Small Wind Energy Systems

# BWEA Briefing Sheet

# Small Wind Energy Systems

BWEA
Delivering the UK's wind, wave and tidal energy

This briefing is intended as an approximate guide and covers the issues listed below along with further information sources for those wanting to investigate in greater detail:

What is small wind? • Is it worthwhile installing a wind turbine? • How does it work? • Turbine design • Turbine sizes • Siting a small/micro wind turbine • What if I can only mount my turbine on a building? • Further installation advice: noise, wildlife, broadcasting & telecommunications links, metering, maintenance • Assessing wind resource • What wind speed do I need to operate a turbine? • What is the best product for my site? • How much do small/micro wind turbines cost and how much will they save? • Stand-alone and grid-connected turbines • Can I sell excess electricity? • Is there any funding available? • Do I need planning permission? • Small/micro wind turbine manufacturers and installers • Further information

*Proven turbine at Ladygrove Primary School © Michael Webb*

## What is small wind?

Small wind is generally used to describe a wind energy generator system that could be purchased and used by a householder or business to provide a contribution to domestic or onsite electricity consumption. BWEA draws a distinction between 'micro wind' which is a term typically used to describe a wind turbine size under 3.5 kilowatts (kW), 4 metres diameter and 15 square metres approximately, and 'small wind' which is a term typically used to describe a wind turbine size under 50 kW, 16 metres diameter and 200 square metres rotor area approximately.

A small/micro wind system is normally mounted on a mast in an open exposed area, and in some cases it may be technically possible to mount a turbine on a building if the building is of a suitable construction, although a building mounted turbine will be subject to a poor wind regime compared to a free-standing equivalent – more advice on siting is provided below.

## Is it worthwhile installing a wind turbine?

Small/micro wind represents a relatively low-cost method of micro-renewable electricity generation at a good site, providing varying amounts of electricity generation and carbon dioxide savings depending on the site. In addition to these savings, small/micro wind systems can bring associated benefits such as increased security of electricity supply for non-grid connected machines, some protection against electricity price rises and savings on electricity transmission and power station losses. Small/micro wind also has the potential to promote UK manufacturing companies, encourage technological advances, introduce electricity to non-grid connected locations and create positive culture change and increased green awareness.

*5kW turbines © Iskra Wind Turbine Manufacturers*

The Energy Savings Trust (EST) recommends that before installing any renewable energy technology for domestic application householders should always consider energy efficiency measures first. They recommend a home energy check to assess which measures are most suitable for your home and ensure that you are minimising your energy requirements:

• Insulate the entire of the loft of your property to meet current building regulations e.g. 270 mm of mineral wool loft insulation or suitable alternative

• Install cavity wall insulation (if you have cavity walls)
• Fit low energy light bulbs in all appropriate light fittings
• Install basic controls for your heating system to include a room thermostat and a programmer or timer.

@Proven Energy

You may be entitled to grants or offers to help pay for energy saving measures: visit the EST website www.est.org.uk for more information.

If you decide to install a small/micro wind system, you should investigate performance data for the products you are considering to ensure you are knowledgeable of the amount of energy expected for the average wind speed at your particular location. This is discussed in more detail later.

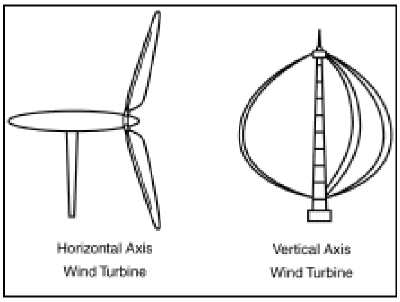
## How does it work?

The simplest way to think about this is to imagine that a wind turbine works in exactly the opposite way to a fan. Instead of using electricity to generate moving air, turbines use the wind to generate electricity:

1. The wind blows on the blades and makes them turn.
2. The blades turn a shaft inside the nacelle (the box at the top of the turbine) which operates
3. The generator, which uses magnetic fields to convert the rotational energy into electrical energy. These are similar to those found in normal power stations.
4. The power output goes to a transformer, which converts the electricity coming out of the generator to 240 Volts (V) for domestic-connected systems or to the right voltage for distribution system, typically 3,300 to 11,000 V for grid connected systems.
5. For stand-alone systems the power is used on site or stored in batteries. For grid-connected systems the power is used on site or distributed to local electricity networks

Some turbines, especially those of capacity greater than 10 kW may have a gearbox which steps up rotor speed to that of the generator, however smaller turbines usually do not require a gearbox. The nacelle protects the gearbox, generator and other components of the turbine from the elements, and a tail vane or yaw system aligns the turbine with the wind.

