Lancashire sustainable energy study

Burnley renewable energy potential

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CLASP. Climate Change Local Area Support Programme

north west improvement and efficiency partnership

maslen environmental part of the JBA Group

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Contents

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Glossary

This glossary provides explanations of certain words and terms used in this report in order to assist with clarity on their meaning.

Air Source Heat Pumps - using outside air as a heat source or heat sink. A compressor, condenser and refrigerant system is used to absorb heat at one place and release it at another.

Anaerobic digestion - a series of processes in which microorganisms break down biodegradable material in the absence of oxygen, the release of energy in this process can be harnessed to create a useable renewable resource.

Animal biomass - for the purposes of this study, animal biomass covers wet organic waste and poultry litter.

Bioenergy - renewable energy made available from materials derived from biological sources.

Biomass - a renewable energy source of biological material from living or recently living organisms (plant or animal) which can be used to generate electricity or heat.

Combined Heat and Power/Combined Cooling Heat and Power (CHP/CCHP) - the simultaneous generation of usable heat and power (usually electricity) in a single process, thereby reducing wasted heat and putting to use heat that would normally be wasted to the atmosphere, rivers, or seas. CHP is an efficient form of decentralised energy supply providing heating and electricity at the same time. CHP's overall fuel efficiency can be around 70-90% of the input fuel, depending on heat load; much better than most power stations which are only up to around 40-50% efficient.

Cumulative impact - impact resulting from the permanently increased impact caused by a number of developments within the same area. According to European Commission guidelines 1999 '*While assessing the potential cumulative impacts, the impact of another project is also assessed, the combination of which can lead to more extensive and severe impacts. Each project may have an insignificant impact on its own, but the combined effects may be considerable*'.

DECC methodology - the Department of Energy and Climate Change (DECC) and the Department of Communities and Local Government (CLG) published the Renewable and Low-Carbon Capacity Assessment Methodology (produced by SQW and Land Use Consultants) in 2010 in order to help ensure a robust evidence base to support the deployment of renewable energy. The evidence produced by applying the methodology will help to support local authorities and communities to make the most of opportunities for renewable energy deployment in their areas. DECC has provided funding to support the application of the methodology across the whole of England.

Decentralised energy supply - energy supply from local renewable and local low-carbon sources (i.e. on-site and near site, but not remote off-site) usually on a relatively small scale.

Decentralised energy is a broad term used to denote a diverse range of technologies, including micro-renewables, which can locally serve an individual building, development or wider community and includes heating and cooling energy.

Deployable capacity - the amount of technically available renewable energy capacity that is likely to be generated within a specific timescale.

Designated areas/protected landscapes - areas which are subject to a statutory designation on the basis of environmental or cultural characteristics e.g. National Park, Area of Outstanding National Beauty, Conservation Area.

District Heating System - a system for distributing heat generated in a centralised location for residential and commercial heating requirements such as space heating and water heating. The heat is often obtained from a cogeneration (CHP) plant burning fossil fuels but increasingly biomass.

Energy crops - plants grown as a low cost and maintenance harvest used to make biofuels or combusted for their energy content to generate heat or electricity. Usual crops are woody species such as willow or poplar, as well as temperate grasses such as miscanthus.

Energy efficiency - making the best or most efficient use of energy in order to achieve a given output of goods or services, and of comfort and convenience.

Feed in Tariff - a cashback scheme, supported by Government funding, that pays people for creating their own ‘green electricity’.

Grid constraint - any factor that impacts on connection to the national grid at any given point, which would ultimately impact on harnessing renewable energy sources to provide electricity to the grid.

Ground source heat pumps - these use pipes buried underground to extract heat from the ground. This is usually used to heat radiators or underfloor heating systems and hot water.

Hydropower - generation of power derived from the force of moving water.

Load factors - the theoretical maximum outputs likely to be generated from renewable energy sources. For example, a modern wind turbine produces electricity 70-85% of the time, but it generates different outputs dependent on wind speed. Over the course of a year, it will generate about 30% of the theoretical maximum output. This is known as its load factor.

Managed woodland - a woodland which is controlled by felling, coppicing, planting, etc.

Microgeneration - small-scale onsite low carbon and renewable energy technologies – also known as microgeneration which generated less than 45KW heat and 50KW for electricity, offer ways of producing energy from renewable, low carbon and carbon-neutral sources. They harness energy sources such as wind, photovoltaics, solar thermal, biomass, hydro and heat pumps.

Poultry litter - poultry manure which consists of the original litter material (bedding in poultry operations such as wood shavings, sawdust, straw etc), feathers, and spilled feed. Poultry litter can be used as an energy feedstock for heating and electricity generation either in on-farm combustion systems or in centralized waste-to-energy conversion facilities.

Renewable and low-carbon energy - includes energy for heating and cooling as well as generating electricity. Renewable energy covers those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass. Low-carbon technologies are those that can help reduce carbon emissions but that are not from renewable sources. Renewable and/or low-carbon energy resources include: biomass and energy crops; CHP/CCHP (and micro-CHP); waste heat that would otherwise be generated directly or indirectly from fossil fuel; energy-from-waste; ground source heating and cooling; hydro; solar thermal and photovoltaic generation; wind generation.

Solar photovoltaics - is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors. Photovoltaic power generation employs solar panels composed of a number of cells containing a photovoltaic material.

Supply chain constraint - in this context, this refers to constraints in the supply chain for renewable energy deployment which includes the manufacture, installation, operating and servicing of installations. Constraints could relate to both access to the required hardware and access to the required skills.

Wet organic waste - biomass fuel arising from animal waste (slurry and manure).

1: Introduction and context

1.1 SQW Ltd, supported by Maslen Environmental and CO2Sense, was commissioned by Lancashire County Council in February 2011 to undertake a study to facilitate the development of sustainable energy resources and provide follow up guidance and support to local planning authorities.

1.2 The purpose of the study is two fold:

- To bring the information contained in the Northwest Renewable and Low Carbon Energy Capacity and Deployment Study (2010) to a local footprint level by using the evidence base provided by the study to produce an individual bespoke report for each of the fourteen Lancashire Local Authorities (LAs) detailing their potential renewable energy capacity at 2020.
- To provide further technical advice to each LA to enable greater understanding of the potential for renewable energy development.

1.3 The study methodology builds on the Northwest Renewable and Low Carbon Energy Capacity and Deployment Study[1] which SQW and LUC completed in 2010. This was undertake using the national Renewable and Low-Carbon Energy Capacity Methodology developed by SQW for DECC and CLG in 2010[2] (hereafter referred to as 'the DECC methodology'). The Northwest study provided a comprehensive assessment of the potential accessible energy resources at 2020, for the region and each sub region. This identified that the Lancashire sub region has the potential to generate 25% of the total Northwest region's renewable energy capacity (9,929MW). More specifically, the report concluded that:

> *The sub region has an extensive commercial scale wind resource (6,497 MW or 28% of the Northwest's total) and a corresponding 30% of the Northwest's total small scale wind resource. It has a relatively balanced accessible resource potential across most biomass categories, with medium to high resources relative to other parts of the Northwest. It has significant microgeneration potential including 2,554 MW for ground source and air source heat pumps (21% of the Northwest's total resource).*

1.4 The data assembled and assumptions used in the Northwest study provide an excellent starting point for this new study from which we have developed more detailed and localised analysis for the specific circumstances of the LAs in Lancashire.

1.5 This document reports the findings for **Burnley** from the resource assessments that have been undertaken. This is one of fourteen LA specific reports and is supported by GIS mapping and

[1] Available from: http://www.nwriu.co.uk/research_and_intelligence/environment/environment_publications/renewable_capacity.aspx

[2] Available from: http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/ored/1_20100305105045_e_@@_methodologyfortheenglishregions.pdf

an overarching technical report, which provides more detail on the assumptions that have been utilised. These additional outputs are available from www.lancashire.gov.uk.

