Small Scale Wind Energy



FACTSHEET 6

Introduction

Harnessing wind as a renewable energy source involves converting the power within a moving air mass (wind) into rotating shaft power which in turn generates electricity. Modern wind turbines contain rotors fitted with aerodynamic blades, which utilise lift forces caused by the wind on the blades.

Wind energy resources

In the UK we have a large potential wind resource. Although we have 40% of Europe's total wind energy resource, it remains largely untapped, currently meeting only 0.5% of our electricity requirements.

Power from the wind is proportional to the cube of the wind speed therefore relatively minor variations in wind speed can result in large changes in potential output.

Individual turbines vary in size and power output from a few hundred watts to 2-3 megawatts (as a guide, an electrical kettle uses approximately 2,000 watts or 2 kilowatt). Uses range from very small turbines supplying energy for battery charging systems (e.g. on boats or in homes), to turbines grouped on wind farms supplying electricity to the grid.

Siting and planning considerations

Wind speed increases with height so it is best to have the turbine high on a mast or tower. Generally speaking the ideal siting is a smooth-top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, houses or other buildings. However, other areas may have a sufficient wind resource to make an installation worthwhile.

Knowledge of the local wind resource is critical to designing a wind energy system and predicting output. For domestic installations a good source of information on local wind speeds is the NOABL database which can be accessed from the British Wind Energy website at http://www.bwea.com Alternatively you can collect primary information by setting up your own monitoring mast to record wind speed. An ideal way of doing this is with an anemometer which can be purchased for around £120.

Planning issues such as visual impact, noise and conservation issues also have to be considered. System installation normally requires permission from the local authority. Smaller battery charging systems meet few problems as they are treated as similar to TV aerial installations - as long as they are not in a conservation area or next to a listed building. For larger systems seek the advice of planners at an early stage.

Stand-alone or grid-connected systems?

Small scale wind power is particularly suitable for remote off-grid locations where conventional methods of supply are expensive or impractical.

Most small wind turbines generate direct current (DC) electricity. Off-grid systems require battery storage and an inverter to convert DC electricity to AC (alternating current - mains electricity). A controller is also required to ensure the batteries are not over or under-charged and can divert power to another useful source (e.g. space and/or water heaters) when the battery is fully charged. It is common to combine this system with a diesel generator for use during periods of low wind speeds. A combined wind and diesel system gives greater efficiency and flexibility than a diesel-only system. It allows the generator to be used at optimum load for short periods of time to charge batteries when there is little wind, rather than by constant use at varying loads.

Wind systems can also be installed where there is a grid-connection. A special inverter and controller converts DC electricity to AC at a quality and standard that is acceptable to the grid. No battery storage is required. Any unused or excess electricity can be exported to the grid and sold to the local electricity supply company.

System sizes

Turbines vary in size - for small scale applications the typical sizes range between 600 watts and 6kW. Turbines are rated to a certain capacity, however this output is only

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achieved for the time that wind speed is at its optimum level. As a rough guide, a good wind site will produce an average output of 30% of the rated capacity of the turbine. The size of the wind turbine determines the total amount of energy generated each year. For example, if a 5kW wind turbine generates the equivalent to rated power for 30% of the year, it will generate 5 x 0.3 x 8760 (24 hoursx365 days) = 13,140kWh per year.

For off-grid systems, the size of the battery bank determines the time appliances can be run if there is no wind. The size of the inverter installed determines the number of appliances that can be run at the same time from the stored electricity.

Small scale applications

Small scale applications range from individual battery charging systems to those that provide power for homes, schools or community halls. A small system of 600 watts could be used for charging batteries for caravans and boats. A larger system of 5-6kW could be used to provide power to a community hall or other public building. The optimum size for the average household would be 1.5-3kW, though larger or smaller turbines could still be applied.

Smaller systems of less than 100 watts are used for charging batteries of 12V or 24W. Uses include low voltage household lighting, remote weather stations or electric fencing.



Fig 1: 2.5kW wind turbine used to provide electric storage heating for a household in the Inner Hebrides. Copyright Energy Saving Trust.

Cost and maintenance

Systems up to 1kW will cost around £3000 whereas larger systems in the region of 1.5kW to 6kW would cost between £4000 - £18,000 installed. These costs would be inclusive of the turbine, mast, inverters, battery storage (if required) and installation, however it's important to remember that costs always vary depending on location and the size and type of system.

Turbines can have a life of up to 20 years but will require service checks every few years to ensure they continue to work efficiently. For battery storage systems, typical battery life is around 6-10 years, depending on the type, so batteries may have to be replaced at some point in the system's life.

Are there grants available?

Yes, householders and community groups can access grants from the Scottish Community and Householder Renewables Initiative (SCHRI) which is funded by the Scottish Executive and managed jointly by Energy Saving Trust (EST) and Highlands and Islands Enterprise (HIE). Householders can access capital funding of up to £4000 and community organisations can access up to £10,000 for feasibility assistance and up to £100,000 for capital assistance. For more information contact the SCHRI Hotline on 0800 138 8858.

Where can I get more information?

The SCHRI is a one-stop shop that provides funding, advice and project support to further the development of small-scale renewable energy projects. To assist community projects there is a network of 12 SCHRI Development Officers who provide an advisory and project management service to community groups within their local region; to find your nearest Development Officer contact the Hotline on 0800 138 8858.

Information and advice for householders is provided by SCHRI via the Energy Efficiency Advice Centre (EEAC) network which is managed by EST to provide householders with free and impartial advice on energy efficiency in the home. EEAC advisors have also been trained to provide advice about renewable energy technologies. To talk to a trained advisor contact your nearest EEAC call 0800 512 012.

Useful links

- Scottish Community and Householder Renewables Initiative: www.est.org.uk/schri
- For an overview of renewable energy, case studies, FAQs and other funding sources: http://www.saveenergy.co.uk/renewables/
- British Wind Energy Association (BWEA); trade association of the UK wind industry: www.bwea.com/

Title picture courtesy of Proven Engineering

Other factsheets available: • Renewable Energy - An Introduction • Green Electricity Tariffs • Solar - Water Heating • Solar - Photovoltaics • Ground Source Heat Pumps • Small Scale Hydro- Electricity • Biomass