

# Small Scale Wind Generation for Farms

## Introduction



The cost of connecting mains electricity to a remote site can sometimes prove prohibitive. In such cases alternative energy sources such as wind generation may be considered. Small scale 'on farm' wind

generation can be used for a wide range of applications from powering electric fence units or small water pumps to producing enough electricity to run a reasonably sized dairy farm.

Wind power is the most widely available source of renewable or alternative energy for farmers and growers. Britain has the greatest wind resource in Europe; about 500 large turbines with a total capacity of 175MW are in place, mostly in our windier regions in the Southwest of England and in Wales. It is believed that we could eventually get up to 20% of our electricity from wind power, if suitable sites can be found.

The techniques for capturing the power are proven and readily available. Wind power is unpredictable and weather dependent; outputs vary from zero to full power. Small scale wind generation can be used alone or in conjunction with solar P. V. panels or a diesel generating set and battery back-up to produce a stand alone power source. How sophisticated the system has to be depends on the application and the need for continuity of supply.

Generating power by means of a wind turbine has a high initial capital cost and relatively low running costs. Sites that experience only light winds may not be able to capture enough power to make the turbine economic. Wind power is usually converted to electricity but for some applications it can be used as mechanical power.

## Technology

*Some small scale wind generator applications*

Lighting	- domestic; farm; security
Heating	- into buffer storage heaters
Water pumping	- for domestic or stock water tanks (these need to be sized for minimum 3 days sup-
Electric fence units	- trickle charging for battery powered systems
Other domestic uses	- water heating; household appliances

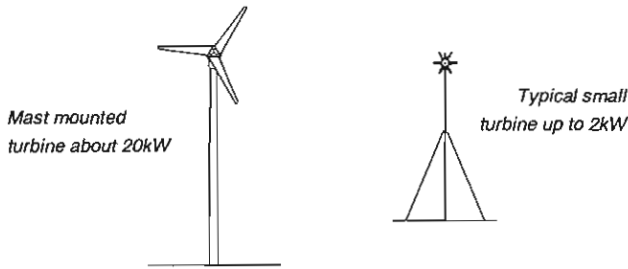
A wind turbine usually comprises:

- a propeller i.e. a bladed rotor that will turn when wind passes over it
- the shaft on which the rotor is mounted
- gears or a gearbox to match the speed of rotation to that required by the generator
- an electrical generator driven from the gearbox
- the nacelle i.e. the housing at the top of the tower that contains some of the above
- a vane or equivalent to turn the propeller into the wind
- a feathering or furling device to disconnect the turbine if winds are too high
- a tower or column upon which the propeller or nacelle is mounted
- electrical control equipment to ensure the output is in the form required.

# Sizes

Wind turbines can be simply classified into two types:

1. Large grid connected machines rated at between 200kW and 1 MW.
2. Smaller turbines for remote power generation (about 50W to about 25kW).



Typical wind generator sizes When

Rotor Diameter (metres)	Mast Height (metres)	Generating output at 10m/sec wind speed	Operating Voltage
0.9	6	50 – 72W	12 / 24
1.14	not specified	300W	12 / 24
1.8	6.5	340W	12 / 24
2.55	5.5 or 6.5	600W	12 / 24 / 48
3.5	6.5	2.5 kW	24 / 48 / 120
5.5	9	6.0 kW	48 / 120 / 240
10.2	15	20 kW	415 - 3 phase

considering the size of generator required it should be noted that favourable generator wind speeds can only be assured for about 30% of the time. Thus the average output of a 6kW machine is about 2kW.

Wind speeds on the Beaufort Scale

Beaufort Scale	Description	Speed		Description
		knots	m/sec	
0	calm	0	0	smoke rises vertically
1	light air	1 – 3	0.5 – 1.5	vanes do not turn
2	light breeze	4 – 6	2.0 – 3.1	leaves move
3	gentle breeze	7 – 10	3.6 – 5.1	twigs move
4	moderate breeze	11 – 15	5.6 – 7.7	paper whirles up
5	fresh breeze	16 – 20	8.2 – 10.3	leafed branches move
6	strong breeze	21 – 26	10.8 – 13.4	wind whistles through wires
7	moderate gale	27 – 33	13.9 – 17	small trees move
8 and above	most turbines will 'feather' or turn out of the wind at high speeds			

# Siting

## Planning Permission

When considering a permanently sited wind generator contact should be made with your Local Authority at an early stage regarding any necessary planning permission. In certain cases it may be necessary to submit an Environmental Impact Assessment along with the planning application. Also if the planned structure is close to an active airfield then contact and deliberation with the appropriate authority involved should also be made.