Context

1.6 The UK's Renewable Energy Strategy was published in 2009. This sets out the measures to pursue to achieve the **target to supply 15% of the UK's energy needs from renewable sources by 2020** as part of broader efforts across the European Union. Under expected national scenarios, this translates to meeting 30% of the UK electricity demand and 12% of the UK heat demand from renewable sources by 2020. This involves a step change in the provision of renewable energy capacity in the UK and action at all geographic levels is necessary to help to plan and deliver this strategy between now and 2020. In particular, most onshore renewable energy development projects across a wide range of commercial scale, small and microgeneration technologies are controlled at sub-regional and local levels and therefore action is required at these levels to maximise deployment.

1.7 The most recent DECC energy consumption statistics for the Northwest indicate a total energy consumption of 187,652 GWh (including transport as well as domestic and industrial consumption) of which 34,569 GWh is electricity from non renewable sources[3]. This equates to 21 GW total energy consumption of which 4 GW is electricity from non renewable sources. Current renewable energy generation capacity within the Northwest stands at 572.9 MW[4] which is comprised of contributions from various technologies as detailed below (please note that figures for solar photovoltaics and micro wind are only provided at the national level – 26.5 MW and 20.4 MW respectively).

Table 1-1: Northwest Renewable Energy Generation, 2009 (MW)

Hydropower	Wind & wave	Landfill gas	Sewage gas	Other biofuels	TOTAL
5.9	357.2	163.1	17.4	29.3	572.9

Source: DECC

1.8 The most recent DECC energy consumption statistics for the Northwest indicate a total energy consumption of 187,652 GWh (including transport as well as domestic and industrial consumption) of which 34,569 GWh is electricity from non renewable sources. This equates to 21 GW total energy consumption of which 4 GW of electricity is from non renewable sources. Current renewable energy generation capacity within the Northwest stands at 572.9 MW which is comprised of contributions from various technologies as detailed below (please note that figures for solar photovoltaics and micro wind are only provided at the national level – 26.5 MW and 20.4 MW respectively).

1.9 Table 1-1 indicates that the Northwest is starting from a low base in terms of realising its renewable energy potential. However, it must also be understood that this study provides an assessment of **potential** *not* **deployable** renewable energy potential. Whilst the DECC methodology requires that some headline constraints are built into the assessment (such as minimum wind speeds for onshore wind, proportion of properties suitable for microgeneration etc), it does not take into account more detailed economic, environmental

[3] http://www.decc.gov.uk/assets/decc/Statistics/regional/total_final/1094-total-subnatl-final-energy-cons-2005-2008.xls
[4] https://restats.decc.gov.uk/cms/assets/Uploads/Results_2009/Regional-2009/Regional-spreadsheets-2009.xls

and social constraints which are likely to reduce this capacity considerably. It also does not take into account load factors. Once these are taken into account the potential contribution of renewable sources is reduced to a greater degree than for conventional sources. For example, for onshore wind, due to varying wind speeds and other factors, it is widely accepted that only 30% of potential wind capacity will convert into electricity generated.

1.10 The most recent energy consumption statistics (2008) for Burnley estimate total consumption of 42.2 MW (electricity) and 106.0 MW (gas)[5] which provides the context for the renewable energy capacity identified.

Structure of the report

1.11 The remainder of the report is structured as follows:

- Section 2 explains the methodology employed to assess renewable energy potential capacity across a chosen range of technologies. Assumptions are based on the Northwest study (which in turn is based on the DECC methodology) customised for the Lancashire sub-region, where appropriate.
- Section 3 provides the results of each of the completed resource assessments for Burnley, following a summary of the results at the Lancashire level.
- Section 4 provides an overview analysis of the grid constraints that will have an impact on renewable energy deployment within Burnley and Lancashire more widely. All figures can be accessed from www.lancashire.gov.uk.
- Section 5 sets out some concluding comments and details some suggested next steps.

[5] http://www.decc.gov.uk/assets/decc/statistics/regional/mlsoa2008/1_20100324183806_e_@@_mlsoa2008nondomgasnorthwest.xls

2: Methodology

2.1 This section sets out the approach used to undertake the assessment of renewable energy potential for Burnley.

2.2 The starting point for determining the potential for renewable energy in Lancashire - and Burnley more specifically - was the methodology used in the 2010 North West study which in turn is in line with the original DECC methodology (the supporting technical report provides more detail on these assumptions). The methodology has been utilised to assess the capacity and technical potential across a chosen range of technologies detailed in Table 2-1.

Table 2-1: Renewable categories covered by the study

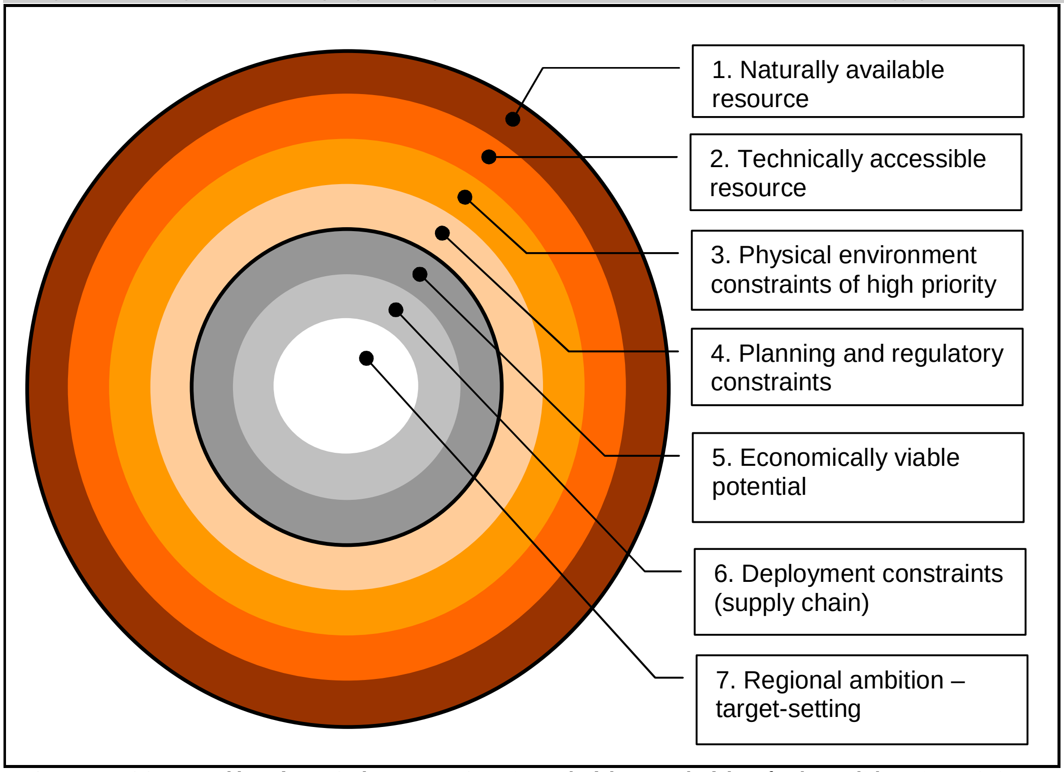
Category	Sub-category level 1	Sub-category level 2
Wind	Wind – commercial scale	
	Wind – small scale	
Biomass	Plant biomass	Managed woodland
		Energy crops
		Waste wood
		Agricultural arisings (straw)
	Animal biomass	Wet organic waste
		Poultry litter
	Municipal Solid Waste (MSW)	
	Commercial & industrial Waste (C&I)	
	Waste heat	
	Biogas (Energy from Waste)	Landfill gas
		Sewage gas
Hydropower	Small scale hydropower	
Microgeneration	Solar	Solar Photovoltaics (PV)
		Solar Water Heating (SWH)
	Heat pumps	Ground Source Heat Pump (GSHP)[6]
		Air Source Heat Pump(ASHP)[7]
Low carbon	CHP and tri-generation	

Source: SQW

[6] This category covers horizontal trench and vertical borehole systems across the closed loop and open loop types (open loop GSHP uses ground water from an aquifer)
[7] Only those systems that achieve a coefficient of performance (COP) in line with the Renewables Directive (European Parliament and Council, 2009)

2.3 Figure 2-1 sets out the key stages which are required by the DECC methodology to develop a comprehensive evidence base for regional renewable energy potential. The DECC methodology provides guidance on how to undertake the Stages 1 to 4 of this process. It should be noted that whilst Stages 1- 4 do take into account a number of constraints on the available resources, the resulting capacity still needs further refinement to reach a figure that approximates to deployable capacity taking into account how much capacity is already in place and how quickly new capacity is likely to be put in place. The methodology does not cover stages 5 to 7, which ultimately lead to target-setting.

