DOMESTIC WIND TURBINES

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The UK is the windiest country in Europe, and wind farms can produce electricity at rates competitive with fossil fuels and cheaper than nuclear power. It is sometimes feasible to invest in large wind schemes and sell electricity to the national grid - so making a profit. This can be done as an individual or in partnership with others in your local area. Do ask us for advice on investing in renewable energy.

Grid electricity is relatively cheap, so small-scale wind turbines for grid-connected houses are not usually cost-effective. In addition, turbines must be mounted high up and away from obstacles that cause turbulence - most homes are not good sites.

If you are on a budget, then the best option is to sign up to a green electricity tariff and concentrate on reducing energy use. See our 'green electricity through the grid' and 'energy efficiency in the home' sheets for advice. After that, renewable heating systems such as solar water heating or wood fuel are a more cost-effective way to lower your environmental impact. See our information sheets on these options for more advice.

Although there are grants available, a domestic wind turbine will still be a relative luxury. Many companies are aiming to reach a point where they can mass produce turbines and bring the costs down. Until then, if you have a good windy site and a little extra cash to spend you can be a green pioneer - helping to develop the market in micro-generation by being one of the first to go for it.

Off-grid homes

Small-scale wind power can be a worthwhile option for off-grid homes. It's a good alternative to either grid connection (which can be expensive) or a diesel generator (not only noisy and polluting, but with ongoing fuel costs).

If you're lucky enough to have access to a fast flowing stream, then a small hydro-electric system could be the best renewable energy option (see our Micro-hydro Factsheet for advice). Otherwise, many off-grid homes can make good use of a combination of wind and photovoltaic (PV) solar power. These complement each other well, with more wind in winter and more sun in summer.

See our 'electricity for off grid homes' information sheet for more advice on calculating your energy demand and sizing batteries.

How much wind?

Wind energy is very site specific. To estimate the average output from a wind turbine you will need to find out the average wind speed at your site. In our experience, many people overestimate how windy their home is. A turbine that sits unmoving most of the time will not promote either renewable energy or your bank balance. So it is worth checking to make sure, before you end up with a very expensive wind vane!

Approximate information on average wind speeds in the UK is freely available from an online wind speed database. You'll need the OS (Ordnance Survey) grid reference for the kilometre square in which the site is located. For some good advice on finding your OS reference, and a link through to the online database, see *www.bwea.com/noabl*

This database will give a wind speed (in metres per second) at 10 metres above ground - but this is not the whole story. The database is a general guide, and does not take account of walls, trees or other small obstacles. These create turbulence and reduce the wind available, so it is crucial to avoid them. If the average wind speed is less than 5m/s a wind turbine may not be worthwhile.

Siting a turbine

The power generated will be proportional to the cube of the wind speed. This means that if the wind speed doubles, the power generated is eight times as much. If it halves, you get an eighth! To get the best from a turbine you need to put it where it will receive the fastest possible winds. An ideal site is a smooth hill top with a clear open stretch (at least in the prevailing wind direction). This is why turbines are rarely sited in towns.

As wind speeds increase significantly with height, it makes sense to mount a turbine very high up. The extra cost of a tower should be repaid by the extra energy generated. Most suppliers provide poles or towers (often several metres high) to mount their turbines on. This will also avoid turbulence, created by obstructions such as buildings and trees. Lots of turbulence will reduce power output and increase wear and tear on the machine.

The installation of a wind turbine usually requires permission from the local planning authority. It's also sensible to consider your neighbours, as a

properly mounted turbine is likely to be very visible. Neighbours will generally be more supportive if they are consulted before an application goes in.

Can I put a wind turbine on my roof?

We would not recommend a rooftop or a building as a suitable mounting point. A turbine operating in high winds will create lots of force. This will produce resonance within the structure, which may damage the building as well as being a nuisance.

In addition, most houses are relatively sheltered, and won't get wind speeds anywhere near the UK average of 6 metres per second (m/s). On most rooftops, average wind speed will be more like 2 or 3 m/s. As many turbines do not generate at less than 3 or 4 m/s, they'd sit idle much of the time.

Finally, a turbine mounted close to a roof will be operating in very turbulent winds. This means that when it is windy, the machine is likely to spend a lot of time turning round and round to find the wind, rather than actually generating any electricity.

What will it cost?

The smallest kind of wind turbines, costing a few hundred pounds, are not big enough for most homes – they are designed to charge up a 12 volt battery in a boat or caravan. These small machines are a little bigger than a satellite dish, measuring between half a metre and one metre across.

To generate enough to make a decent contribution to household energy use, a much larger turbine is needed, with a rotor 2 or 3 metres across. The prices quoted for some new turbines look very attractive - much less than models already on the market. However, the cheapest can only be roof-mounted, and as mentioned before, this would be a very poor site. Low price installations also don't include equipment for selling electricity though the grid. For a decent installation, including a tower, current costs are in the region of £5,000 - £10,000. The Low Carbon Buildings scheme offers grants that will cover 20% to 30% of this cost.

Sizing cables

Wind turbines normally operate at low voltages, such as 12 or 24 volts DC. Thick cabling needs to be used to prevent power losses at low voltages, and as this is expensive it may affect turbine siting.

Choosing a turbine

A good turbine manufacturer should be able to supply figures for the energy that will be generated by their turbine at different wind speeds. These data are normally presented as a 'power curve' - a graph showing how the power output varies with wind speed. Otherwise, if you have a figure for the output of the turbine at 10 m/s, you can use the following formula: $P_A = (V - 2.5) \times P_{10} / 9.5$ P_A is the average power output, when P_{10} is the power output at 10 m/s and V is the average annual wind speed. To get the daily output in kWh you'll need to multiply P_A by 24, and then multiply that by 365 to get the estimated annual output.

You can find installers through the grant scheme (see below). Also, CAT's *Wind Power Resource Guide* lists hundreds of suppliers and installers.

Exporting power to the grid

Because their output is variable, most small wind systems will struggle to effectively export much power to the grid. Generation of over 500 units of electricity (kWh) is a prerequisite for most export schemes. In practice, much more is necessary to make the cost of grid-connection worthwhile, probably 5,000kWh per year, for which you'd need a turbine of at least 2kW (a 3 metre rotor) on a good site. Companies usually pay a set fee of about 4 or 5 pence for each kWh of electricity generated, but you will need to have an ofgem approved meter installed with the system. See our grid-connected renewables sheet for more advice.

Other Options

Once you've taken all possible efficiency measures and signed up for a green tariff, then solar water heating is usually the most effective renewable energy system. For electricity, solar PV tends to be more effective than wind for most grid-connected homes. A PV roof needs less maintenance (there are no moving parts), and electricity export is easier. See our other information sheets for advice.

Further information

For advice on choosing and setting up a small wind system, see our book *Choosing Windpower*

For those with engineering experience, a well-equipped workshop and lots of time and enthusiasm, we publish 'Windpower Workshop', which describes how to build your own wind turbine from second hand and scrap materials.

We also run courses on renewable energy systems, including wind power, here at CAT. *Tel: 01654 705981 or see: www.cat.org.uk/courses*

British Wind Energy Association's online guide to small wind systems: *www.bwea.com/small*

Low Carbon Buildings: *Tel: 0800 915 0990; Web: www.lowcarbonbuildings.org.uk*
Grants for householders, small businesses, community schemes, and larger projects.
In Scotland: **Scottish Renewables Initiative**
Tel: 0800 138 8858 Web: www.est.org.uk/schri