FACTSHEET 4
WIND POWER

Wind power can be harnessed almost anywhere and on almost any scale. Large wind farms can provide sufficient power for tens of thousands of grid connected households, while small turbines can provide electricity to an individual house or a farm. Even smaller turbines (of say between 50W-250W) can meet a wide variety of needs, supplying power for:

- Animal feed dispensers.
- Remote weather stations,
- Electric fences for farms,
- Communication equipment,
- Lighting for isolated buildings
- Lighting and a TV for a caravan.

There are many isolated households which use wind turbines to provide for their electricity needs where it is not feasible to connect to the electricity grid. This typically involves using a turbine with a capacity between 1 kW and 4 kW connected to a system of batteries, sometimes in combination with a backup generator (typically diesel) which can operate during periods when there is no wind. In times of high wind surplus, output can be used to heat water, but it is not usually economic to have this as the primary usage. Remote communities or business premises can make use of larger turbines as part of such a system. Turbines, which have a capacity of 50 kW, or more, are usually connected to the electricity grid system. Modern turbines usually have three blades, but there are multi-blade turbines which are more suitable for pumping water than generating electricity.

WIND SITE SURVEY

One of the main factors which will determine the economic viability of a wind power project is the annual mean wind speed at a site. The power produced by a wind turbine depends on several parameters including the wind speed (the main factor), the area swept by the blades and the efficiency of the rotor and generator. The power output can be doubled by increasing the rotor blade length by 40%, or by an increase in wind speed, for example from 6 metres per second (m/s) to 7.5 m/s

Wind speeds vary enormously from region to region and from valley floor to hill-top, so wind speed measurements will usually be needed for virtually all proposed developments, other than those for only a few kilowatts. For schemes larger than about 10 kW, on-site, wind measurements will usually be required, with results being correlated to longer term, local meteorological data of average wind speed in the region. For smaller schemes, meteorological data may be all that is required, even though there will be some discrepancy between the data and the actual wind speed at a given site.

A full wind speed assessment will normally involve:

- Erecting a mast, preferably of similar height to the proposed turbine, with a recording anemometer,
- Monitoring the wind speeds and direction over an extended period,
- Correlating the data with long term records from local meteorological stations.

A data collection period of six months is generally thought to be minimum to obtain reasonably reliable results, but a 12 month collection period will reduce the uncertainty in the estimates as all seasonal weather patterns will have been recorded.

DEVELOPING A SCHEME

The development process that needs to be followed for a wind power scheme is highly dependent on the size of the schemes. Larger schemes will require the involvement of specialist wind power consultants. As well as the steps shown on factsheet 7, it will also be important to:

- Investigate the site's geological conditions,
- Determine the optimum turbine positions, and
- Check on access routes for construction vehicles and for maintenance of the turbines and power lines.

ECONOMICS

The cost of electricity from wind turbines is extremely site-specific. Typically, large wind turbines selling electricity to the grid can be financially viable where the average wind speed is greater than about 7m/s. Smaller turbines and wind pumps may be viable with average wind speeds as low as 5m/s, if the alternative is a more expensive power source such as a diesel generator.

A manufacturer will usually provide information on the anticipated annual energy production for a range of average wind speeds. A doubling of the wind speed leads to an eight-fold increase in power and in very light winds no power will be produced. It is therefore vital to try to site a turbine in a place where the wind speed is greatest, but is sensitive to local environmental conditions. Siting a turbine on a nearby hill, however, may yield more energy but the cabling costs may be greater than if the turbines had been located close to the buildings where the energy is to be used. This may be particularly relevant for small schemes. If a turbine is placed too close to buildings or trees, however, the wind speed can be reduced. For larger schemes the availability of a local grid connection point can also be a major factor to be considered in siting the scheme.

Generally the costs involved in setting up a grid-connected wind farm are: manufacture of wind turbines (65%); infrastructure (25%); financing and legal costs (5%); and grid connection (5%). Successful schemes in the UK, for example, are able to develop the whole scheme for a capital and installation cost of between ECU 1,000 to ECU 1,700 per installed kW. Annual operating and maintenance costs are approximately 1.5% of the total capital costs.

The European Wind Energy Association states that 1 MW of installed capacity creates jobs for 1519 people on average in Europe.

OUTPUT FROM SOME TYPICAL WIND TURBINES

Av. Wind speed (m/s)	8	7.7	7.5	6.2
Hub Height (m)	41	31.5	25	6.5
Rotor (m) Diameter	41	27	15	3.5
Rated Output (kW)	500	225	50	2.5
Energy MWh/year	1650	740	180	5.7

Risks associated with a wind power development which need to be considered and possibly insured against include: lightening, blade damage, third party injury, storm, vandalism, electromagnetic interference, inaccurate wind data, refusal of planning consent and failed grid connection. It should be pointed out that the risks involved are typically not greater than for other similar types of development.

WIND POWER AND THE ENVIRONMENT

Wind turbines use only a small area, typically only 1%-2%, of the land upon which they are sited. Consequently, where the land has been used for crops or livestock, this can continue right up to the turbine base, allowing 98-99% of the land to remain in agricultural use.

The issue of visual impact is often considered to be the most important. It is, however, a highly subjective issue and can depend on a variety of factors, particularly the landscape in which the turbines are sited. Careful siting and layout of wind turbines can help address these issues and enhance public acceptability of a scheme. A preliminary assessment of visual impact using, for example, photomontage techniques can help to give an indication of the way in which a scheme will look.

There is also some concern over the amount of noise made by the turbines. In fact, studies have shown that at a distance of 350 metres, a wind farm is only slightly louder than a quiet room. Furthermore, the trend is towards quieter turbines as the technology develops and improves. Very small wind turbines are often quiet enough to be sited much closer to a dwelling without causing a disturbance.

Another possible issue of concern in some regions is the impact which a wind farm can have upon birds. In general, however, bird strikes are typically no higher than those experienced with other forms of infrastructure, such as roads, or overhead powerlines.

Wind farms can interfere with television and radio reception as well as other communications signals. For large schemes an assessment will be needed to determine whether the installation of signal boosters will be needed to overcome the problem.

Example: ***Dottrel Cottage Pig Farm (England, UK)***
An 80 kW wind turbine was installed at this moderately windy site, 100 metres above sea level. About 60%-70% of the power is used on the farm, displacing electricity purchased at an average of ECU 0.089/kWh. Surplus power is sold to the local electricity utility for ECU 0.03/kWh.

Annual cost savings over what used to be paid for the electricity amount to ECU 12,800 and the expected pay-back period for the capital expenditure of ECU 100,800 is 10 years. The availability of cheap electricity has also boosted the economics of a new milling business on the farm. Routine servicing is done twice per year by the farmer and occupies about half a day on each occasion.

(**Source**: Scottish Agricultural College, Edinburgh)