Figure 2-1: Stages for developing a comprehensive evidence base for renewable energy potential



Source: DECC, Renewable and Low Carbon Energy Capacity Methodology: Methodology for the English Regions, 2010

2.4 Table 2-2 (below) provides a summary of the DECC assessment process which the English regions were required to undertake through the stages (1-2) of identifying the opportunity for harnessing the renewable energy resources on the basis of what is naturally available within the context of the limitations of existing technology solutions and then addressing the high level resource constraints (stages 3-4) to the deployment of technologies in relation to the physical environment and planning regulatory limitations to identify a more realistic measure of capacity and potential. It is appropriate to adopt the same approach to undertake sub-regional and local assessments whilst allowing for some of the assumptions behind the calculations to be more tailored to the local situation.

Table 2-2: DECC methodology

Main element	Stage and description
Opportunity analysis	
Stage 1: Naturally available resource	Regions need to explore and quantify the naturally available renewable energy resource within their geographical boundary. This will be based on data and information analysis including resource maps and inventories
Stage 2: Technically accessible resource	Regions need to estimate how much of the natural resource can be harnessed using commercialised technology (currently available or expected to reach the market by 2030)
Constraints analysis	
Stage 3: Physical environment constraints	Regions need to explore the physical barriers o deployment such as areas where renewables schemes cannot practically be built – e.g. large scale wind turbines on roads and rivers etc. This layer of constraints will reduce the overall deployment opportunity. The analysis will be based on GIs maps and various relevant regional inventories
Stage 4: Planning and regulatory constraints	Regions need to apply a set of constraints relevant to each renewable technology that reflects the current planning and regulatory framework, such as excluding from the assessment areas and resources which cannot be developed due to e.g. health and safety, air/water quality, environmental protection etc.

Source: SQW

2.5 For both the opportunity and constraints analyses, the DECC methodology sets out a list of parameters and key data sources which must be used. However, in some areas there are problems adhering to this guidance as the data sources suggested within the guidance are no longer available or new, more appropriate data have become available. It is also important to note that the DECC methodology was designed to identify the potential for renewable energy at a regional level as opposed to at a county or LA level, therefore, some of the data sources and assumptions proposed within the DECC methodology have had to be amended/refined to take account of the requirements of this study and the need to disaggregate the results down to the local level.

2.6 The next section providing the renewable energy resource capacity results outlines the key assumptions used in brief, with the overarching technical report containing the final list of detailed assumptions used to undertake the resource assessments for Lancashire explaining where these have diverted from the standard DECC methodology and the assumptions used in the Northwest study.

3: Potential accessible renewable resource

3.1 This section presents the Lancashire county level and the Burnley local authority level potential accessible onshore renewable energy resource as at 2020, developed using the sequential national DECC methodology as set out in the previous section.

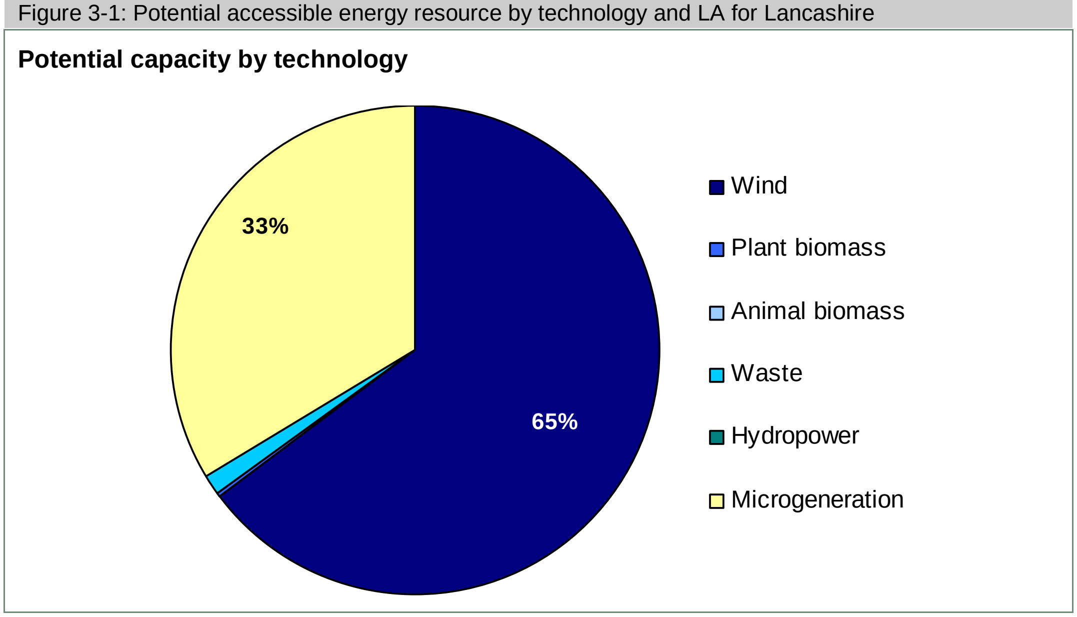
3.2 The assessment of potential accessible resource broadly represents the opportunity for harnessing the renewable energy resources on the basis of what is naturally available and accessible. Some natural resources, for example solar and wind, are available in abundant supply. In these cases the analysis focuses on what the available technology can capture and convert into useful energy.

Lancashire potential accessible resource results

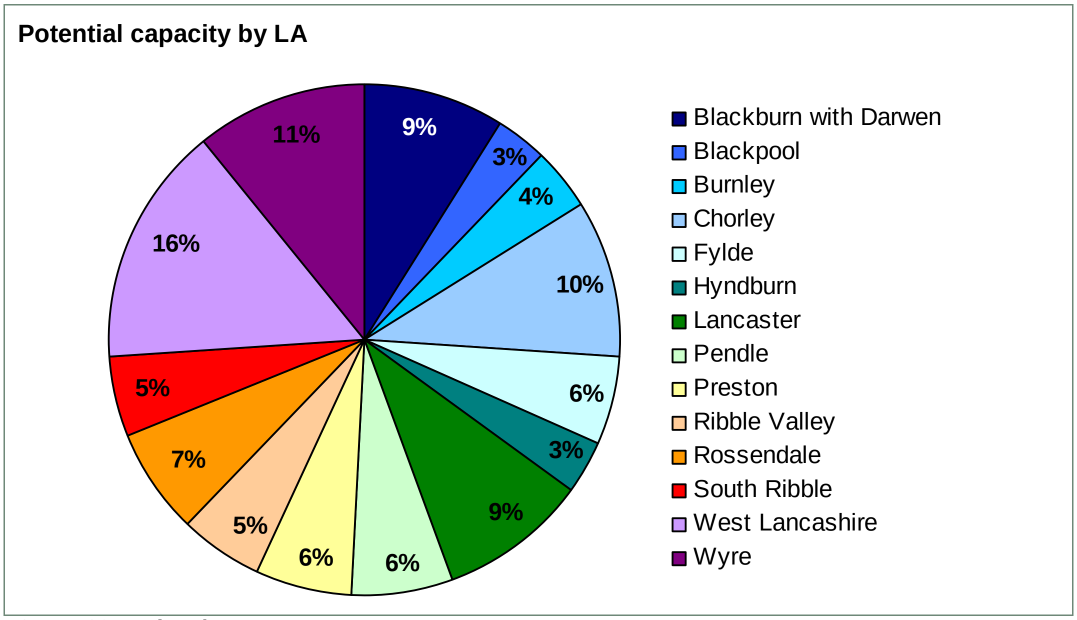
3.3 Lancashire has a potential accessible resource of 10,613 MW[8]. The distribution of this potential energy by technology type and LA contribution is depicted in the figure below. Further details of the potential energy resource by technology and LA can be found along with their heat and electricity potential in Tables A-1 and A-2 in Annex A.

