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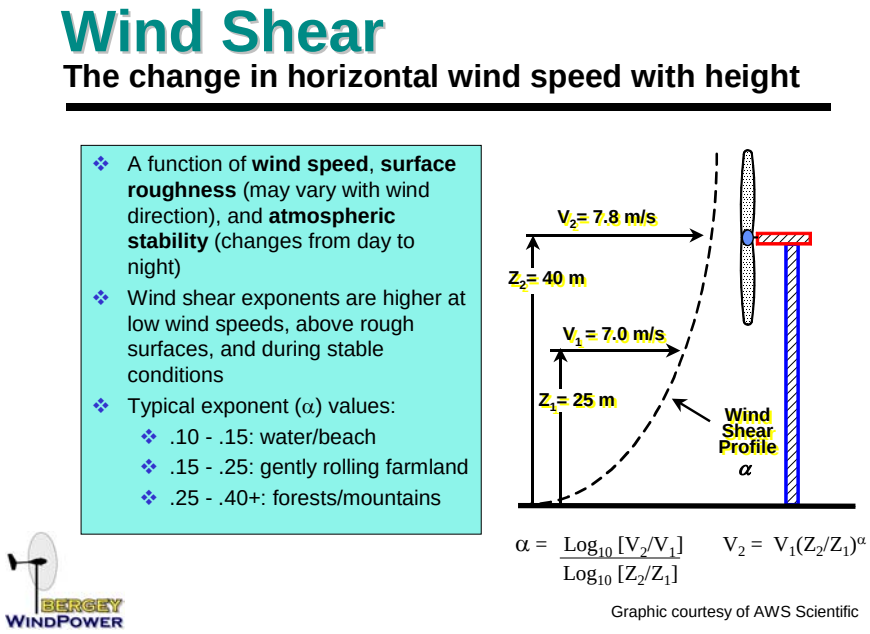
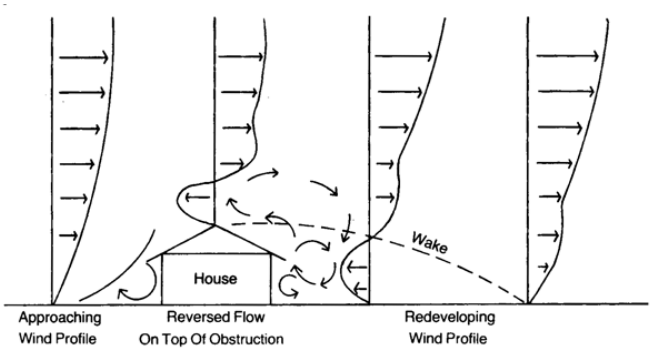
Why Short Towers are Very Bad for Small Wind Turbines

The smooth flow of the wind over the land is interrupted by obstructions and topographical variations. These interruptions bring about two important phenomena: **wind shear** and **turbulence**. Wind shear describes the fact that close to the ground the wind is slowed down by friction and the influence of obstacles. Thus, wind speed is low close to the ground and increases with increasing height above the ground. Wind shear is more pronounced over rough terrain and less pronounced over smooth terrain. Turbulence is essentially rough air caused by the wind passing over obstructions such as trees, buildings, or terrain features. Turbulent air reduces energy output because it diminishes the effectiveness of the



aerodynamics of the rotor blades. Turbulence also puts greater strain on the wind turbine because it increases vibration.

Turbulence



Turbulence cuts performance by reducing the effectiveness of the blades

The effects of both wind shear and turbulence diminish with height and can be largely overcome simply by putting the machine sufficiently high above the ground. This may be accomplished by putting the machine on the highest possible ground and on the highest feasible tower. As a minimum, the machine should be at least 12 meters (40 feet) above any obstructions within 100 meters (330 feet) in the prevailing wind direction, and preferably in all directions. Even in perfectly flat areas, we recommend that the tower be at least 24 meters (80 feet) high for an 10 kW BWC Excel-S wind turbine installation and 18 meters (60 feet) for the 1 kW BWC XL.1. In areas with trees, please bear in mind that trees grow and the tower height needs to be based on the mature height of trees in the vicinity.

Further, the power in the wind increases as the cube of the wind velocity (i.e., doubling wind speed increases power by a factor of eight, 2 x 2 x 2 = 8). Therefore, small increases in average wind speed will result in significant increases in long-term energy output.

Table 1 below shows the influence that tower height can have on annual energy output for the BWC Excel-S wind turbine at a typical inland site.

Tower Height (ft)	Wind Speed at Top of Tower (mph)	Annual Energy Output (kWh)
60	11.2	9,600
80	12.0	11,500
100	12.6	13,100
120	13.3	14,700

Table 1: Variation in wind speed and expected annual energy output with tower height.

The Bottom Line:

Putting a wind turbine on a short tower is like putting a solar system in the shade!

Tower heights for the 10 kW BWC Excel-S can range from 80 - 140 feet and most installations use the 100 ft. or 120 ft. towers.

The FAA does not require the approval of towers under 200 feet unless they are in close proximity to an active airport runway. The need to obtain FAA permission (known as a "determination") is triggered in this case if the tower punctures a slope of either 50:1 or 100:1, depending on the runway length, taken from the nearest point on the airport runway. For example, for a runway over 3,500 ft in length a 100 ft. (112 ft. to tip of blade) tower would need to be closer than 11,200 ft from the runway to require FAA approval. This situation has arisen about a dozen times over the last 25 years for BWC installations and the FAA has granted permission in every case.