity and heat figures as alternatives
Example of large scale electricity generation	100	753.4			100MW plant would require approx 900,000tonnes/yr of woodchip @30%MC
Example of non-domestic heat application			4.5	8.0	Using estimated heat demand for the 100 schools within the HW AONB
Hydro	0.3	1.5			Environment Agency methodology
Solar					
PV	22.9	18.1			Application to the domestic sector only, 25% of total properties
Thermal			22.9	10.1	Application to the domestic sector only, 25% of total properties
Heat pumps			unknown	unknown	Methodology not defined

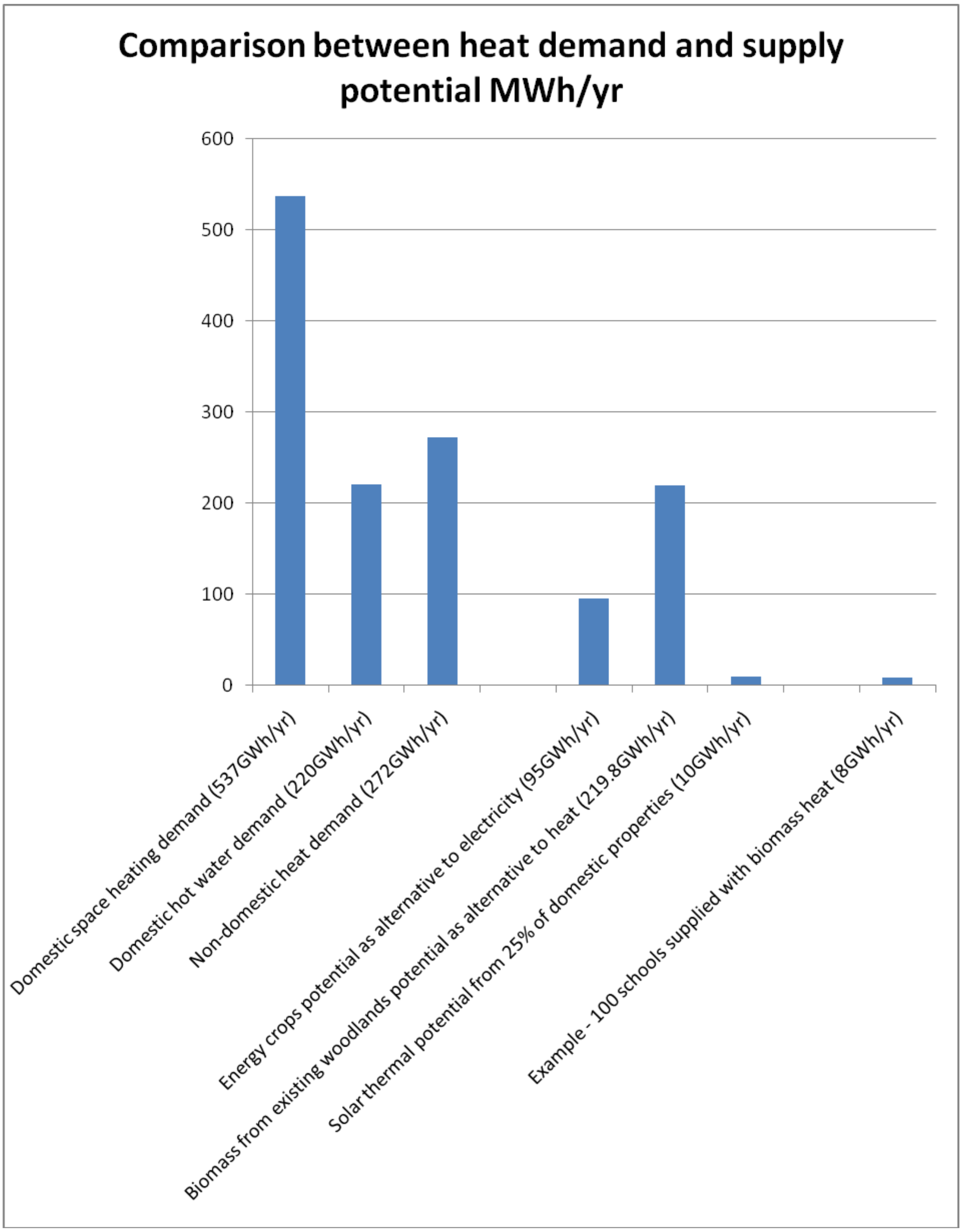
The figures above can be compared with energy consumption as shown in the table below.