3.4 Overall this shows the largest resource comes from wind (65%) followed by microgeneration (33%) with waste, biomass and hydropower providing much more modest proportions at 1%, 0.9% and 0.2% accordingly.

Figure 3-1: Potential accessible energy resource by technology and LA for Lancashire



[8] This total excludes the potential capacity for managed woodland (electricity), energy crops (electricity) and waste wood (heat) as these technologies provide both electricity and heat potential which are mutually exclusive.

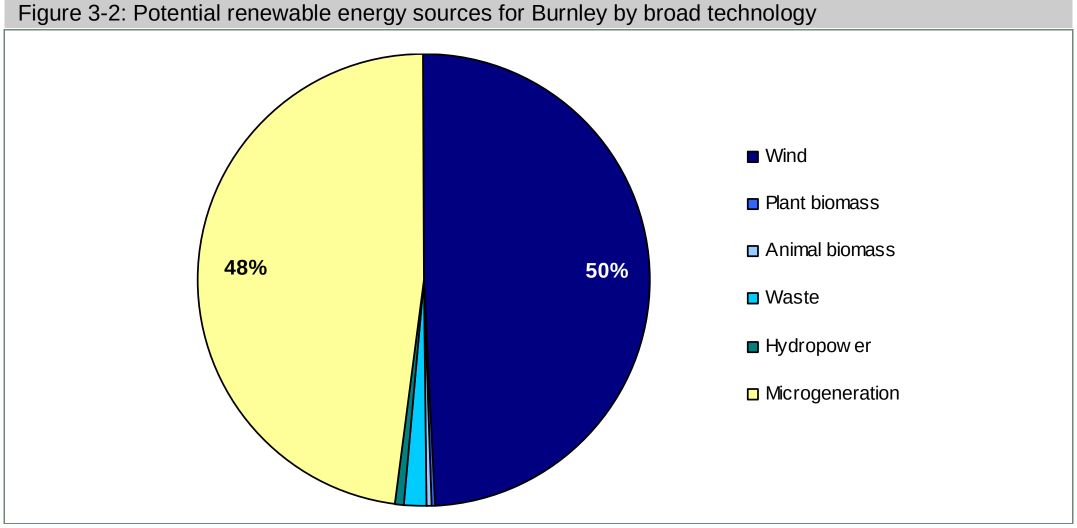


Source: SQW and Maslen

Burnley overview

3.5 The resource assessment reveals that Burnley has a potential renewable energy capacity of **408 MW**, which equates to 4% of the total capacity identified for Lancashire. The area has considerable potential for renewable energy generation from wind and micro-generation reflecting Burnley's outer urban characteristics and population density. Burnley also has the potential to generate around 7 MW of renewable energy from waste whilst other technologies such as hydropower and plant/animal biomass offer very little potential as these resources are more accessible within rural areas. A breakdown of the areas potential by broad technology is shown below.

Figure 3-2: Potential renewable energy sources for Burnley by broad technology



Source: SQW and Maslen

3.6 Burnley has no potential for the following specific technologies: energy crops, agricultural arisings, poultry litter and sewage gas.

Individual technology assessments

3.7 The remainder of this section provides further detail on the technology resource analysis for Burnley including, maps, commentary and key assumptions. Each technology is analysed in terms of:

- definition and scope (for broad technology categories)
- main assumptions
- results – all of which relate to a forecast of the potential accessible resource for renewable energy production in 2020.

Onshore wind – commercial and small scale

Table 3-1: Potential accessible wind capacity for Burnley by 2020

The natural energy of the wind can be harnessed to drive a generator that produces electricity.

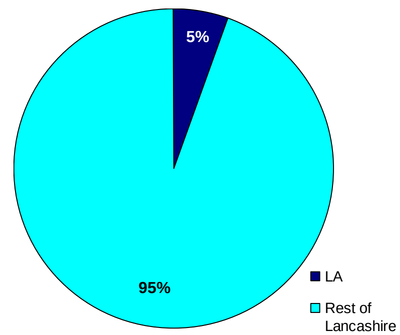
Commercial scale wind refers to on-shore wind farm developments for commercial energy generation and supply. Most such developments are connected to the national grid, however private-wire schemes are also an option and some already exist. Configurations of groups of wind turbines or individual turbines are used.

Assessing the resource potential and the deployment opportunities relates primarily to the wind speeds available within the region and the ability of current technology to harness this resource in terms of turbine design (size, efficiency) and installation requirements.

A sub-category of onshore wind is the small scale wind installations which can be defined as having capacity of less than 100 kW and typically comprise of single turbines. Small scale wind schemes have different characteristics to large scale developments.

The majority of small scale wind installations are ground-based developments, with only a few that are building integrated (on top roofs). Small scale ground-based turbines, by their nature have lower hub/tip heights of about 15 m above ground level and are viable at lower wind speeds (4.5 m/s at 10 m above ground level).

Source: DECC/CLG 2010

	Assumptions	Results
Commercial scale	The headline wind turbine assumptions consistent with the DECC Energy Capacity methodology are related to minimum wind speed (5 m/s at 45 m above ground level), specific turbine sizes, spacing between turbines, excluding residential, industrial and commercial areas and designated areas (National Parks, Areas of Outstanding National Beauty etc) and reduced deployment in bird and peat sensitive areas.	Due to its relatively urban characteristics and high population density, Burnley offers **200 MW** of potential energy from commercial wind. This is amounts to 3% of the potential commercial wind energy identified for the sub region as a whole. 
Small scale	In conjunction with the DECC methodology, the assessment of small scale wind potential is again based on specific assumptions related to minimum wind speed (4.5 m/s at 10 m above ground level), exclusion of residential, industrial and commercial areas and assumed generation of 6 kW per address point.	Burnley has virtually nil (**1 MW**) small scale wind capacity.

Source: SQW and Maslen

Biomass

Table 3-2: Potential accessible biomass capacity for Burnley by 2020

Biomass is a diverse category with regard to the type of available fuels, fuel conversion technology and type of energy output.

Fuels – different fuel categories have been used in the literature and a single agreed categorisation is still difficult to identify. The EU Renewable Energy Directive and the UK Biomass Strategy however, provide more comprehensive (and legally binding) definitions for biomass fuels. Generally, biomass fuel can arise from plants (woody or grassy), animals (manure, slurry) and human activity (industrial and municipal waste). All of these options are considered in the guidance. In most cases, the useful fuel is in a solid or gaseous form. Bioliquids (i.e. liquid fuel for energy purposes other than for transport) are also available and varied, however they are not directly included in this guidance as:

(1), they compete with the other biomass fuel categories for natural resource (productive land or bio waste) and therefore are not an additional resource, and

(2) they often need to be imported to meet commercial scale demand (e.g. palm seed oil), for which regional resource assessment is not appropriate. Biofuels (e.g. biodiesel) are those fuels used for transport purposes and are not included in this study.