## Wind Speed

Wind power varies with the cube of wind speed. The best positions have exposure to the prevailing wind and are away from obstructions such as large trees and buildings. Excessive turbulence caused by nearby topographical features or buildings can cause fatigue damage to the wind turbine and shorten its working life. A smooth hilltop facing into the prevailing wind is an ideal site.

Average annual wind speed data should be acquired when considering the siting of a wind generator or a wind survey over several months should be carried out (the longer the time, the better). Wind speed data are available based on a 1 km x 1 km square grid covering the whole of the UK. Details of this can be obtained from ETSU and BWEA. (See end of document)

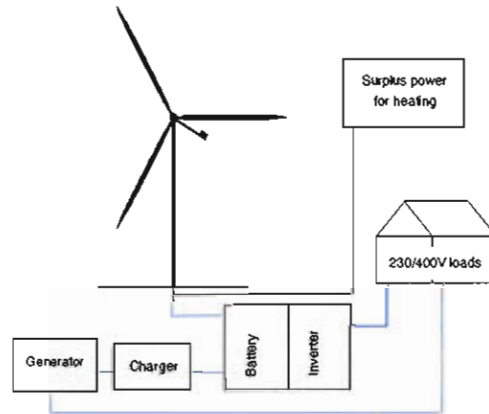
Generators can produce power at very low wind speeds but an annual mean wind speed at the wind generator hub of around 6.5 metres per second is reckoned to be about the minimum for viability. (See table opposite)

## Noise

Wind generators produce noise which can be irritating at best and in the worst cases, cause complaints from neighbours. Careful consideration should be given to the noise impact a wind generator may have on a particular location. (See table below)

Noise levels

Decibel (dBA)	Loudness
0	threshold of hearing
10	virtual silence
20	quiet room
30	watch ticking at 1 metre
40	quiet street
small turbine in light winds	
50	quiet conversation
60	quiet motor at 1 metre
small turbine in high winds	
70	loud conversation
80	door slamming
90	busy typing room
100	near loud motor horn



Self contained wind and generator system for an isolated site

Excess power can then be fed back into the mains network. A purchasing contract can be entered into with a Public Electricity Supply company under its arrangements to purchase power from renewable sources, subject to metering and strict adherence to safety and mains protection arrangements.

## Technical Details

### Exporting excess power back to the mains

The power from small scale wind generators is often used directly or it can be stored in batteries. These systems are said to operate in 'islanded' mode i.e. there is no interconnection and therefore no facility to export excess power into the mains electricity network. A generator of 20 kW can be reckoned to be about the minimum viable size for an export arrangement. The main reason for this is the cost of the export mains protection equipment and administration charges. In the UK if a 400/415V 3 phase electricity supply exists on the farm then it could be possible to connect a 20 kW wind generator to export power (if the economics stand up) subject to agreement with the local electricity distribution company.

## Turbine Costs

These illustrative figures do not include batteries, ground work, cables or control gear which are specific to each project.

Turbine costs

Wind Generator Rating		Typical/ Approximate costs
Output	Voltage (V)	
70W	12/24	£200 - 400
300W	12/24	£400 - 650
340W	12/24	£1200
600W	24	£2700
2.5 kW	24	£6500
2.5 kW	240	£9800
6.0 kW	240	£11000
11 kW	240/415	£26000
20 kW	415 - 3 phase	£32750

## Further Advice

### **Renewable Energy Association**

17 Waterloo Place  
London SW1Y 4AR  
Tel: 020 7747 1830  
Fax: 020 7925 2715  
[www.r-e-a.net](http://www.r-e-a.net)

### **British Hydropower Association**

Unit 12, Riverside Park,  
Station Road, Wimborne  
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Tel: 01202 880333 fax: 01202 886609  
[www.british-hydro.org](http://www.british-hydro.org)

### **The Centre for Alternative Technology**

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Tel: 01654 705950 Fax: 01654 702782  
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### **Energy Saving Trust**

21 Dartmouth Street,  
London, SW1H 9BP  
Tel: 020 7222 0101, Fax: 020 7654 2460  
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### **European Wind Energy Association**

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### **New & Renewable Energy Enquiries Agency**

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### **Renewable Energy for the Home**

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*Farm Energy Centre  
September 2006*

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