South Ribble Borough Council

Opportunities for Renewable Energy in the Borough

June 2010

Renewable Energy

The Governments definition of renewable energy is:

"Renewable energy is the term used to describe those energy flows that occur naturally and repeatedly in the environment, e.g. from the sun, wind and the oceans and from plants and the fall of water. It also refers to the energy available from the emerging clean technology of fuel cells, unless the electricity used to charge such fuel cells is sourced from conventional non-renewable sources" DTI

Onshore Wind Developments

Wind power is technically proven energy technology. The use of wind as a renewable energy source involves harnessing of power contained in moving air by wind turbines. Wind turbines use aerodynamic forces ('lift' and 'drag') to produce mechanical power that can be converted into electricity.

Turbines can be classified into three main types – large grid connected machines (i.e. >200 kw), smaller, stand alone turbines (i.e. 25kw to 50kw) and micro-scale/building mounted turbines (<25kw). Turbines typically start operating at wind speeds of 4-5 metres/second, reaching a maximum level at 15 metres/second. For economic electricity generation, wind turbines need an uninterrupted wind flow. The performance of the turbine will be affected by a variety of factors, including the average wind speed, variation in wind speed, size of the blade, height of the turbine, the area 'swept' by the blade and presence of obstructions.

Small-scale wind developments are typically schemes with an output of less than 3MW. These can be built to power facilities of any kind and/or can be used connected to the electricity grid network. In the UK, wind turbines have traditionally been used to power remote farms and houses but can equally be used to contribute towards power generation for offices, industrial premises and public buildings, provided the prevailing wind conditions and location are suitable.

Main factors to consider for larger developments, greater than 3MW:

- The annual mean wind speed is greater than 6.5 metres per second (at 40 metres).
- Turbines should be located either within 12 km of the 33Kv grid network, or 20 km of the 132km network.
- Turbines should not normally be located nearer than 500m to domestic dwellings, this distance relates to noise levels rather than visual effects.
- Turbines can be located within national designations (eg SSSI's, National Nature Reserves, National Parks, AONB's and Heritage Coasts) if the objectives of the designation of the area are not compromised by the development and when significant adverse effects on the qualities for which the area has been designated are clearly outweighed by the environmental, social and economic benefits.
- Turbines can be located in Green Belts only where developers can demonstrate special circumstances that clearly outweigh any harm to the openness of the area.
- Sites should be accessible to all components and machinery used during the construction phase.

Main factors to consider for smaller developments up to 3MW installed capacity:

- The annual mean wind speed is greater than 6.5 metres per second.
- Turbines should be located within 4 km of a high voltage network substation.

Main factors to consider for building-mounted micro scale and other small scale turbines:

- Applicable to any type of property.
- Wind speed needs to be greater than 4 metres per second.

Potential Opportunities for South Ribble

The maps show that all of the Borough has wind speeds of greater than 4m/s. There is therefore considerable potential for building mounted micro scale and other small scale turbines in the Borough. Building mounted facilities could be fixed onto all residential, public or business related buildings, subject to any special historical planning restrictions and technical conditions. In the case of schools, this would need to be investigated in conjunction with Lancashire County Council, as the Local Education Authority. Wellfield Business and Enterprise College in Leyland currently has a small scale turbine. The Tesco Extra Store, in Leyland, has planning permission for six small turbines on the roof of the building, but this permission has yet to be implemented. Many of the public buildings in the Borough could be suitable for the integration of small scale wind turbines. Small and micro scale wind turbines should be considered as part of all planned housing and business developments/new employment sites but account will need to be taken of any significant physical obstructions.

The relatively low lying nature of South Ribble means that there are fewer potential opportunities for both small and large scale developments of wind turbines in South Ribble compared to areas with elevated typography. There are only very few areas which have wind speeds of greater than 6m/s, and several of these could not be explored due to their proximity to residential areas. However, the Ribble estuary area is free of major obstructions and exposed to the prevailing westerly winds.

Small Scale Hydro

Description – Electricity produced by hydro power occurs when a flow of water is channelled through a turbine connected to an electricity generator. The amount of power produced at a site depends no the rate of flow and the volume of water available. Hydro-electric schemes are generally divided into two broad categories: large scale (more than 5MW output); and small scale (less than 5MW output).

Small scale hydro schemes can supply electricity direct to the national grid for use in any sector, or can be used to supply power to commercial properties and residential developments. It should also be noted that only small-scale hydro schemes are eligible for support under the Renewables Obligation.

Main factors to consider:

- Hydro electric turbines should be located at sites identified within the “Small-Scale Hydro Electric Generation Potential in the UK” study.
- Small scale hydro installations should be located either immediately adjacent to a single point user (i.e. an existing non-domestic energy user or allocated employment site) or within 4km of the high voltage network (this is size dependent).
- Small-scale hydro may be applicable within existing infrastructure.