Conversion technology – three main processes are currently available and used:

(1) direct combustion of solid biomass

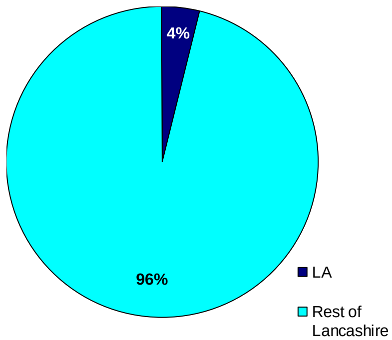
(2) pyrolysis and gasification of solid biomass

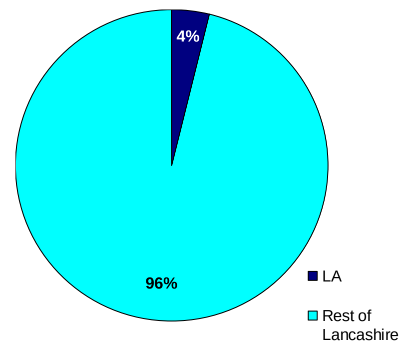
(3) anaerobic digestion of solid or liquid biomass.

Biomass fuels are in principle suitable for use in combined heat and power (CHP) plants; however, its use has not been exploited to its full potential in the UK. Assessing the capacity potential for biomass CHP however will not change the total outcome for the regional biomass opportunity and therefore is not required.

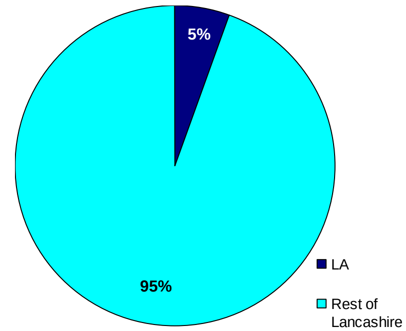
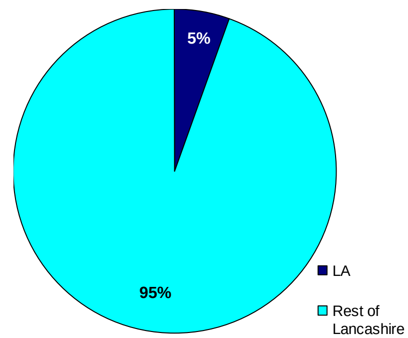
Energy output – this can be in the form of electricity or heat.

Source: DECC/CLG 2010

	Technology	Assumptions	Results
Plant Biomass	**Managed Woodland**	As per the Northwest study, the assessment has been a 'bottom-up' assessment starting with GIS data on woodland locations. Tree yield classes, a reduction for harvestable yield and proportions suitable for alternative markets have been applied in this assessment in line with those applied in the Northwest study.	Burnley has the potential to produce **0.8 MW** of heat energy from managed woodland and 0.1 MW of electricity. This equates to around 4% of the sub region's total capacity from this technology. 
	Energy crops	The DECC/CLG methodology requires the generation of estimates for heat and electricity from biomass energy crops under three scenarios - high, medium and low as follows: • High – assumes that all available arable land and pasture will be planted with energy crops • Medium – assumes that all abandoned land and pasture will be planted with energy crops • Low – assumes that new crops will only be planted to the extent of submitted applications to the Energy Crop Scheme. The High scenario is considered to be unrealistic and therefore the Medium and Low scenarios have been adopted with results provided for the Medium scenario as	Burnley does not have the potential for energy crops due to its urban characteristics.

		this is considered the most appropriate and realistic.	
	Waste wood	As in the Northwest Study, the 2009 WRAP Report 'Wood Waste Market in the UK' was used as a basis for the resource assessment; the figures have been disaggregated to a local level based on the employee numbers in each area. The main assumptions consistent with the DECC methodology are: • the exclusion of Municipal Solid Waste • the conversion to useful energy through direct combustion • benchmark of 6,000 tonnes oven dried tonnes per year generate 1 MW electricity • increase in resource of 1% per annum to 2020.	The resource assessment identified that **0.3 MW** of heat and 0.3 MW of electricity could be produced from waste wood in Burnley respectively. Amounting to 4% of the sub region's total waste wood potential. 
	Agricultural arisings (straw)	The assumptions and data sources for agricultural arisings (straw) are in line with the DECC/CLG methodology. Straw is assumed to come from wheat and oil seed rape only, specific yields are identified (3.5 tonnes per ha of wheat; 1.5 tonnes per ha of oil seed rape) and the available resource is constrained by competing uses of straw for animal bedding.	There is no potential for agricultural arisings in Burnley.
Animal Biomass	**Wet organic waste**	As in the Northwest study standard animal waste factors have been applied. Food and drink waste has been approximated by the total 'animal and vegetable wastes' produced by the food, drink and tobacco and retail and wholesale sectors. The main assumptions include:	A total of **1 MW** of wet organic waste potential has been identified for Burnley, this equates to around 2% of the sub region's aggregate capacity from this technology.

		• 37k tonnes of wet organic waste is required per 1 MW • livestock numbers will stay the same whilst food and drink quantities will rise by 0.5% pa • there are no competing uses for animal resource but 50% for food and drink.	
	Poultry litter	The 2007 DEFRA Agricultural and Horticultural Census has been used to obtain the number of broiler birds (table chickens) within each LA. It must be noted that gaps exist in the LA figures due to confidentiality issues. The general assumptions used are: • production of 16.5 tonnes of poultry litter per 1,000 birds • 11k tonnes equals 1 MW • no competing uses for poultry litter.	Burnley has no potential to produce energy from poultry litter.
Waste	**Municipal solid waste (MSW)**	The potential for MSW was assessed assuming direct combustion of the resource. A benchmark of 10 kilo tonnes of MSW for 1 MW of electricity capacity was applied. The Biodegradable Municipal Waste (BMW) portion of municipal waste was assumed to be 68% of the total MSW amount. The remainder of the resource was excluded, reflecting the DECC/CLG methodology. In projecting to 2020, waste is assumed to rise in line with household growth, but in terms of the assumptions to 2020, it was assumed that waste would rise in line with household growth in each local authority, but the amount of waste generated per household is assumed to remain constant.	Due to its relatively dense population Burnley has the potential to produce **2 MW** of renewable energy from municipal solid waste, over 5% of the sub region's total MSW potential.

			
	Commercial & Industrial (C&I) waste	The potential for C&I waste was assessed assuming direct combustion of the resource, using similar assumptions to the MSW assessment. Only the waste streams that had a high organic content (animal and vegetable waste and non-metallic waste) that were not accounted for in any of the other resource categories were used. In order to derive figures for the LA, employee numbers were used as a proxy, as used for the industrial waste wood assessment.	The resource assessment identified that Burnley has the potential to produce **3 MW** of electricity from commercial and industrial waste, almost 5% of the sub region's total potential for this technology. 

	Biogas	The assumptions made for Biogas varied from those in the DECC methodology, due to a lack of data but are consistent with the Northwest report. It is assumed that Landfill Gas production will lag behind the decrease in waste sent to landfill due to the natural process of waste decomposition resulting in constant landfill capacity to 2015, followed by a straight line reduction in capacity thereafter. For sewage gas it is assumed that there will be a 50% increase in capacity from 2010 to 2020 based on more efficient technology and smaller units becoming more economically viable. Population projections have also been taken into account to determine the future resource.	A significant amount of landfill gas potential has been identified for Burnley (**2 MW**) equating to around 11% of the sub region's total landfill gas potential. In contrast, Burnley has no potential for sewage gas.

Source: SQW and Maslen

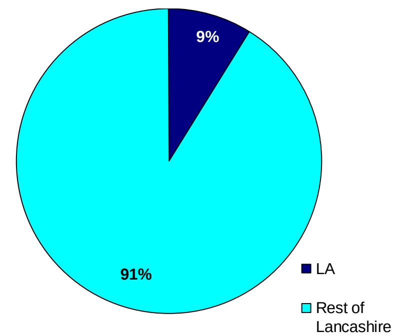
Hydropower

Table 3-3: Potential accessible hydropower capacity for Burnley by 2020

Hydropower involves harnessing the power of flowing or falling water through a turbine in order to produce electricity. The parameters determining the amount of electricity produced include the turbine generating capacity, the turbine discharge flow (the volume of water passing through the turbine at any given time, which will change depending on the time of year) and available head (the vertical distance between the point where the water is highest and the turbine). The larger the head, the more gravitational energy can be converted to electrical energy. Hydropower can also be combined with storage (pumped storage), by pumping water from a low elevation to a high elevation at times of plentiful supply of electricity for release when needed.

