Wind Turbines: How many blades?

Why Not an Even Number of Blades?

Modern wind turbine engineers avoid building large machines with an even number of rotor blades. The most important reason is the stability of the turbine. A rotor with an odd number of rotor blades (and at least three blades) can be considered to be similar to a disc when calculating the dynamic properties of the machine.

A rotor with an even number of blades will give stability problems for a machine with a stiff structure. The reason is that at the very moment when the uppermost blade bends backwards, because it gets the maximum power from the wind, the lowermost blade passes into the wind shade in front of the tower.

The Danish Three-Bladed Concept

Most modern wind turbines are three-bladed designs with the rotor position maintained upwind (on the windy side of the tower) using electrical motors in their yaw mechanism. This design is usually called the classical Danish concept , and tends to be a standard against which other concepts are evaluated. The vast majority of the turbines sold in world markets have this design. The basic design was first introduced with the renowned Gedser wind turbine. Another characteristic is the use of an asynchronous generator. You may read more about the Danish concept in the articles section of this web site.

Two-Bladed (Teetering) Concept

Two-bladed wind turbine designs have the advantage of saving the cost of one rotor blade and its weight, of course. However, they tend to have difficulty in penetrating the market, partly because they require higher rotational speed to yield the same energy output. This is a disadvantage both in regard to noise and visual intrusion. Lately, several traditional manufacturers of two-bladed machines have switched to three-bladed designs.

Two- and one-bladed machines require a more complex design with a hinged (teetering hub) rotor as shown in the picture, i.e. the rotor has to be able to tilt in order to avoid too heavy shocks to

the turbine when a rotor blades passes the tower. The rotor is therefore fitted onto a shaft which is perpendicular to the main shaft, and which rotates along with the main shaft. This arrangement may require additional shock absorbers to prevent the rotor blade from hitting the tower.

One-Bladed Concept

Yes, one-bladed wind turbines do exist, and indeed, they save the cost of another rotor blade! If anything can be built, engineers will do it. One-bladed wind turbines are not very widespread commercially, however, because the same problems that are mentioned under the two-bladed design apply to an even larger extent to one-bladed machines.

In addition to higher rotational speed, and the noise and visual intrusion problems, they require a counterweight to be placed on the other side of the hub from the rotor blade in order to balance the rotor. This obviously negates the savings on weight compared to a two-bladed design.