

Wind Energy



If you are interested in generating electricity from a wind turbine then these guidelines should help you get started. These notes are applicable to the UK only and note that some of the details vary for Scotland and Northern Ireland.

Location, location

The first question is: do you really have enough wind to make a turbine a feasible proposition? Installing a turbine only to find it produces a small fraction of the energy you expected is going to be a big disappointment. Ideally you would do what wind farm companies do and erect a mast (the same height as you plan for the turbine), put a data-logging anemometer (wind gauge) on it and record your actual wind speed on site for at least 12 months. Obviously that's going to be costly and time consuming so there is an alternative, though with some trade-off in accuracy.

BERR (The Department for Business Enterprise & Regulatory Reform, formerly the Department of Trade and Industry) have made available a database that details the average annual wind speeds at three different heights above ground level - 10, 25 and 45 metres - for each 1 kilometre square area across the UK.

To use it you need to know the Ordnance Survey 6-figure map reference for the particular 1 km square where you plan to site your turbine - see the links section below for further instructions. Note that these figures are calculated based upon known factors such as wind measurements at a few locations and the topology of the land. Factors such as turbulence from trees and buildings are not taken into account.

Be aware that the annual average wind speed doesn't tell the whole story. Averages can hide information just as easily as reveal it. For example, if your average is 5 m/s then this could mean that your site has 5 m/s winds for all 365 days a year (a low speed for a medium size turbine and an unlikely scenario) or it could mean that you have 10 m/s winds for half the year and no winds at all for the other half (a much better wind profile for a turbine and also a little more likely in the UK at least).

If the BERR database indicates that your average annual wind speed is much less than 5 m/s then a wind turbine is probably not a good option for your location.

It is possible to get a better idea of the overall wind pattern across a year by using a statistical tool called a Weibull distribution - for more details, look at the [Danish Wind Industry Association website](#). The Weibull figures are themselves an averaged approach and may not accurately depict the wind speed pattern at any one particular location. Nevertheless, in the absence of any anemometer readings, it is the best estimate of wind speeds you will get.

What size turbine should I get?

Having discovered what the notional average annual wind speed is for your planned turbine location you can re-read the turbine manufacturers' datasheets with fresh eyes. Most manufacturers base their claimed generation figures on a wind speed of 12.5 m/s. Was your figure this high? Probably not, as pretty much nowhere in the UK has an average wind speed anything like that high. Between 5.0 and 7.0 m/s is much more likely. So if you had thought that a 1 kilowatt turbine was going to produce all your electricity needs then you may have to think about a slightly bigger size instead.

As the energy available from the wind varies in proportion to the cube of wind speed the amount you can generate from a 6 m/s wind is only a little more than 10% of what you would get from a 12.5 m/s wind. So a 1 kilowatt turbine is only going to generate approximately 110 Watts at 6 m/s wind speeds.

If you are trying to calculate what percentage of your annual electricity consumption you will be able to offset by installing a wind turbine do remember that the wind does not blow all the time. Most figures suggest that in the UK the wind is in fact only blowing about 30% of the time on average.

By applying the wind turbine manufacturer's power curve data - which details how much power can be generated by their turbine at each wind speed interval - against the Weibull distribution curve representative of the spread of wind speeds at your location you can calculate a rough figure to estimate the total amount of power you can expect to generate in an average year.

Mast or building mounted?

If you are planning to have a turbine mounted on a mast then you will want to install as tall a mast as possible so as to minimise the effect of ground turbulence on the turbine.

How far will the mast be from the house? This distance will affect the size (and therefore cost) of cables and also the voltage of turbine you should select - the greater the distance, the higher the voltage you should choose in order to minimise power loss in the cables.

Alternatively you may be planning to have a turbine bolted to your house. If so then you need to be aware of any turbulence caused by nearby structures (other houses, trees, etc) that may cause a lower amount of wind energy to be available. You will also want to be certain that your building is structurally sound and capable of holding the mast. Be aware that there are many people who hold the view that building-mounted turbines are a waste of time and money due to much lower than predicted generation caused by turbulence. Some studies have shown that roof-level wind speeds in urban areas can average as low as 2 m/s which is too low to generate any meaningful amount of energy.

Do I need planning permission?

In 2007 the UK government announced plans to introduce a new Statutory Instrument to simplify the planning process for small-scale renewable generation schemes. The idea was to remove the need for full planning approval for some installations by extending the scope of Generally Permitted Development Orders (GPDOs). At present new legislation has only been put in place for solar panels - both solar thermal and photovoltaics. Wind turbines have so far been excluded from the GPDO changes as deciding upon the conditions that would be acceptable without the need for planning approval has proved to be a little too controversial and so they have been dropped for the time being. Further changes, however, are currently undergoing consultation and are expected to be implemented in the near future.

So, in the meantime, you are going to need full planning approval in order to erect a turbine of any useful size. Some planning authorities have decided not to charge a fee for applications to site building-mounted wind turbines. Check with your local office to see if this applies in your area.

Generally speaking, planning departments are supportive of small-scale renewable generation schemes. However if you live in a Conservation Area or a National Park then you may find a few extra obstacles in your path and may even find that the planning officers require you to produce an Environmental Statement based upon an Environmental Impact Assessment. You will need to do some background research into the details of your area's Local Plan, which should be available on the Internet, to see if it has anything specific to say about small-scale wind turbines.