The power in the wind that’s available for harvest depends on both the wind speed and the area that is swept by the turbine blades i.e. the area of the circle.




www.omafra.gov.on.ca/english/engineer/facts/03-047.htm

## Turbine Design

There are two basic configurations of wind turbines; the more common horizontal axis wind turbines (HAWTs) with a propeller-type rotor and a tailvane to continuously point the turbine in the direction of the wind and vertical axis wind turbines (VAWTs) which don’t have a tailfin as they accept wind from all directions.

## Turbine Sizes

There are a variety of different sizes and models of small/micro wind systems. These range from 100 watts (W) for very small systems that are less than 1 metre in diameter, and typically used to charge 12 V or 24 V batteries in stand-alone systems such as boats. Turbine capacities increase to 50 kW for larger systems that can be 15 metres in diameter, mounted on a 25 metre hub and used for large buildings, by industry or for communities. Individual houses and business would usually use turbines ranging from 0.6 kW to 20 kW, with models marketed as potentially suitable for rooftops varying from 0.5 kW to 2.5 kW in size.

## Siting a small / micro wind turbine

Good siting is essential if a small/micro wind system is to deliver the energy expected from its rated capacity. Some tips for siting are set out below:

### Wind speed

The greater the average annual wind speed the better! Remember that turbine electricity output is a function of the cube of the wind speed – so if the wind speed doubles, the available energy will increase by a factor of eight. More information on wind resource is set out below.

### Prevailing wind

Work out from which direction the prevailing winds in your area usually come. This can be done by observation during wind storms, and by looking at the trees near your site; trees that are all leaning the same direction and that have branches mostly on one side of the trunk are a good indication of prevailing wind speed and direction. Local airports and weather stations may also be able to provide you with this information.

### Height

The higher the better! Turbines should ideally be mounted 9 metres above any obstruction that is within 100 metres. With building-mounted turbines it may not be possible to use a 9 m mast and turbulence will be increased. If there is severe turbulence caused by nearby obstructions this lead to significant loss of potential power, and will cause extra wear on the turbine and its components. Ensure that there are no obstructions between the turbine and the prevailing wind. Elevated positions with smooth approaches are preferable to those near sharp ridges or cliffs.

### Obstructions and turbulence

A wind turbine should not be located in a position where it will be subject to very turbulent air flow. Therefore keep the turbine clear as clear of obstructions as possible (see above), including trees and buildings. In particular, sites with obstacles upwind of the prevailing wind should be avoided. Light turbulence will decrease performance since a turbine cannot react to rapid changes in wind direction; while heavy turbulence may reduce the turbine's operational life. You can detect turbulence by streaming a long ribbon from a guyed pole or mast at the height of the proposed turbine. If the ribbon streams easily and smoothly in high winds from various directions the wind flow should be suitable.

### Building mounted turbines

The most ideal site for a small wind turbine is mounted on a free-standing mast in an exposed location. Many conventional designs of wind turbines should not be mounted to buildings, however if the only site available is on a building then installing a small wind system may still be feasible if mounted high enough to minimise turbulence or if the wind regime at that particular location is favourable. If this is the case, it should be noted that performance will still be reduced compared to an equivalent mast mounted machine. The building itself will act as an obstruction and can result in turbulent air flow – this may not allow the turbine to operate as smoothly and could shorten its operational life.

*Montana 5.8 kW turbine © Fortis*

### Variations in built up locations

For a building-mounted turbine site in an open area, wind speed theoretically can actually increase as it passes over the top of a building, however this is only likely if the building itself is in a very exposed location. A building on the edge of a settlement may also be subject to acceptable wind speeds and reasonably smooth airflow on the occasions that the wind is blowing from the direction of exposed land; however when the wind blows from the direction of the settlement, then the wind regime will be poor. A building located in the middle of a settlement or built up area is highly unlikely to benefit from a good wind regime.