Potential Opportunities for South Ribble

There are a number of rivers in the Borough, but currently no specific identified locations where small or micro scale hydro electric facilities are feasible. Roach Bridge Mill in Samlesbury is the only location where this technology will be operational in the near future. It is understood that any electricity generated will be used to power the development currently under construction, which is predominantly for the provision of office and employment accommodation on the site of the former Roach Bridge Mill. The topography of the Borough, which is relatively flat, would result in opportunities for this technology in the Borough being limited.

There is a weir located near to Coupe's Foundry in Higher Walton. However, potential here could be affected by the residential development on the site, and the distance away from the high voltage power-line network.

The use of tidal energy is also an option. The River Ribble is tidal to up stream of Preston. There have previously been proposals for a barrage across the river but less ambitious schemes involving semi-submerged tidal turbines may well be viable in the future.

Landfill Gas

Description – Landfill gas is generated by the natural processes of decay in biodegradable waste or biomass (anaerobic decomposition). Methane is the main product, particularly in later phases of gas generation. At larger landfill sites, the gas generated may occur in quantities which make electricity production economically viable. The technology for harnessing landfill gas is well established. The gas is collected from the landfill site through gas wells, consisting mainly of perforated plastic pipe drilled into the waste. The gas is extracted through the use of a suction pump. Landfill sites vary widely in the amount of gas they produce, as the size of the site, the moisture content of the waste and other factors can affect the generation of landfill gas.

The common types of engine used to combust landfill gas in the UK is expected to rise as EU Directives to control the methane emissions in the atmosphere are put into effect. In the longer term, beyond 2005, the number of new landfill gas recovery schemes is expected to decline as the implementation of the EU Landfill Directive diverts organic wastes away from landfill and this reduces the potential for methane generation.

Main factors to consider:

- Landfill gas plants should be located at existing licensed or permitted landfill sites, which accept biodegradable waste.
- Landfill sites should not be smaller than 500,000 tonnes in waste capacity of which this volume must have been deposited post 1993.
- The landfill site should be located within 5km of the high voltage grid network.
- Sites should still be receiving waste and have contracts in the future.
- An existing gas migration system should be in place.

Potential Opportunities for South Ribble

There are several landfill sites identified within the Borough. The management of methane emissions are done through the Lancashire County Council Minerals and Waste Development Framework Core Strategy (2008). The Core Strategy identifies no sites as safeguarded in South Ribble for the future disposal of waste and also states there are no existing strategic biodegradable landfill sites in South Ribble either. So the scope for utilising the energy of landfill gas in South Ribble is limited.

Anaerobic Digestion

Anaerobic digestion (AD) is a process where organic wastes are digested under anaerobic (i.e. oxygen-free) conditions by bacteria to produce biogas. The bacteria used in the AD process eat away at the organic waste and produce methane rich biogas which is then used to generate electricity and/or hot water/heating and as a transport fuel similar to compressed natural gas (CNG).

Anaerobic digestion bio-reactors can be used wherever there is a suitable organic waste stream. AD processes can be used to generate electricity/heat using industrial food waste, agricultural waste and sewage waste. This waste feedstock can also be supplemented by other organic waste

products such as waste from paper and textile mills, dairy waste products, fish oil and residues, crushed oil waste (for example, rape and sunflower seed) and brewery residues.

Projects can be developed on a small-scale to suit individual facilities and wastes (for example, in farm or dairy situations), or on a much larger scale to take a variety of wastes (including industrial amounts) as part of a centralised anaerobic digestion facility.

Main factors to consider:

- Centralised Anaerobic Digester (CAD) plant should be located on industrialised sites or previously developed land.
- CAD and smaller scale plant should be located in close proximity to feedstock (e.g. food/farm waste, other organic wastes).
- CAD plant should be located close to the high voltage grid network (proximity to the network depends on the size of the plant).
- Sustainable outlets must exist for the by-products of anaerobic digestion [i.e., liquor (liquid fertiliser) and fibre (soil conditioner)]

Potential Opportunities for South Ribble

South Ribble has a number of farms located within the Borough boundaries which may, either by themselves or co-operatively, be suitable locations for a facility that takes farm waste and other organic waste materials from within the Borough. It will be necessary to explore what facilities there are producing unused organic waste materials and the quantities produced. There are currently no anaerobic digestion facilities of any kind in the Borough.

Biomass (woody waste and/or energy crops)

Wood is another form of biomass that can be used to generate heat and electricity. British BioGen indicate that wood-based biomass feedstocks fall into the following two main categories:

- Dependent biomass resources: Arising as byproducts of other activities (for example, wood residues and recovered wood waste and straw, and forest residues).
- Dedicated biomass resources: Energy crops grown specifically for fuel (for example, Short Rotation Coppice (SRC) and grasses).