	Electricity	Space heating	Hot water	Cooking/ catering	Notes
	GWh/yr	GWh/yr	GWh/yr	GWh/yr	
Domestic energy consumption	148	537	220	27	As applied to the 45,888 dwellings within the HW AONB
Non-domestic energy consumption	133	272		unknown	Interpreting MSOA data
Totals	**281**	**1029**		unknown	

The demand for heat is dominant at roughly 3½ times that of electricity. Graphs showing comparisons between energy supply and demand figures are shown below.


Comparison between electricity demand and supply potential GWh/yr
3000
2500
2000
1500
1000
500
0
Domestic electricity demand (148GWh/yr)
Domestic energy for cooking (27GWh/yr)
Non-domestic electricity demand (133GWh/yr)
Non-domestic energy for cooking (unknown)
Small scale wind potential from 17,178 6kW turbines (145GWh/yr)
Energy crops potential (31GWh/yr)
Biomass from existing woodlands potential (67.1GWh/yr)
Small scale hydro potential (1.5GWh/yr)
Solar PV potential from 25% of domestic properties (18GWh/yr)
Example - 10 large wind turbines (32GWh/yr)
Example - 100MW electricity from biomass plant (753GWh/yr)
Dungeness nuclear power station 1.08GW (2,490GWh/yr)


Comparison between electricity demand and supply potential GWh/yr
160
140
120
100
80
60
40
20
0
Domestic electricity demand (148GWh/yr)
Domestic energy for cooking (27GWh/yr)
Non-domestic electricity demand (133GWh/yr)
Non-domestic energy for cooking (unknown)
Small scale wind potential from 17,178 6kW turbines (145GWh/yr)
Energy crops potential (31GWh/yr)
Biomass from existing woodlands potential (67.1GWh/yr)
Small scale hydro potential (1.5GWh/yr)
Solar PV potential from 25% of domestic properties (18GWh/yr)
Example - 10 large wind turbines (32GWh/yr)



To provide non-domestic energy consumption figures a number of broad assumptions have had to be made to enable a comparison of the potential for renewable energy generation and the total consumption of energy associated with buildings within the High Weald AONB. Given the assumptions, the exercise has nevertheless enabled some interesting comparisons to emerge. The potential electricity generation from small scale wind turbines within the domestic sector is very similar to domestic electricity consumption, and is around 4 times the potential electricity generated by solar PV systems. An important caveat to add however is the uncertainty over the practical potential for small scale wind, when considering planning, local available wind resource and long term operation of the technology. In the case of solar hot water, energy consumption is over 20 times the potential generation for this technology. It should be noted that the DECC methodology is likely to underestimate the total potential from solar thermal, given that this technology typically provides 50% of annual hot water needs, in this translating to a figure of 12.5% of total demand, given that the potential is based upon 25% of the housing stock providing suitable roof orientation.

The potential for large scale wind turbines is unknown, however given the summary statement within the Wind Energy Regional Assessment the likelihood of there being more than a handful of single turbines hosted by non-domestic energy consumers, or clusters of turbines, is considered to be small. To allow a comparison to be made and as an example, 10 large turbines of 2MW capacity each would generate the equivalent of around 20% of domestic electricity consumption, or 10% of total electricity consumption per year.

In the case of energy crops and biomass from existing woodlands, the potential for heat generation is nearly 40 times the estimated energy demand from the 100 schools within the area.