## What if I can only mount my turbine on a building?

If your site is unable to accommodate a free-standing wind turbine, it may still be worth investing in a building-mounted machine:

- Although it may be less economic, useful electricity can still be delivered by your turbine, saving some of the electricity otherwise drawn from the grid and therefore $CO_2$ emissions. Wind turbines produce no pollution after the energy used during manufacture has been repaid and by using wind power you will be offsetting pollution that would have been generated by conventional fuel sources. Some electricity is used during the manufacture of the turbines, but this is 'repaid' after two to five years. After this time, all the electricity generated by the turbine contributes to reducing $CO_2$ emissions.

- Research also suggests that individuals who invest in microgeneration technologies are influenced in other areas of their lifestyle, and become more energy efficient *(Source: Sustainable Development Commission, Oct 2005, 'Seeing the light: the impact of microgeneration on the way we use energy', available online at www.sd-commission.org.uk/publications/downloads/Micro-generationreport.pdf).*

- Even modest amounts of electricity generated onsite will result in $CO_2$ savings elsewhere; an average large power station wastes over a third up to two thirds of its fuel through heat, and a further 10% is wasted in transmission and distribution, meaning less than half of the fuel is used productively. Onsite microgeneration will reduce these inefficiency and transmission losses.

- There is no reason not to install a turbine if an individual is keen and interested.

## Further installation advice

### Vibration

A turbine mounted to a building may result in some vibration through the mast – ensure that the turbine is fixed so as to minimise vibration, and investigate the anti-vibration specifications of different products.

### Safety

Safety is an important consideration, particularly if a wind turbine is to be attached to a building:
1. Where turbines are to be fixed to a building an assessment must be made by suitably qualified personnel such as a structural engineer or an architect. Installed turbines should be 'strength' or 'pull-tested' to ensure the structural ability of the building to withstand forces that will be exerted on it by the turbine and mast.
2. Some types of buildings and building materials such as lime mortar are unsafe for the installation of wind turbines. Always check the manufacturer's specifications.
3. The turbine should avoid overhead lines, cables, window openings and areas where persons are likely to become injured by the moving parts.
4. In selecting the location for your turbine, consideration must be given for access for maintenance. Where wind generators are fixed to masts or towers these should be capable of pivoting and lowering to the ground for maintenance.

### Noise

Newer models of small wind turbines have been designed to keep blade noise to a minimum. Product specifications may provide noise data for different wind conditions. The issue of predicting and measuring noise from wind turbines is complicated. For large wind farms extensive and complex testing is carried out, but this is not realistic for a small turbine site. The key concept to consider is that noise from a wind turbine is only of relevance to potential receptors such as nearby occupied buildings and residents. If there are no sensitive receptors then the noise specifications of a product are of little importance, whereas if a turbine is located close to a bedroom window you would need to ensure it had a quieter noise specification.

The effect of noise from a turbine is also dependent on the background noise of a given location, for example a turbine sited near a busy road may not affect sensitive receptors. As wind speed increases then background noise created by the wind increases, and therefore turbine noise is masked.

### Wildlife

Anecdotal evidence indicates that birds occasionally collide with small/micro wind turbines, as with any other type of structure. However there is no evidence that small wind turbines are a significant threat to wildlife including birds and bats - in fact, birds are far more likely to be harmed by cats or by flying into windows.

### Broadcasting and Telecommunications links

Small/micro wind turbines are very unlikely to cause any disruption to broadcast or telecommunications links, and accompanying information on this matter should not be required with a planning application.

### Metering

If the machine does not come with circuitry that is approved for connection to the grid network you will need to ensure that your installation complies with the wiring regulations. Alternatively, you may operate your machine independently of the mains, and perhaps provide electricity for an auxiliary water heater or equipment in the home on a separate circuit.

### Maintenance

Many small/micro turbines have few moving parts and some do not require regular maintenance. They are designed for a long working life (up to 20 years) and operate automatically. However in selecting the location for your turbine, consideration must be given for access for maintenance.

