



WIND TURBINES

What is a Wind Turbine?

Wind turbines convert the kinetic energy of the wind into electrical energy. Given that the **UK has roughly 40% of the entire wind resource of Europe**, there is significant potential to extract energy from this source. However, to date this has been under utilised. Domestic systems need wind speeds of at least 5 metres per second, preferably 6 m/s to produce output from just a few tens of Watts to several kilowatts. Of all the domestic renewable energy systems, wind turbines are the most controversial, and also the most difficult to predict performance. There are however, devices that you can install to confirm suitability of where you are thinking of installing a wind turbine or solar PV panels, that record data of the wind speed, direction etc and the solar radiation (eg www.powerpredictor.com)

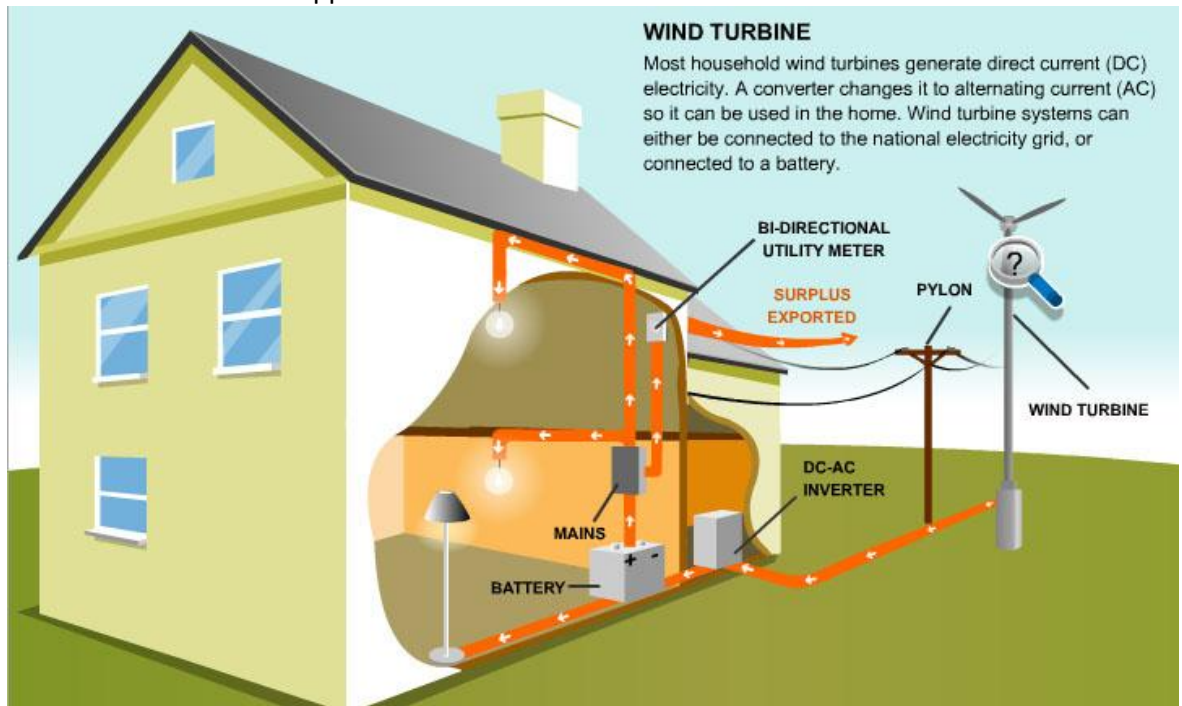
Types of domestic wind turbine

Turbine design depends largely upon whether it is horizontal axis (HAWT) or vertical axis (VAWT), with horizontal axis machines by far the most commonly installed and typically have three or more rotor blades. They automatically orientate themselves with the direction of incoming wind, but turn away from it in times of high wind speed to prevent damage

- Pole mountings consist either of a steel or composite material (tubular tower), a lattice tower, or a guyed mast on top of which the turbine and generator are located
- Building mountings should be treated with caution because of the forces involved.

How does a Wind Turbine work?

With HAWT when air flows past the blades of a turbine a force is exerted onto the blades and tail fin, pushing the turbine in the direction of the wind. Because of the special shape of the rotor blades, a lift force is also created forcing rotor to revolve about the central axis in the familiar way. The rotor is connected to a shaft which drives a generator directly, producing the electrical output from the machine. Larger machines can make use of a gearbox to maintain a fixed generator speed for different wind conditions. Domestic wind turbines tend to produce electricity of variable AC voltage and frequency, which needs to be converted to DC and then AC of the correct characteristics for integration to the local electricity grid and for use with household appliances.