A wide range of biomass feedstocks can be used directly or processed into solid biomass fuels (for example, wood chips and pellets). These feedstocks can be burnt directly to produce heat using stoves, boiler plant and process heat, or raise steam to generate wood fuel heating systems. Wood heating has the lowest capital costs of all the renewable energy technologies being almost as cheap as mains gas. Wood fuel heating systems can be used in a range of sectors, including domestic, commercial, public and industrial.

In biomass gasification processes, biomass is partially oxidised at high temperatures (typically 800-900℃) to produce a combustible gas to generate ele ctricity. The gas is then cleaned to remove impurities and then can be used directly in a furnace, in a gas engine or turbine to generate electricity, or can be further refined for use in fuel cells and Combined Heat and Power (CHP) applications. Gasification technologies used for electricity production are in the main at the demonstration stage of development, notwithstanding the development of plant, most notably the ARBRE project in North Yorkshire.

Main factors to consider:

- Large-scale Biomass Generation plants should be located on industrial sites or previously developed land.
- Biomass generation sites should be located in close proximity to a wood fuel resource (for e.g. a 4 MW facility should be located within a 40km wood fuel resource that is a minimum of 4,000 hectares and/or 20,000 tonnes of forestry waste).
- Biomass installations should be located near to the high voltage network.
- Coppice criteria:
    - Coppice should not occur within an Environmentally Sensitive Area
    - Coppice should occur on land below 500ft AOD in elevation
    - Coppice plantations should be accessible to machinery

Potential Opportunities for South Ribble

Micro scale wood burning plant can be used in any building, right down to the domestic level and might typically utilise locally sourced logs. Small scale plant could be applied to schools, public buildings, district heating schemes, businesses etc, subject to a steady supply of suitable fuel and other feasibility parameters.

It is not known where suitable wood fuel is located within the Borough. Potential sources could include sustainably managed woodland, local saw mills etc. Open land within the Borough which is not considered to be suitable for agriculture could potentially be investigated for its suitability to grow biomass crops.

We are aware that a small acreage in the Samlesbury area is utilised as part of a leisure use as an elephant grass (miscanthus) maze and that it is harvested annually as a biofuel.

Solar Power

There are two types of technology using energy directly from the sun; photovoltaic electricity generation and solar water heating.

Photovoltaics

Solar radiation can be converted directly into electricity using photovoltaic (PV) cells. Individual cells can be combined into modules which in turn can be formed into arrays or panels. PV cells are predominantly made from silicon which is semi-conductor that liberates negatively charged particles (electrons) when exposed to light which is on most days as the generator is not dependant on bright or direct sunlight. PV cells have at least two layers of semi conductor (one is negatively charged and one is positively charged). When these layers are exposed to light an electric field is generated across the junctions between the layers causing electrons, and hence electricity to flow. PV cells can be used wherever electricity is needed and where there is sufficient light. PV arrays and panels range in size and can be used for a variety of applications including; consumer products (for example, calculators); stand alone power generation for remote locations (for example, street lighting and parking metres); building integrated systems; and large-scale power generators. The latter two applications can be typically linked to the electricity grid network.

Solar water heating

Solar water heating systems are designed to capture the heat of the sun and use it to directly heat water. Systems of this nature comprise a roof mounted solar collector or panel, constructed tubes, and flat plates or concentrating collectors. These highly absorbent panels, mounted at an angle of between 10° and 60°, draw heat from the sun and tra nsfer it to a heat transfer fluid (for example,

cold water) the water then runs through the heating system – either actively (via the use of a pump) or passively using gravity. The panels operate at their best when they are positioned in a south facing direction and are free of shade.

Solar water heating can be used to heat water and/or provide space heating in domestic, commercial, agricultural and industrial premises. It is currently used mainly in domestic situations to supply hot water and leisure facilities to heat swimming pools. In addition, systems are increasingly being used in multi-occupancy premises (for example, hotels) and office buildings. Solar heat may also be used in low-temperature industrial applications including drying, food preparation and laundries. This technology does not require year round sun to operate effectively and is therefore applicable for properties in the North West of England.

Main factors to consider:

- Better suited to new build housing association properties, commercial and leisure properties and higher value private residential properties.

Potential Opportunities for South Ribble

Solar water heating will work in the Borough and should be promoted for use in domestic properties, housing associations communal facilities etc and considered in other buildings where there is a relatively constant demand for hot or warm water. Both solar water heating and PV should be explored as an option for all new housing/employment developments and other redevelopments, along with appropriate energy efficiency measures.