For the purposes of assessing the hydropower resource, small-scale hydro power (under 20 MW) is considered because opportunities for large-scale hydro (e.g. large dams) are becoming more and more limited. This is because most of the major sites for hydro have already been used along with environmental concerns over the adverse impact of large-scale hydro on local ecosystems and habitats and changes to the natural river flow and intensity. In contrast, small-scale hydro installations can be sited at small rivers and streams with little adverse impact on the river's ecology, for example, on fish migration patterns.

Source: DECC/CLG 2010

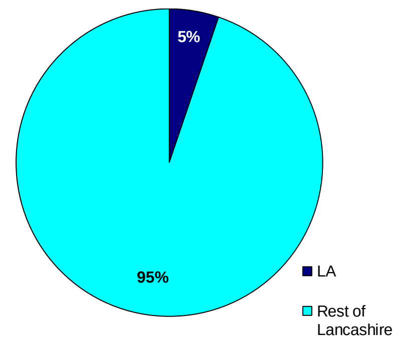
	Assumptions	Results
Small scale hydropower	In accordance with the DECC methodology GIS data from the Environment Agency was obtained and disaggregated to the LA level. All barriers were included as recent studies that have resulted in more constrained capacity by excluding in designated areas and barriers with low generation potential have been more concerned with commercial opportunities. Barriers with small generation potential and in designated areas may still provide opportunities for small scale community level schemes.	Burnley accounts for around 9% of Lancashire's potential hydropower capacity with a potential capacity of **2 MW**. 

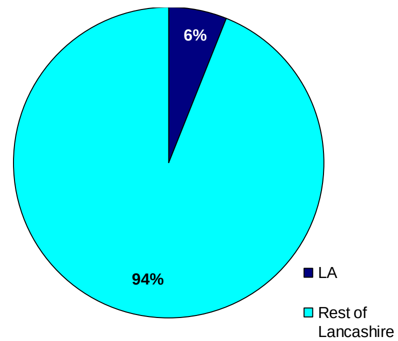
Source: SQW and Maslen

Microgeneration

Table 3-4: Potential accessible microgeneration capacity for Burnley by 2020

Microgeneration typically refers to renewable energy systems that can be integrated into buildings to primarily serve the on-site energy demand. They are applicable to both domestic and non-domestic buildings and can be connected to the grid although this is not required as most of the output is used on-site. Thus micro-generation systems are typically designed and sized either in relation to the on-site demand or in proportion to the physical constraints on-site such as available space, which ever is more appropriate. Micro-generation technologies cover the full range of renewable energy categories: wind, solar, biomass, hydropower and heat pumps. Technologies that directly depend on the built environment capacity to take micro-generation systems are solar – solar water heating (thermal) and solar photovoltaic (electric) – and heat pumps – grounds source heat pumps and air source heat pumps. *Source: DECC/ CLG 2010*	

	Technology	Assumptions	Results
Solar	**Solar photovoltaic** **Solar waste heat**	The assumptions made for solar micro-generation were largely consistent with the DECC/CLG methodology. As with the Northwest study, it was necessary to make some additional assumptions for the average unit capacity for industrial properties. In this case it was assumed that the average size for solar was 10 kW for industrial properties. In line with the DECC methodology and the Northwest study, this assessment considers the potential based on number of residential, commercial and industrial properties as well as new housing that will be built up to 2020. The DECC assumptions concerning the proportion of suitable properties and the MW capacity of each property type have been used. This study has also taken account of the potential increase in the number of commercial, industrial, public and community buildings, through the application of employment and annual population growth rates.	Micro-generation accounts for 48% of Burnley's total renewable energy capacity. The potential solar capacity of Burnley in 2020 is **35 MW** consisting of **17 MW** from solar photovoltaic and **18 MW** from solar water heating. This equates to 5% of the Lancashire sub region's total solar potential. 
Heat pumps	**Air Source Heat Pumps (ASHP)** **Ground Source Heat**	The assumptions made for Heat Pumps are largely consistent with the DECC methodology and follow that of the Northwest study. The main diversion from this methodology is that the potential increase in the number of commercial, industrial, public and community buildings has been included. The split between ASHPs and GSHPs was assumed to be 80% ASHP and 20% GSHP because ASHPs are suitable for installation in more properties and cause less disruption when installing; hence making them more attractive to	The total potential heat pump capacity of Burnley in 2020 is **161 MW**, which equates to 6% of the Lancashire sub-region's total heat pump capacity. Burnley has a potential ASHP capacity of **129MW** and a GSHP of **32 MW.**

	Pumps (GSHP)	potential customers. The key assumptions used to calculate heat pump capacity include the proportion of suitable existing and future property, the proportion of off-grid and on-grid properties; the proportion of dwelling types and the MW capacity of each property type.	

Source: SQW and Maslen

Low carbon and waste heat

Table 3-5: Potential accessible low carbon and waste heat resource for Burnley

Low carbon energy is defined for the purposes of the DECC methodology as Combined Heat and Power (CHP) or tri-generation (to include cooling), and district heating schemes. Whilst not directly fulfilling commitments under the UK Renewable Energy Strategy, low carbon sources of energy supply will be an important part of the mix of technologies that the Lancashire sub-region can employ to reduce carbon emissions. Low carbon technologies represent potentially cost effective alternative solutions. Both district heating and CHP plants can be fuelled by a number of sources, including biomass. The choice of fuels can affect the overall carbon savings for a plant.

At a national level, energy policy is being developed to help meet the significant heat and low-carbon energy requirement of the UK. For example, DECC is currently developing the Renewable Heat Incentive (RHI)[9], aimed at encouraging the use of renewable heat sources. Unlike most of the renewable energy categories which are assessed on the basis of the supply side (i.e. resource availability), low carbon opportunities referred to in the DECC methodology are a function of available heat demand.

No regional waste heat assessment methodology is outlined in the DECC methodology. However, it was considered important to include within this study as part of the overall assessment of low carbon sources. As such, the study team has used a methodology specifically for this purpose.

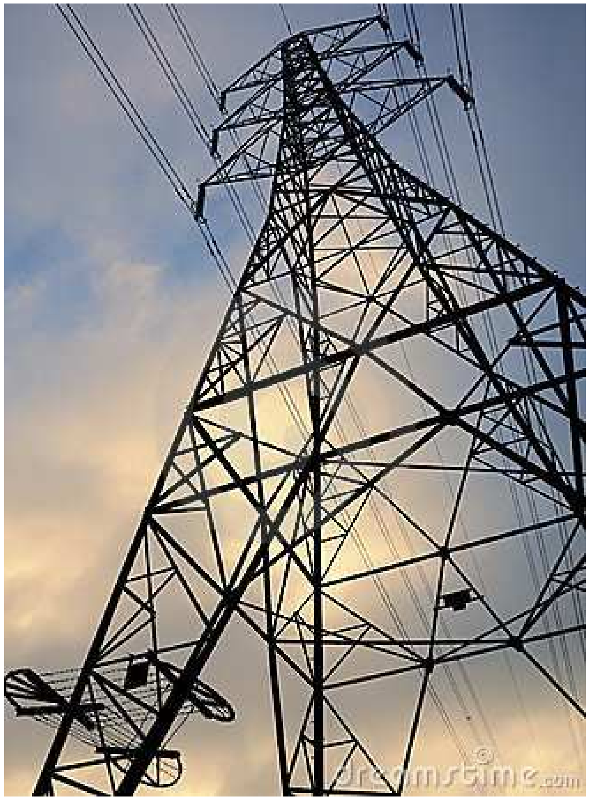
Waste heat is heat produced within a process which is not in a directly useful form (e.g. heat produced by air conditioning system, heat from an exhaust, or heat radiated from a blast furnace). Though no longer directly useful to the initial process, this heat could be put to use if there is an end-user who requires the heat and has a way to recover it.