## Assessing wind resource

The first stage of any wind energy project is assessing the availability of your resource base. Electricity produced by a turbine over the course of the year depends critically on the annual mean wind speed at the site – higher wind speeds produce more energy. Conversely low average wind speeds may mean that the turbine will not operate much of the time. There are two options for ascertaining wind speed: onsite assessment or database modelling.

### Onsite assessment

The best option is to carry out an onsite assessment of the wind resource. This can be done in a variety of ways. In order to achieve an accurate figure, wind speed should be measured at the proposed location using an anemometer over the course of several months, ideally one year. You may be able to purchase an anemometer and hire a mast and monitoring equipment, some manufacturers may be able to loan an anemometer and logging equipment or you could employ consultants to do this for you. Measuring wind speed onsite can be complex, for example data will need to be interpreted and physically it may be difficult to erect the anemometer at height on the proposed turbine location. Anemometers with logging equipment or a small weather station can be purchased at a cost starting from approximately £200. A weather station can track wind speed and direction, and logs data to its own memory, including average and peak readings, and interfaces directly to a PC. It must be noted that a spot reading of onsite wind speed differs to regular onsite measurement with data logging – required to establish average annual wind speed. In order to properly estimate expected output, an average annual wind is needed. A spot reading of 10m/s on a particularly windy day my lead to conclusion that a given site has very good wind speeds, whilst in reality the annual average could be only 3 m/s.

For anyone considering spending a significant amount of money on a small wind system, onsite anemometry will probably be worth the investment. The websites listed below provide further detail on determining wind-speed:
• www.windandsun.co.uk • www.windsurvey.co.uk • www.nexgen.com

### Database modelling

Designed for open, exposed locations, NOABL, the UK National Wind Speed Database is the result of an air flow model that estimates the effect of topography on wind speed. Each value stored in the database is the estimated average for a 1 km square at 10 m, 25 m or 45 m above ground level (agl).

The application of NOABL has been designed for exposed locations, and may give an indication of average wind speed in different parts of the country. However it is very unlikely to give an accurate idea of wind speed at a proposed site for a small wind system, particularly in urban or built up areas. The urban environment includes numerous and significant obstacles and much higher levels of roughness (such as tall crops, stone walls or trees) than are seen in the open countryside. Urban wind regimes are also subject to localised directionality, such as can be seen near tower blocks and other large structures. To use NOABL in the assessment of the potential yield of a small wind facility in an urban setting without any adjustment is very likely to result in an inaccurate result.

If NOABL is used for rural or exposed areas then the following site specific factors should be considered:

• The data is more accurate for flat, open countryside, and less so for complicated, rough terrain
• NOABL makes no allowance for the effect of local thermally driven winds such as sea breezes or mountain/valley breezes, which can increase coastal sites by up to 0.5-1.0 m/s
• NOABL takes no account of topography on a small scale or local surface roughness, which may have a considerable effect on the wind speed. Therefore if your site has a lot of surface roughness revise average wind speed down
• A site at the bottom of a valley or hollow will have a lower wind speed than the average, therefore revise the average wind speed down
• A site on top of a hill or knoll will have a higher wind speed than the average, therefore revise the average wind speed up
• If there is an obstacle between the turbine and the prevailing wind then expect a significantly reduced wind-speed
• If the height of the turbine is less than 10m, a correction to the 10 m estimate will need to be made. At 5 m, the wind speed will be roughly 10-20% lower.

Other methods of estimating wind speed using existing data could include the use of measured data from local meteorological stations and further data from real measurements may also be available from universities or other organisations with an interest. Again this data will only give an approximation for a particular part of the country and may not be accurate at a specific location.

## What wind speed do I need to operate a turbine?

The greater the annual mean wind speed the better. In general, most small/micro wind turbines start to generate electricity in wind speeds of approximately 3-4 m/s, and most products achieve their maximum, or rated output at a wind speed of 10-12 m/s - which is critical when comparing products. You should investigate performance data for the products you are considering to ensure you are knowledgeable of the amount of energy that would be expected for the wind speed at your particular location.

