Measuring the Swept Area of Your Wind Turbine

Being able to measure the swept area of your blades is essential if you want to analyze the efficiency of your wind turbine.

The **swept area** refers to the area of the circle created by the blades as they sweep through the air.

> To find the swept area, use the same equation you would use to find the area of a circle. Follow this equation: $\text{Area} = \pi r^2$
>
> $\pi = 3.14159$ (pi)
> r = radius of the circle. This is equal to the length of one of your blades.

Why is This Important?

You will need to know the swept area of your wind turbine to calculate the total power in the wind that hits your turbine.

Remember the Power In The Wind Equation: $P = 1/2 \times p \times A \times V^3$

P = Power (Watts)

p = Air Density (about 1.225 kg/m^3 at sea level)

A = Swept Area of Blades (m^2)

V = Velocity of the wind

By doing this calculation, you can see the total energy potential in a given area of wind. You can then compare this to the actual amount of power you are producing with your wind turbine (you will need to calculate this using a multimeter—multiply voltage by amperage). The comparison of these two figures will indicate how efficient your wind turbine is. Of course, finding the swept area of your wind turbine is an essential part of this equation!

SAMPLE PROBLEMS

1. What is the swept area of a wind turbine with 6 blades that are each 45 meters long?

2. What is the swept area of a wind turbine with a rotor diameter of 60 meters?

3. If the wind is blowing at 10 meters/second, how much total power is in the wind hitting the wind turbine from question one (blades 45 meters long)? How much total power would it receive from the wind if it was blowing at 20 meters per second?

4. How much more power (watts) would the wind turbine get if the winds was blowing at 12 meters per second?

5. The second wind urbine (60 meter diameter) is also at sea level, but it is in a windier place. How much total power would it receive from the wind if it was blowing at 20 meters per second?

6. Why can't a wind turbine with 60 meter blades actually produce this much power in 20 m/s winds?