9 DECC Renewable Heat Incentive (RHI)
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/policy/renewable_heat/incentive/incentive.aspx

	Technology	Assumptions	Results
Heat Demand **(Domestic and Commercial)**	**CHP and District Heating,**	The DECC methodology states that if the heat density exceeds 3,000 kW/km^2, the heat density is considered to be high and, district heating is likely to be economically viable in a high proportion of buildings, such as flats. • Heat density was calculated by assuming that gas consumed by a Mid Level Super Output area is consumed solely within the settlement areas. The area outside of these is assumed to have a heat demand of zero.	In the authority of **Burnley** heat demand exceeds the DECC recommended threshold of 3,000 kW/km^2 to the north of the area, immediately in and around the town of Burnley itself, and therefore provides good opportunities for CHP and district heating. The surrounding areas are unsuitable, particularly to the east, south and west of the authority. See total heat demand, domestic heat demand and commercial/industrial heat demand maps at Local Authority level to identify priority areas.
Waste Heat	**CHP and District Heating,**	Using Standard Industrial Classification code date means it is impossible to know the exact nature of the processes at each enterprise. However it does give an indication of the number of opportunities available. To develop this initial assessment further to identify the best opportunities for waste heat resource development within each local authority, the following steps could be undertaken; • Obtain site specific data available for the sites in the SIC categories with the best potential to be a waste heat source. This is available on request for Local Authorities from the Office for National Statistics (http://www.statistics.gov.uk/idbr/localauthorities.asp); • Compare the locations of these sites with the heat map developed for this study, to identify sources in areas with high heat densities, and thus potential end-users; and • Approach individual enterprises with the best mixture of heat source and end users to conduct site specific assessments.	In **Burnley** there one existing CHP site, no thermal power stations and no sites with particularly high heat loads. The assessment has identified a large numbers of potential waste heat sites (20 with high, 85 with medium and 210 with low heat demands respectively). It is assumed most sites are concentrated near the town of Burnley with a potential for end users to tap into this resource, for those in more rural locations this is less likely.

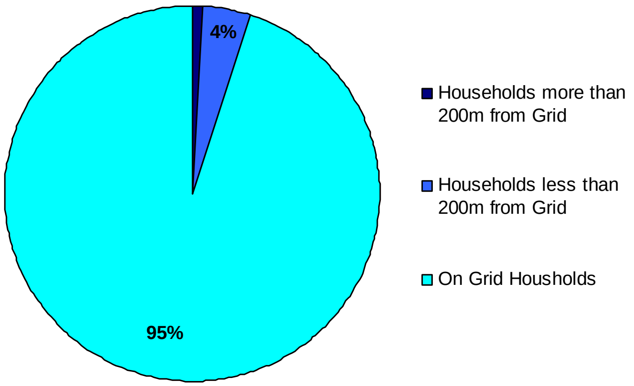
4: Grid constraints

Table 4-1: Grid Constraints for Lancashire

Within Lancashire there are three electricity District Network Operators (DNOs): Electricity North West (ENW) and Scottish Power (SP MANWEB). The DNO's role is central to understanding the feasibility of renewable sources connecting to the local distribution networks. All the DNOs which serve the Lancashire area recognise in their Long Term Development Plans that there will be a variety of generators wishing to export to their grids in the future and that their networks will have to adapt to this. The distribution networks often have limited spare connection capacity and may require upgrading or modifying to allow connection of a renewable energy installation. Access to higher capacity grid connections (33 kV and 132 kV) usually affect larger capacity technologies such as commercial wind farms. Smaller scale technologies such as hydropower and anaerobic digestion plants can usually connect to 11 kV networks or lower which are more readily available particularly around urban areas. Micro-generation plants are not required to enter into a contract with the DNO, which limits grid constraints upon them. It also should be noted that if a plant is below 300 kW heat and 50 kW electricity installed capacity a smaller connection capacity is required and so it is much easier to connect.	

		Methodology	Results
Electricity Network	**Network Distribution and Capacity**	A **Lancashire** wide approach has been adopted, to provide analysis at sub-regional level which involved: • Development of a GIS map for Lancashire based on published network operator Long Term Development Plans, including 33 kV and 132 kV networks has been produced demonstrating the extent of the network and distance to a grid connection. • Future investment plans for the network operators (particularly those related to renewable energy) will also be mapped in GIS. At **Local Authority** scale it was possible to provide a higher level of understanding of the extent of three DNO networks; ENW, YEDL and SPManWeb (data currently unavailable for SP ManWeb) operating in the study area. Further analysis was carried out using further research, ArcGIS and a renewable energy grid connection assessment tool developed by Senergy e-connect to validate our findings. It was possible to highlight the main constrained renewable development areas limited by grid connection – i.e. areas a large distance away from the grid. The distance between the sub-station and the connection point is of critical commercial relevance, if distance to grid increases so does cost and in many cases planning significance. Electricity distribution grid data has not been mapped at Local Authority scale due to limitations of data, but is available for the Lancashire study area (see fig. A15) In addition capacity data of the distribution network was not	Across Lancashire as a whole there are no major issues concerning access to the grid. However, designated areas are prone to poor grid connection, due to planning constraints. For example the Forest of Bowland AONB in Lancaster and the Ribble Valley and the Arnside and Silverdale AONB at Carnforth to the north west of Lancaster have poor grid access making them a much more constrained and costly place to develop. It is important to note that quite a number of windfarms have been developed in and around the south east of Lancashire to exploit the unconstrained wind resources. Therefore these areas are serviced particularly well by the grid. **Burnley** on the whole is well served by distribution 33 kV and 132 kV networks to the north around the town of Burnley itself. Renewable resources developed around Deerplay Moor would require some investment to enable a grid connection as approximate distance is between 1-2 km.

		available at local authority scale. Therefore these factors have not been taken into account in the analysis. Through consultation with the DNO's it was stated that all site related capacity issues be raised directly with ENW, YEDL or SPManweb. Or third party services are available such as the Senergy grid assessment tool.	
Gas Network	**Distribution Network**	Through consultation with the National Grid, Gas Network digital mapping data was obtained. Using this, areas where there is 'a lack of a gas distribution network' have been identified and mapped in GIS at Local Authority Level. This analysis identifies properties in areas without gas provision, these properties pose better economic opportunities for alternative forms of heat sources; these could include ASH, GSH, CHP, CCHP and Solar Thermal. To provide practical analysis, all properties were identified as without gas network provision (i.e. 'off-grid') if located 200m or more away from the nearest distribution gas pipe. This 'off-grid' estimate allows an identification of properties using a gas alternative for heating and cooking provided or electricity as a heating method, (common in recent flat developments). The total number of residential properties 'off-grid' has been estimated from DECC domestic gas consumption statistics	The proportion of 'off-grid' properties in each local authority ranges between 5 and 20%. However it appears a proportion of these properties that are not connected to the grid due to distance constraints, varies between authorities. By analysing the proportion of properties with a distance greater than 200 m from the gas grid ranges from 0 to 15%, with an average of 3%. The local authorities at the higher end of this range include Ribble Valley and Lancaster. These authorities have large rural populations, with large areas not served by the grid. Authorities at the lower end of this range include Blackpool and Hyndburn. The majority of off-grid properties in these authorities appear to be in the urban areas close to the gas network and therefore a lack of gas grid provision is not the reason for there no connection. All properties 200 m from the grid offer a better economic case for development of renewable heat sources.

		and OS address point data. For **Local Authority** specific gas grid information see figure A16. A calculation spreadsheet has been provided for this assessment.	The main urban areas of **Burnley** are served by the gas network with large areas to the east and south being poorly served. 5% of residential properties in the area are off the gas grid, and 0.78% are greater than 200 m from the grid. This 0.78%, in the more isolated areas, is likely to present the best economic opportunities for micro-generation heating. 