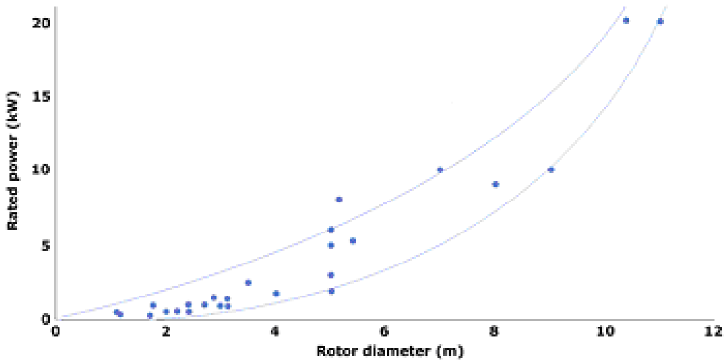
## What companies make or install small wind turbines?

A list of manufacturers and installers is supplied at the end of this briefing sheet

## What is the best product for my site?

Obtain product literature from several manufacturers, and research those you want to pursue to ensure they are recognised businesses and their parts and service will be available when you need them. Find out how long the warranty lasts and what it includes, and ask for performance data for the product.

Different products may perform differently at a variety of wind speeds and air flow conditions, therefore your choice of turbine may be affected by the wind resource at your site. There is no industry standard for a consistent wind speed at which to measure the output from wind turbines, so you may want to give consideration to the rotor diameter of different turbines, which is a key factor determining electrical output. A modest increase in the rotor diameter will lead to significant increases in both the swept area of a turbine and the amount of electricity that the turbine can generate. The actual power production from a wind turbine will be influenced by many other factors, such as: the efficiency that the wind turbine is able to extract energy from the wind; the height and position at which the turbine is located; and other design characteristics of the wind turbine. The diagram below on the right shows a range of current small wind systems and illustrates rated output against rotor diameter.




You may base your choice on the amount of electricity you wish to generate or how much money you are prepared to invest initially – larger systems will cost more but produce more electricity. An average household uses approximately 3,000–5,000 kWh (units) of electricity per year, therefore to produce 20% of your household electricity you would need a turbine that could generate 600-1,000 kWh per year from the average wind speed of your site.

In order to work out what size of turbine is required, you would need performance data of the products you are considering for a range of wind-speeds (which is different from rated capacity). You can then work out the energy yield to arrive at a reasonably accurate figure for annual expected output at your site, although you will need to use an estimate of the wind distribution. The website www.windpower.org has a calculator to help you with this. By way of example:

### Micro wind turbine (1 kW)

For a site with a good annual mean wind speed of 5 m/s, a turbine with a rating of 1 kW, and a diameter of 2.3 m, would produce approximately 1,200 kW hours or units of electricity per year. For an average household to meet all its electricity needs from a small wind turbine, a system of between 2.5-6 kW would be needed, depending on wind speed.

## How much do small wind turbines cost, and how much will they save?

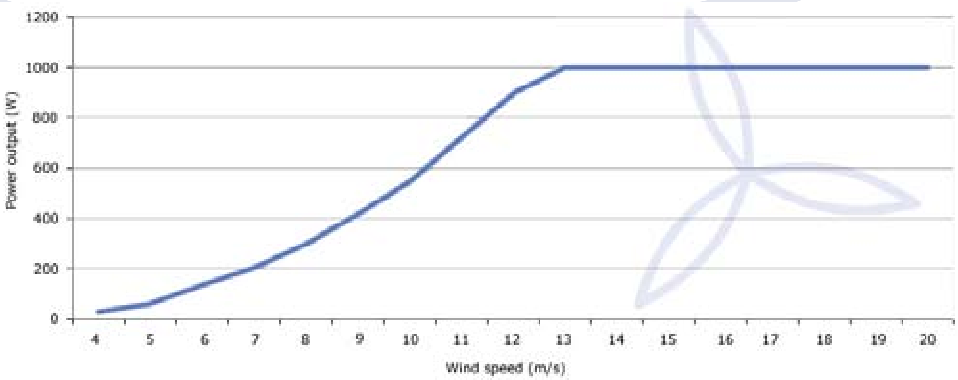
Small/micro wind systems range in cost from a few hundred pounds for a small battery charging system, to several thousand pounds for a larger system capable of meeting electricity needs for an entire household or business. A turbine rated at 600 W-1.5 kW might cost between £1,500- 3,000, whilst turbines rated at 2.5 kW to 20 kW can cost between £6,500 and £20,000. The amount of money a wind turbine will save you depends on the amount of initial capital outlay, electricity prices and how much electricity your turbine produces.

