

# Energy from wind: an explanation of terms

## *Wind Energy Fact Sheet 13*

Many terms are used to describe the power and energy derived from wind turbines. This Fact Sheet explains some of them and relates the electrical output to the energy that we consume.

### **Installed capacity and power**

**Installed capacity** (sometimes called **rated capacity**) is the maximum steady power that an electricity generator can produce. Installed capacity is usually expressed in kilowatts (kW) or megawatts (MW), where 1MW = 1000kW.

A typical light bulb consumes about 60W (0.06kW); energy-efficient light bulbs do the same job consuming as little as 10W. This means that 1kW of delivered electricity would power nearly 17 ordinary light bulbs or 100 energy-efficient ones. A one-bar electric fire, rated at 1kW, left on for 1 hour consumes 1kWh of energy (one unit on an electricity meter). A kettle consumes about 1.5kW to boil 1 litre of water, but only for a short time. Not all devices consume power all the time. The total power we consume at any one time depends on the number of devices we are using.

For various reasons, generators do not run at full output all of the time. In the case of wind turbines, this is mostly because the wind does not blow at full strength all the time. To account for this difference we use a measure called the **capacity factor** (see Fact Sheet 14).

### **Declared Net Capacity (DNC)**

**DNC** is used mainly in reference to schemes contracted under the Non-Fossil Fuel Obligation (NFFO) in England and Wales and under parallel arrangements in Scotland and Northern Ireland. It is legally defined in the Electricity Act 1989 (see REB-7 under References, for a full definition). It is used to provide a rough comparison of the output of different energy technologies against conventional plant, allowing an assessment of the contribution of all renewable energy to UK electricity supply.

Very broadly, DNC is a measure of the equivalent capacity of base-load plant (that is coal, gas or nuclear power plant) that would generate the same average annual energy output as the renewable energy plant. The DNC for wind is calculated by multiplying the net installed capacity (ie the capacity allowing for on-site losses) by 0.43.

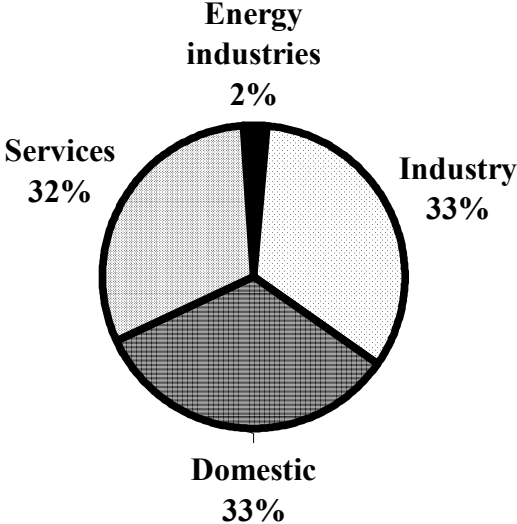
### **Electricity generation from wind turbines**

A prime aim of wind energy is to generate pollution-free electricity. The installed capacity tells us the potential output of a wind turbine. However, it is more relevant to look at the historical or expected annual electricity yield, as this is electricity that we will actually use.

Electricity is most commonly measured in kilowatt-hours (kWh), although some people use Joules (J) or tonnes of oil equivalent (toe). 1kWh is the amount of electrical energy generated by a 1kW generator running at full output for one hour, and is equivalent to 3,600,000J or  $8.6 \times 10^{-5}$ toe. Similarly, 1kWh of delivered electricity would keep a 1kW load (such as a one-bar electric fire) running continuously for one hour.

A modern wind farm might have, for example, ten 1MW wind turbines. If it were possible to run all the wind turbines at full output for a year, they would produce 10 x 887,600,000kWh/year. However, the wind does not blow constantly so this does not happen. We can usually expect to generate around 30% of this maximum amount from an average site (more at windier sites). This means that in a reasonably windy location such a farm would actually produce roughly 26,280,000kWh/year for each turbine.

The electricity generated by a wind farm is used by industry, in our homes and to power our services. Each of these consumes roughly one third of the energy generated, with about 2% used by the energy industry. The chart below shows how much energy is used by the various consumers in the UK overall.



**UK electricity use in 1999, by sector**

The full picture is both more complex and very dependent upon location. In some cases much of the electricity generated by a wind farm is used locally and this reduces the total losses in the electricity network.

The electrical output of a wind farm is often compared with domestic sector use. The average UK home uses approximately 4100kWh/year. This statistic is provided by OFGEM (The Office of Gas and Electricity Markets) and is an average figure for the UK including the correct proportion of homes heated by electricity. On this basis, the ten 1MW-turbine wind farm described above would provide enough energy to power about 6400 homes.

The total UK electricity consumption in 1999 was approximately 330TWh ( $330 \times 10^9$ kWh). To supply 1% of this energy from wind would require one hundred and twenty five wind farms of 10MW.

## Energy payback

A certain amount of energy is used in the manufacture of wind turbines. The time taken for the wind turbine to generate as much energy as was used in its manufacture and installation is called the *energy payback* period. A reasonable estimate of the energy payback of modern wind turbines is 3-10 months, depending upon the site wind speed and turbine installation. Wind turbines are expected to operate for more than 20 years and so over their lifetime will generate at least 24 times the energy that was used in their manufacture and installation.

## References

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**NEW REVIEW**, the DTI's quarterly renewable energy newsletter, is available on the Web at [www.dti.gov.uk/NewReview/](http://www.dti.gov.uk/NewReview/)

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