Allow up to three months to get full planning approval.

Grid-tied, batteries or hybrid?

As the wind is only an intermittent source of energy you'll normally want a method of providing power even when the wind isn't blowing. There are three basic options.



Grid-tied

You basically use the grid as a 'big battery'. Whenever you are not generating enough to meet your consumption needs you will use electricity from the National Grid just as you do now. If you are generating more than you are using then the excess will be exported to the grid.

Anyone with a grid-tied generator of any description (wind, PV, hydro, CHP, etc) can only connect with the agreement of their local Distribution Network Operator (DNO). All equipment and wiring used will need to be approved by them and be certified to meet the G83/1 (for up to 16 amps per phase) or G59 (over 16 amps) regulations. The DNO have some discretion on this matter and can accept generators over the 16A limit under G83/1 if they wish. The paperwork required for G59 is more complicated than G83/1 and is really aimed at small power stations. You'll most definitely want to stay with G83/1 if at all possible and your plans need to be discussed with the appointed person who handles small-scale generation in your local DNO at an early point in the project.

Part of the regulatory compliance is that any inverter you use has to be capable of monitoring the grid voltage and closing down automatically whenever the grid goes down. So with a simple grid-tied system whenever the grid is down then your own generator is effectively down as well. The relevant programmable parameters in the inverter have to be agreed with the DNO.

You also need an On/Off switch (clearly labelled) that can be padlocked in the Off position so that if someone needs to work on the line nearby they will be able to come and lock your generator off the grid if they wish to. They will also want a schematic of your installation and a copy of the electrical engineer's commissioning certificate within a month of going 'live'.



Off-grid using batteries

Off-grid systems generally use a series of lead-acid batteries as a store. These are similar to car batteries but are more specifically like 'leisure' batteries used in caravans and boats. These are designed to cope with deep discharge situations. Selecting the right size batteries, in terms of amp hours, will be a critical part of the project. Correct maintenance of your batteries is time well spent and will prolong their life which itself is limited so you'll need to budget in the longer term for their eventual replacement.

Power is taken from the batteries and can either be used by specific low voltage DC devices or passed through an inverter to convert to 230V. Note that there are a variety of inverters available at widely differing prices and the quality of the power these produce can vary as well. You may find that the cheaper inverters do not produce 'clean' AC power and can cause problems with some appliances.



Hybrid

You can also have a system that uses a combination of both grid-tie and batteries with an intelligent switch that can swap over to the batteries if the grid is down. This gives you the best of both systems but obviously will be a more expensive option.

With any of these options you'll need to ensure that you have enough space to install the required equipment and, with batteries, you'll need to provide adequate ventilation as well.

What grants are available?


The Low Carbon Building Programme grant scheme has now been closed, for both Phase I and Phase II (domestic and non-domestic), for electrical generation systems (wind, PV and hydro) from February 2010. All funding in England, Wales and Scotland is now via the Feed In Tariff (FIT) scheme (see below for more details). Northern Ireland will continue to use the Renewable Obligation Certificate scheme for the time being. Other local or regional grant systems may still continue to operate.

Can I earn any income from what I generate?

The new Feed-In Tariff scheme is scheduled to come into operation from 1st April 2010 and enables an income to be derived from your installation in three ways:

- 1 - a value based upon the total amount of electricity that your system produces. This is the main FIT.
- 2 - the value of any excess electricity that you produce but do not use yourself and so gets exported to the grid. You can opt for a FITs guaranteed price (3p per kWh) or obtain a market value for your export.
- 3 - the value of electricity generated and consumed by yourself which offsets your use of imported power and thereby reduces your bill.

To qualify for FITs your system must be one that is accredited by the Microgeneration Certification Scheme (MCS) and also installed by an MCS certified installer (for systems upto 50kW). FITs payments for wind turbines are guaranteed for 20 years and are also index linked to inflation via the RPI. The initial tariffs, for systems installed up to March 2012, are banded according to the capacity of the system:

 up to 1.5kW - 34.5p
 1.5 to 15kW - 26.7p
 15 to 100kW - 24.1p
 100 to 500kW - 18.8p
 500 to 1.5MW - 9.4p
 1.5 to 5MW - 4.5p

The price you pay for your imports and what you can get back for your exports varies from one provider to another, and also varies depending upon what part of the country you're in. There is a good summary of the current options available on the [Energy Saving Trust website](#).

In the 2009 Pre-Budget Report the Chancellor confirmed that income from FITs will, subject to a few conditions, be free of income tax.

Links

BERR windspeed database - <http://www.berr.gov.uk/windspeed-database/page27326.html>

Danish Wind Industry Association - <http://guidedtour.windpower.org/en/tour.htm>

DECC FITs - http://www.decc.gov.uk/en/content/cms/consultations/elec_financial/elec_financial.aspx

Recommended further reading

Wind Energy Basics: A Guide to Small and Micro Wind Turbines by Paul Gipe, 1999, Chelsea Green Publishing

Windpower Workshop by Hugh Piggott, 2000, CAT: The definitive guide to building your own wind turbine.