Once a small/micro wind turbine has produced enough electricity to pay for its cost, it will then start to save you money. A turbine on a good windy site will pay for itself more quickly and start to generate free electricity sooner than on a poor site.

If domestic electricity prices were to remain stable at the current cost of around 12 pence per kWh, a hypothetical micro wind turbine that costs £2,500 and has a rated capacity of 1 kW and a diameter of 2.3 m would take a varying amount of years to pay off according to wind speed. Notional figures for this scenario are set out below:

**Micro wind scenario: 1 kW turbine, initial capital cost £2,500:**

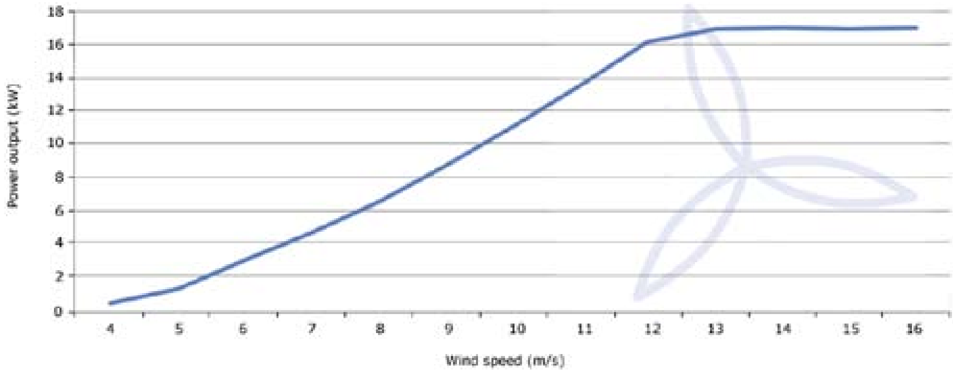
**Power output of a 2.3 m diameter wind turbine, 1 kW rating**




At 4 m/s average annual wind speed, about 600 kWh is estimated to be produced per year with a value of £72, so a 'simple payback' calculation suggests it would pay for itself in 2,500/72 or 35 years. For a good 5 m/s average wind speed, about 1,200 kWh is produced with a saving of £144 therefore the turbine pays back in 17 years. On an exceptionally good site of 6 m/s, about 1,800 kWh is estimated to be produced with an annual saving of £216 and a payback of 11.6 years.

**Small wind scenario: 17 kW turbine, initial capital cost £20,000:**

**Power output of a 10 m diameter turbine, 17 kW rating**




At 4 m/s average annual wind speed, 11,800 kWh is estimated to be produced per year with a value of £1416, so a payback calculation suggests it would pay for itself in 20,000/1,416 or 14 years. For a good 5 m/s average wind speed, 23,000 kWh is produced with a saving of £2760 therefore the turbine pays back in 7.2 years. On an exceptionally good site of 6 m/s - 35,700 kWh is estimated to be produced with an annual saving of £4,284 and a payback of 4.6 years.

Note that for small wind systems, 6 m/s average annual wind speed is considered to be exceptionally good due to the height of the mast and effect of local siting conditions. Within this annual average, wind speeds will vary through a range of 0–20 m/s or more. The examples above demonstrate that the economics of a small/micro wind system very much depend on wind speed, but sizes, prices and outputs vary considerably, so this is only a guide. Electricity prices are unlikely to remain stable, and any increase in prices will shorten the payback period of a small wind turbine. Grant funding may also contribute to the cost of capital outlay and shorten payback periods. A turbine with a longer payback period may be less economic; however there are many good reasons for installing a small/micro system in addition to potential savings

## Stand-alone and grid-connected systems

Wind turbine technology is well-established and due to its flexibility it can be used in a variety of locations where there is good wind speed. There are two basic systems for using wind turbines to generate electricity: stand-alone or grid-connected. Small/micro wind turbines have traditionally been used to generate electricity for charging batteries to run small stand-alone electrical applications, often in remote locations where it is not physically possible to connect to a mains power supply and include examples such as farms, island communities, boats and caravans. Typical applications are electric livestock fencing, small electric pumps, lighting or any kind of small electronic system needed to control or monitor remote equipment, including security systems.