What components comprise a Wind Turbine System?

The main components of a wind turbine are:

1. The turbine and generator
2. Pole/mast/truss/fixings
3. Inverter/power conditioner
4. Battery Bank (**optional** but makes less sense now that you get paid to export energy to the grid)

How much energy can I expect for a wind turbine?

For every doubling in wind speed, the energy available from the wind increases eightfold. Therefore, the more exposed the site and the greater the average wind speed obtainable, the greater the potential for harnessing power from the wind. Furthermore, wind speed increases with height whilst at the same time turbulence reduces, providing more reliable and consistent power output and a safer operating environment for the turbine. Well sited wind turbines can expect to produce energy equivalent to their rated power for around 30% of the year, according to the Energy Saving Trust. For example: for a turbine rated at four kilowatts this equates to $(4\text{kW} \times 0.3 \times 8760 \text{ hours in a year}) = 10,512 \text{ kWh per year}$.

What are the benefits of a wind turbine?

- Potential power generation throughout the year, night and day
- They can be installed at a variety of different sites
- They can be grid connected or stand alone
- They can provide a strong visual statement of a commitment to protecting the environment

Suitability

More advanced blade designs have reduced noise levels dramatically over the past 20 years or so. However, issues may arise over the visual and audible impact your system may have on you and your neighbouring properties, so it is recommended that you talk to your neighbours and seek advice from your Local Authority Planning Department before committing yourself to any purchases. You need to consider whether or not you would prefer a building mounted turbine (will create a lateral load so advice on location required) or one that is mounted on a tower. The tower could either be a guyed mast, or of solid tubular construction; the former is less expensive but requires more land area. There needs to be enough room to raise and lower the mast on a periodic basis for routine maintenance. Wind speed increases with height, so to get the best from your installation you ideally need a combination of a high mast/tower and an exposed site. Any nearby buildings or large trees cause potentially damaging turbulence and reduce energy output, so installations next to these should be avoided if possible.



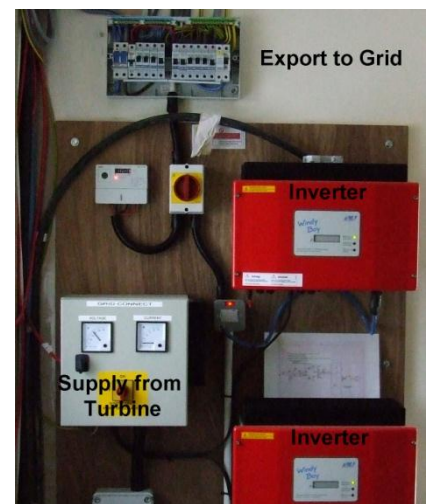
Ted Marynicz's Wind Turbine 6kW

Maintenance

As this is an electrical machine operating in harsh conditions an annual service may be necessary as described in the technical guide of any machine purchased. Maintenance cost around £300 depending upon machine.

Grid connection and exporting excess energy

Before connecting any electricity generating equipment to the local grid, you should seek advice and approval from your Distribution Network Operator (DNO), your turbine installer should be able to help with this. In the event of grid failure (power cut), your wind turbine system will automatically shut down in order to ensure the safety of any engineers working on the power lines. All electricity generated is free for you to use and receives a payment from the National grid with the Feed in Tariffs (FITs) below. With any energy actually fed into the grid receiving an additional 3p per unit.



Ted's Wind Turbine Electrics

Costs

A significant proportion of the **installation cost** of a wind turbine system is the turbine itself and the grid-connect inverter. Wind turbines are mechanical machines and operate in harsh conditions; choosing a machine constructed from higher quality components will generally increase its cost and reliability. The installed and commissioned cost of a grid connected wind turbine system should be in the region of:

- Building mounted: £1,500 for 1 kW rated output
- Tower mounted: £2,500 - £5,000 per kW rated output
- Typical 2.5kW system costs around £11,000 - £12,500
- Typical 6kW system costs around £18,000 - £25,000

Running cost is only the **Maintenance costs** approx £300 pa.

Type	FIT rate
0 – 1.5kW	34.5 p
1.5kW – 15kW	26.7p
15kW – 100kW	24.1p