A 100MW electricity generating plant would have an annual output of 5 times domestic electricity consumption and would require around 900,000tonnes of woody biomass at 30% moisture content per year. This compares with the potential annual available tonnage from energy crops from available land in the High Weald AONB of 25,000odt (35,500tonnes @30%MC) and 50% of the potential annual timber resource from existing woodlands which might be directed towards energy production of around 53,000odt (75,500tonnes @30%MC).

Combining the potential for domestic small scale wind turbines, domestic solar PV systems, hydro schemes and the allowing for 10 large wind turbines the total electricity generation potential is 195.6GWh/yr. This does not include any potential for additional small scale wind turbines outside of the domestic sector, solar PV systems installed on non-domestic buildings or solar PV farms. The potential for electricity generation from biomass is not included for reasons of inefficiency of resource use, uncertainty of the technology as CHP at small (building integrated) scale and the requirement for significant import quantities at large scale. Locally available biomass is more likely to be used in heat applications in areas off the gas grid. The total electricity consumption associated with domestic and non domestic buildings is 281GWh/yr. Based on these figures the potential for renewable electricity generation is 69.6% of total annual electricity consumption. The assessment of potential assumes sufficient capacity could be made available through reinforcement at the local distribution grid level to enable generators to connect and feed power to local loads as well as the wider network safely and efficiently.

The potential for renewable and low carbon heat includes contributions from biomass, solar thermal systems and heat pumps. Quantifying the application of biomass based on resources present within the designated area is uncertain due to the difficulties of disaggregation of data within designated areas, and in any case the potential at small scale will be determined in practice by local heat demand. Including the figures for heat available from the combustion of biomass as energy crops and timber from existing woodland, combined with hot water from domestic solar thermal systems the total heat generation potential is 324.9GWh/yr. This does not include any contributions from heat pumps, this is likely to be small due to limitations in application and in any case has limited carbon saving potential. The total heat consumption associated with domestic and non domestic buildings is 1,029GWh/yr. Based on these figures the potential for renewable heat generation is 31.6% of total annual heat consumption.

4 CONCLUSIONS & RECOMMENDATIONS

It is clear that there is a significant potential for the generation of renewable energy as electricity and heat within the High Weald AONB. This can be achieved by using a range of technologies appropriate to the characteristics of the landscape and buildings within the area, although it is appreciated that in practice some may be more challenging to implement at scale than others. The highest potential for roll-out of renewable energy technologies at a local building-integrated level is likely to be roof mounted solar PV and solar thermal systems, and biomass boilers/ stoves. A high deployment of small scale wind turbines can in theory provide a significant contribution to total electricity demand, large wind turbines have greater potential energy output however opportunities for deployment are likely to be more limited. The potential for electricity generated from hydro sites in the area is small. Additionally there is likely to be potential for electricity generated by large scale solar PV farms although this has not been specifically assessed within the report.

The following recommendations are put forward in order to further develop the picture of renewable energy generation and energy consumption within the High Weald AONB:

10. Quantify the potential for commercial scale wind turbines through further development of the methodology used within the existing Wind Energy Regional Assessment report
11. Carry out an assessment of capacity of the local electricity distribution grid at one or a number of potential points of interest within the area in order to understand the potential implications of grid connection of renewable energy generation above building integrated scale (eg. large wind turbines, solar PV farms)
12. Provide more accurate estimates of energy consumption for the non-domestic sector through interpretation of OS Address Layer 2 and other searches
13. Provide an assessment of solar thermal, solar PV and small wind turbine potential within the non-domestic sector based on searches carried out in 3 above
14. Provide a more accurate assessment of domestic solar thermal and PV potential based on desktop searches of the area
15. Provide an assessment of potential for heat pump technology using a methodology appropriate to the area
16. Assess the potential for local supply of existing woody biomass resources into the area with particular reference to the potential use for heat for schools and other public sector buildings in order to stimulate uptake
17. Quantify the potential heat demand from non-domestic buildings which could be supplied from woody biomass sources, and compare with the total available local resource
18. Quantify current levels of renewable energy capacity and generation through the use of SEE-Stats and other searches