In the case of grid-connected systems, the output of the wind turbine is directly connected to the mains electricity supply through the household distribution (fuse) box or a distribution grid connection. This type of system can be used both for individual turbines and wind farms exporting electricity to the electricity network. A grid-connected wind turbine may be a good option if electricity consumption is high (because a great deal of battery storage would be needed which would be bulky and expensive), or if you are planning a wind system that will be large enough to produce excess power to export to the grid. The electricity produced from a grid-connected system will feed into the grid and will then either be used for the nearest application (by the householder) or exported if it is not needed. In both cases it is possible for energy produced by the turbine to reduce energy that otherwise might come from the grid, depending on the type of application.

## Is there any funding available?

Grant funding for small wind systems is available from the following sources:

**The Low Carbon Buildings Programme (LCBP)** applies UK-wide and provides grants for householders, community organisations, public, not for profit and commercial organisations. The level of funding depends on application type:

### Householders

Grants are possible for a maximum £1,000 per kW installed, up to a maximum of £5,000 subject to an overall 30% limit of the installed cost (exclusive of VAT).

### Community organisations

Grants will be up to a maximum of £30,000 or 50% of the capital and installation cost of the microgeneration technologies installed. These grants will be awarded on a rolling first-come-first-served basis.

### Business, public and not for profit organisations

Grants are between 40-50% of the total installation costs (excl. VAT), depending on the type of organisation, and some organisations may be able to seek match funding for the remainder of project costs from other sources of public funds or government aid.

You must undertake a number of energy efficiency measures before you are eligible to apply for a Low Carbon Buildings Grant. These measures will ensure that you are minimising your energy requirements. Before applying you are required to have:

- insulated the whole of the loft of the property to meet current building regulations e.g. 270 mm of mineral wool loft insulation or suitable alternative
- installed cavity wall insulation (if you have cavity walls)
- fitted low energy light bulbs in all appropriate light fittings
- installed basic controls for your heating system to include a room thermostat and a programmer or timer

More information at www.lowcarbonbuildings.org.uk/home.

**The Scottish Community Householder Renewables Initiative (SCHRI)** provides grants for householders in Scotland, funded by the Scottish Executive and managed by the Energy Saving Trust. Grants are available for solar, water and space heating, small-scale wind and hydro systems, ground source heat pumps and biomass. Funding for householders is set at 30% of the installed cost up to £4,000. If you live in Scotland you can choose to have a SCHRI or a Low Carbon Buildings Programme grant. Please note that you can only apply for one grant per technology from either SCHRI or the Low Carbon Buildings Programme - you cannot have a grant from both programmes for one technology. More information at www.est.org.uk/schri.

**The Environment and Renewable Energy Fund** provides renewable energy grants for householders in Northern Ireland. More information at www.est.org.uk/northernireland/renewableenergy.

## Do I need planning permission?

Currently all small/micro wind installations require planning consent. You will need to submit a planning application with any accompanying information required by the local planning authority. There is some variation between the amount of detail different local authorities will require, however only information concerning relevant planning considerations should be requested. Decisions will be made in accordance with the local planning authority's adopted Development Plan, which should be available to view online, and decisions must also be in accordance with PPS22, PAN45 or TAN8 – the national renewable energy policies for England, Scotland and Wales respectively. Should an application be refused, applicants have the right to appeal to the Planning Inspectorate any decision, and the case will be considered in light of relevant planning policies and considerations.

## Small wind turbine manufacturers and installers

### Ampair (Boost Energy Systems)

Tel: 01344 303 311 • Fax: 01344 303 312 • Email: sales@ampair.com • Web: www.ampair.com
Manufacturer 100, 300 & 600 W wind turbines and microhydro systems for either battery or grid connection.