5: Concluding comments and next steps

Conclusions

5.1 This report has provided a renewable energy resource assessment for Burnley at 2020 for the following technologies:

- Onshore wind – large scale and small scale
- Biomass – plant biomass, animal biomass and waste
- Hydropower – small scale
- Microgeneration – solar photovoltaics and water heating, and heat pumps.

5.2 The report is firmly grounded in the previous renewable energy capacity and deployment study undertaken for the Northwest in 2010. The assumptions used largely reflect those adopted for the Northwest study (which in turn reflect the nationally adopted DECC methodology) with some updates to improve the evidence base for Lancashire authorities. The supporting technical report provides further detail on the methodology and assumptions employed.

5.3 The study has also included an overview of grid infrastructure constraints and gas infrastructure across Lancashire noting where there are any weaknesses and where future improvements are planned in terms of both connections and capacity. There are no significant issues for Burnley concerning grid infrastructure and connections that could constrain future renewable energy deployment.

5.4 Further the capacity potential for low carbon sources - Combined Heat and Power or tri-generation (to include cooling) and district heating schemes has also been explored, but not been included within the overall resource assessment as this warrants further more detailed consideration. In addition, an assessment of the potential capacity from waste heat has also been undertaken but is not included within the overall assessment as this technology is not recognised within the DECC methodology.

5.5 Overall, the assessments have identified an overall renewable energy capacity for Burnley of **408 MW.** The technology providing the largest resource is wind closely followed by micro-generation, with much smaller amounts of available resource in the form of waste, biomass and wind. Moderate capacity is identified for hydropower. It is important that the basis for these assessments is understood. This resource assessment provides an estimation of ***technical*** potential not the ***deployable*** potential. Many other factors need to be taken into account to identify the likely level of deployment overtime including load factors, further economic, environmental and planning constraints, financial support mechanisms and future technological developments which will impact on take up.

5.6 The study has employed Stages 1-4 of the DECC methodology, further work is needed to follow through Stages 5-8 which is where detailed constraints to deployment come into play such as economic viability and detailed planning and licensing issues.

5.7 However, the resource identified is considerable and deployment of a significant proportion of this would help Burnley, and Lancashire make a substantial contribution towards national renewable energy targets.

Next steps

5.8 As detailed above, the assessment of renewable energy resource potential has been developed through identifying the naturally occurring resource and applying some high level constraints in accordance with the national methodology. ***It does not represent the potential that could, should or is likely to be deployed.*** It is essential that the report's findings are disseminated and promoted as such. Any misinterpretation of this overarching message may be to the detriment of future renewable energy deployment within Burnley.

5.9 The study provides an evidence base for Burnley which has been replicated across each local authority in Lancashire. These individual assessment results provide a starting point from which LAs should undertake further work to better understand the ***opportunities and challenges that need to be addressed*** to maximise renewable energy deployment within their areas. This work could consist of the following:

- **Identification of deployment constraints and how they apply locally**. These should be filtered to focus on the constraints that are likely to have a material impact on the potential deployment of the theoretical opportunity. These are likely to include economic viability, supply chain, transmission constraints, and planning constraints.
- **Development of deployment scenarios** to 2020 to enable policy ambitions/targets to be framed. This would involve building in the above constraints to develop a range of potential outcomes based on cautious and identified targets as a percentage of future projected electricity demand.
- **Further work with local communities** to promote renewable energy schemes, supported by the increased focus on localism and financial support available to promote such initiatives.
- **Development of planning guidance** to encourage further deployment of renewable energy resources, which can be further supported through the current work being undertaken through the Climate Change Local Area Support Programme (CLASP). This should also help to ***maximise capacity, knowledge and skills*** within planning and other renewable energy practitioners. As this is still a relatively 'new' area, LAs within Lancashire should work closely together to maximise good practice sharing and learning.

Annex A: Potential renewable energy capacity results for Lancashire

A.1 The following table presents the detailed results for each technology for each local authority across the Lancashire sub region.

Table A-1: Potential accessible renewable energy resource by local authority area

	Wind		Biomass			Hydro power	Micro-generation		
	Commercial scale	**Small scale**	**Plant biomass**	**Animal biomass**	**Waste**	**Small scale**	**Solar**	**Heat pumps**	**Total[10]**
Blackburn with Darwen	592	11	2	1	12	2	58	255	**933**
Blackpool	1	0	1	0.1	9	0	65	286	**362**
Burnley	200	1	1	1	7	2	35	161	**408**
Chorley	755	33	3	4	9	1	47	205	**1,057**
Fylde	371	8	2	5	9	0	39	170	**604**
Hyndburn	171	0	1	1	7	1	32	149	**362**
Lancaster	598	36	6	11	12	4	63	275	**1,004**
Pendle	446	4	1	2	5	1	36	165	**661**
Preston	285	27	2	5	12	1	61	268	**661**
Ribble Valley	361	12	6	9	4	5	31	129	**557**
Rossendale	516	0	1	1	5	3	30	135	**691**
South Ribble	257	11	3	3	9	1	44	200	**529**
West Lancashire	1,292	44	14	3	7	1	50	220	**1,630**
Wyre	828	29	3	8	11	1	51	225	**1,155**
Lancashire total[11]	**6,674**	**215**	**46**	**54**	**117**	**21**	**642**	**2,844**	**10,613**

Source: SQW and Maslen Environment

[10] Figures may not total due to rounding
[11] Figures may not total due to rounding

A.2 The following table presents the heat and electricity potential of each local authority and the proportion of the sub-regional total.

Table A-2: Potential resource capacity split be electricity and heat generation

	Electricity (MW)	Heat (MW)	Total (MW)[12]	Proportion of Lancashire total (%)
Blackburn with Darwen	647	286	933	9
Blackpool	42	320	362	3
Burnley	228	180	408	4
Chorley	826	232	1,057	10
Fylde	413	192	604	6
Hyndburn	196	166	362	3
Lancaster	694	312	1,004	9
Pendle	477	184	661	6
Preston	361	301	661	6
Ribble Valley	407	151	557	5
Rossendale	540	151	691	7
South Ribble	306	225	529	5
West Lancashire	1,375	257	1,630	15
Wyre	903	253	1,155	11
Lancashire total[13]	**7,416**	**3,210**	**10,613**	**100**

Source: SQW and Maslen Environmental

[12] Total does not equal the sum of electricity and heat capacity as they are mutually exclusive for some technologies.
[13] Some totals are inaccurate by 1MW due to rounding

A.3 Finally Table A-3 shows the proportion of sub-regional capacity for each renewable energy resource within each local authority.

Table A-3:Proportion of sub-regional resource within each local authority

	Local authority proportion of sub-regional resource totals							
	Wind		**Biomass**		**Waste**	**Hydro**	**Micro-generation**	
	Commercial scale	**Small scale**	**Plant biomass**	**Animal biomass**	**Waste**	**Small scale**	**Solar**	**Heat pumps**
Blackburn with Darwen	9	5	5	2	10	9	9	9
Blackpool	0	0	1	0	8	0	10	10
Burnley	3	0	2	1	6	9	5	6
Chorley	11	15	8	7	7	4	7	7
Fylde	6	4	4	8	7	0	6	6
Hyndburn	3	0	1	2	6	4	5	5
Lancaster	9	17	12	20	11	20	10	10
Pendle	7	2	2	4	5	5	6	6
Preston	4	13	4	9	10	3	10	9
Ribble Valley	5	5	13	18	3	24	5	5
Rossendale	8	0	2	2	4	12	5	5
South Ribble	4	5	7	6	8	5	7	7
West Lancashire	19	20	30	4	6	5	8	8
Wyre	12	13	7	15	9	3	8	8

Source: SQW and Maslen Environmental