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 3 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.

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 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 England, with Wales and Scotland lagging behind. Unfortunately deciding upon the exact size of wind turbines 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 expected to be made 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 3 months to get full planning approval. You normally must already have obtained this before you submit an application for any grant assistance with the costs.

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. 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 before you go 'live'. So with a simple grid-tied system whenever the grid is down then your own generator is effectively down as well.

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?

For domestic installations in the UK the government introduced the Low Carbon Building Programme (LCBP) in April 2006. If you live in Scotland then the SCHRI scheme replaces the LCBP or if you are in Northern Ireland then there is the EREF.

To qualify for grant funding under the LCBP your property must first be insulated to the highest standards. You can find more information at the LCBP website. This scheme operates on a 'first come, first served' policy with no monthly cap on the total grants approved but once the allocated budget has been spent for the financial year then the scheme will close. So you will need to get in early with your application.

The LCBP scheme will only grant fund a system that uses equipment that is on their approved list and that is installed by an approved company. This funding is not available for any DIY projects.

For wind turbines the grant is £1,000 per kW up to a maximum of £2,500 or 30% of the total cost, whichever is the lower. For example: a 1kW turbine costing £1,500 would get 30% = £450; a 2kW turbine costing £10,000 would get £2,000; and a 6kW turbine costing £20,000 would get the maximum allowable £2,500.

Please note that once issued an LCBP grant approval is time-limited and, for wind turbines, will expire in four months. If you need a time extension, due, for example, to delays caused by the supplier, to allow

you to complete your project then you must ask for one – don't just assume that you'll get the grant money anyway. You can get up to a 2-month extension. When the project is finished you'll need to submit the final bill and a copy of the commissioning certificate for your turbine in order to get the grant monies released to you.

Can I earn any income from what I generate?

You should have a meter that records the running total of the kiloWatt-hours that you generate. You are also entitled to claim a Renewable Obligation Certificate (ROC) for each 1,000 kWh that you generate each year. You can download a document from the OFGEM website entitled 'Renewables Obligation: Guidance for small generators (50kW and under)' which describes the registration process in more detail. The value of ROCs changes over time based on a few variables but you can roughly estimate their likely value from recent past figures – this is around £40 to £45 each.

You may also want to install an 'export meter' which records how much you physically send out to the grid. (You may not want to do this as you have to pay for the meter and it may cost more than the value of your exports – so you could be out of pocket). Also OFGEM decide on the threshold that determines whether a system falls below what is called the Small Scale Third Party Generating Plant (SSTPGP) Limit. Since November 2004 this has been set at 30kW. Any generating system above this limit will need to be fitted with a Half Hourly Meter for export. These are extremely costly to install and have read (in the region of £500 per annum) so the economics need to be checked carefully.

The price you pay for your imports and what you get back for your exports varies from one electricity provider to another, and also varies depending upon what part of the country you're in. There is a good summary of the options available on the West Wales ECO Centre site but be aware that suppliers are coming up with new ideas and the tariffs on offer are changing all the time.

Currently NPower offer a net metering tariff – albeit excluding the VAT element. This means that they pay you for exports at the same price as you pay them for the units you use from the grid.

In the 2007 Budget the Chancellor announced that income from the sale of surplus renewable electricity and income from ROCs will be free of income tax.

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.

Links

Energy Saving Trust Best Practice Guide

This covers all the basic building and electrical requirements for installing small wind-powered electricity generating systems in quite some detail.

www.est.org.uk/uploads/documents/housingbuildings/ce72.pdf

Danish Wind Industry Association: Description of Weibull power curve

www.windpower.org/en/tour/wres/weibull.htm

BERR windspeed database instructions

http://www.berr.gov.uk/energy/sources/renewables/explained/wind/windspeed-database/page27326.html

DIY Wind Turbine Projects - Hugh Piggott

www.scoraigwind.com

Explanation of ROCs

www.en.wikipedia.org/wiki/Renewables_Obligation_Certificates

ROC Registration

www.ofgem.gov.uk

Find your local DNO

www.nationalgrid.com/uk/Electricity/AboutElectricity/DistributionCcompanies

LCBP

www.lowcarbonbuildings.org.uk/home/

EREF

www.est.org.uk/northernireland/

SCHRI

www.est.org.uk/schri/

West Wales Eco Centre

www.ecocentre.org.uk/selling-electricity-back-to-the-grid.html

YUASA Battery Guide

www.yuasa-battery.co.uk/industrial/downloads/LRBOB-pdf.zip

NPower microgeneration scheme

www.npower.com/at_home/juice-clean_and_green/microgeneration.html