### Brumac Wind Systems Ltd

Tel: 01561 378899 • Fax: 01561 378858 • Email: lorna.watson@brumac.com • Web: www.brumac.com
Manufacturer of 5 kW and 50 kW wind turbines.

### Chalcroft Construction Ltd

Tel: 01386 561965 • Fax: 01386 554400 • Email: steveengland@chalcroft.co.uk • Web: www.chalcroft.co.uk
Civils contractor providing an in-house design and build service including installation of small wind systems.

### Chiltern Future Energy

Tel: 01491 845506 • Fax: 0149 845501 • Email: info@chilternfutureenergy.co.uk • Web: www.chilternfutureenergy.co.uk
Installer of microwind and solar systems.

### Econcern

Tel: 020 7618 7977 • Email: info@e-concern.com • Web: www.e-concern.com
Developer of small scale wind turbines/urban turbines through Ecofys BV.

### Fortis Wind Energy

Tel: +31 (0) 152 190 521 • Fax: +31 (0) 847 165 618 • Email: klimbie@fortiswindenergy.com • Web: www.fortiswindenergy.com
Manufacturers of wind turbines in the range of 800 W to 10 kW.

### Iskra Wind Turbine Manufacturers Limited

Tel: 01158 413 283 • Fax: 01158 478 813 • Email: enquiries@iskrawind.com • Web: www.iskrawind.com
Manufacturer of 5 kW wind turbine suitable for on and off grid applications.

### Marlec Engineering Co Ltd Rutland House

Tel: 01536 201 588 • Fax: 01536 400 211 • Email: teresa@marlec.co.uk • Web: www.marlec.co.uk
Manufacturer of 18,72,90 & 250 watt battery charging wind turbines (350 w & 1 kW in development).

### Proven Engineering Products Ltd

Tel: 01560 485 570 • Fax: 01560 485 580 • Email: info@provenenergy.com • Web: www.provenenergy.com
Manufacturer of 600 watt, 2.5, 6 & 15 kW wind turbines for on and off grid applications.

### Renewable Devices Ltd.

Tel: 0131 535 3301 • Fax: 0131 535 3303 • Email: Info@RenewableDevices.com • Web: www.RenewableDevices.com
Manufacturer of 1.5 kW wind turbine.

### Segen Ltd

Tel: 01252 401 025 • Fax: 01252 401 025 • Email: mailshot@segen.co.uk
Authorised distributor and installer of the Iskra AT5-1 5 kW wind turbine.

### Windsave Ltd

Tel: 0141 353 6841 • Fax: 0141 353 6842 • Email: david@windsave.com • Web: www.windsave.com
Manufacturer 1 kW wind turbine.

### XCO2 / Quiet Revolution

Tel: 020 7700 1000 • Fax: 020 7700 4455 • Email: juliag@xco2.com • Website: www.quietrevolution.co.uk
Manufacturer of 6 kW vertical axis wind turbine.

*Skegness Gramar Scoll's turbine © Prove Energy*

*City rooftop installation © Prove Energy*

## Further Information

### Websites

Buildings Research Establishment: www.bre.co.uk
BWEA: www.bwea.com
Danish Wind Energy Association: www.windpower.dk
Department of Trade and Industry: www.dti.gov.uk/renewables
Distributed Generation Co-ordinating Group: www.distributed-generation.gov.uk
Energy Savings Trust: www.est.org.uk
Hugh Piggot's Homepage: http://scoraigwind.com
Low Carbon Buildings Programme: www.lowcarbonbuildings.org.uk
Micropower Council: www.micropower.co.uk
National Energy Foundation: www.nef.org.uk
Ofgem: www.ofgem.gov.uk

### Reading

Choosing Windpower, Hugh Piggott, October 2006.
Installing small wind-powered electricity generating systems – Guidance for installers and specifiers, Energy Savings Trust: www.est.org.uk/uploads/documents/housingbuildings/ce72.pdf
Wind Energy basics: A guide to small and micro wind turbines, Paul Gipe, 1999. ISBN I 890132 07 1

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