PV can be particularly cost effective when considered as part of refurbishments, in new build and as cladding material when replacing building facades. At the moment there are no plans to update buildings within South Ribble. If further works were required, this would be an opportunity to integrate PV and raise awareness in the process. Runshaw College, in Leyland, has photovoltaic panels on the roof of the new extension to the Mardale Building. Some of the <u>other</u> public buildings in the Borough could be suitable for the integration of solar water heating and/or PV.

There are currently no known examples in South Ribble, although solar water heating was trialled by Barratt Homes (i.e. the Ecosmart Project) on 7 houses on Buckshaw Village during 2006/2007, and it proved to be cost effective.

<u>Air Source Heat/Cooling Pumps</u>

Air, necessarily existing at some temperature above absolute zero (-273℃), is a heat container. An air-source heat pump moves ("pumps") some of this heat in to a building to provide hot water or heating. This can be done in either direction, to cool or heat the interior of a building

The main components of an air-source heat pump are:

- a heat exchanger, over which outside air is blown, to extract the heat from the air
- a compressor, which acts like a refrigerator but in reverse and raises the temperature from the outside air
- a way to transfer the heat into a hot water tank or heating system, such as radiators or under-floor heating tubes

Heating and cooling is accomplished by moving a refrigerant through the heat pump's various indoor and outdoor coils and components. A compressor, condenser, expansion valve and evaporator are used to change states of the refrigerant from a liquid to hot gas and from a gas to a cold liquid. The refrigerant is used to heat or cool coils in a building or room and fans pull the room air over the coils. The overall operation uses the concepts described in classic vapor compression refrigeration.

Main factors to consider:

- An external outdoor heat exchanger is located on an outside wall.

Potential Opportunities for South Ribble

Air source heat pumps have been granted at the Pavilion at the Fox Lane Cricket Club, in Leyland. It is one of the most viable and efficient renewable technologies available. Air source heat pumps are particularly efficient in larger industrial units.

Ground source heat pumps

Ground Source heat pumps take heat from under the ground using liquid (water and antifreeze) circulating in horizontal pipes or a vertical borehole. The heat extracted is generally used to warm water for space and under floor heating.

Main factors to consider:

- Ground source heat pumps need land around the property to bury the coil underground horizontally between 120 to 180 m long of polyethylene tubing at a depth of 1 to 2 m.
- or require a deep vertical hole 23–150 m deep.

Potential Opportunities for South Ribble

Ground source heat pump are one the most viable and efficient renewable technologies available. Air source heat pumps are particularly efficient in larger industrial units.

Other Technologies

It should be noted that in addition to the above, energy from coal bed methane and mines gas, energy from mixed municipal waste and hydro-electricity schemes with an output greater that 5MW were identified as potential renewable energy technologies. However, consultations with the Government has indicated that electricity generated from these sources would not count towards the UK's renewable energy targets, nor would they attract financial assistance via the Renewables Obligation. As such, these technologies have not been included here.

Maps:

1. **Wind Micro and Building Mounted**

Map shows wind speeds over 4m/s in the Borough where there is potential for this technology.

Wind speeds over 4m/s

2. **Wind single turbines and clusters under 50mw**

Map shows wind speeds in the Borough greater than 6.0m/s, and buffers of 500m are show around all residential areas.

500m buffers

Wind speeds over 6m/s

3. **Wind large clusters of large wind turbines**

Map shows wind speeds in the Borough greater than 6m/s, with buffers of 500m placed round all residential areas. All national and local designations, i.e., Scheduled Ancient Monuments, SSSI's, Listed Buildings are also shown (see below).

Green Belt

Wind speeds over 6m/s

Local Nature Reserves

Biological Heritage Sites

Scheduled Ancient Monuments

Sites of Special Scientific Interest (SSSI's)

500m Buffers

Listed Buildings

4. **Hydro – Small Scale**

Main rivers and canals are shown, along with high voltage power lines.

Green Belt

Settlement boundaries

High voltage power line

Main waterways

5. Landfill

Landfill sites are mapped

Green Belt

Settlement Boundaries

Landfill sites

6. Woody Biomass

Major new housing and employment sites are shown on the map. Woodlands are also shown on the map, as are other environmental/historic designations to show areas to avoid.

Green Belt

Settlement Boundaries

Local Nature Reserves

Biological Heritage Sites

Scheduled Ancient Monuments

Sites of Special Scientific Interest (SSSI's)

High Voltage Power Line

Listed Buildings

Woodlands

7. Solar Water Heating/PV

Map shows major employment sites and major new housing sites where there is potential for such technologies to be installed on properties.


Major existing employment sites


Potential New Employment sites


Potential New Housing Sites

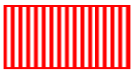

Settlement Boundaries

Green Belt

8. Anaerobic Digestion

Map shows new housing and employment sites, and the high voltage power line.


Potential New Employment sites


Potential New Housing Sites


Settlement Boundaries

High voltage power line