# Shopping for a Wind Turbine: Power vs. Energy

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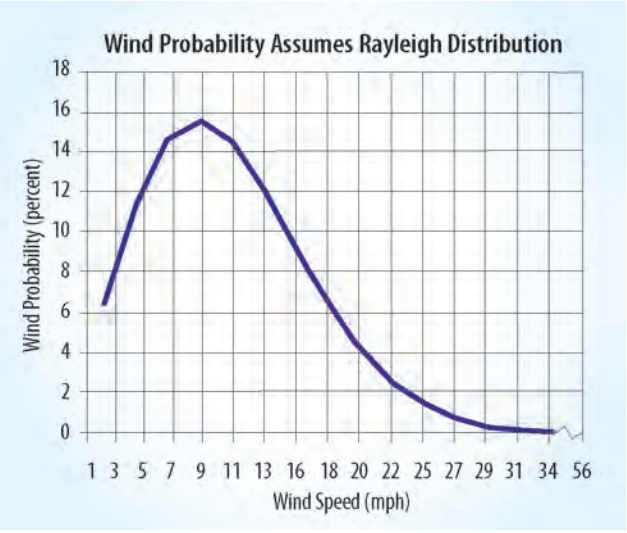
All too often, when people interested in a wind turbine go shopping, they compare turbine models based on power rating of the generator and cost of the turbine. Doing so is foolish. By comparison, when you shop for a car you look for the features you need, the warranty, the fuel efficiency and proximity of the dealer. You would not choose a car based only on the upper number on the speedometer and the cost.

Most speedometers top out at 120 mph, although some range up to 130 mph or so. Does a higher speedometer range mean the car is better? If the speedometer only reads to 100 mph, does that mean the car is inferior? How often do you drive at 120 mph, or even 80 mph?




To prevent damage to the speedometer, its top reading is a number higher than the car might do with the throttle wide open, going downhill with a tailwind. Will it ever reach that top number? Probably not. But to someone who doesn't know about the engineering rationale, the top number looks impressive.

| Turbine model | Rated power of the generator | Rated wind speed | Rated power at 25 mph per AWEA standard | Swept area of the rotor | Electricity generated annually at 11 mph average wind speed |
|---|---|---|---|---|---|
| #1 | 10 kW | 40 mph | 2.4 kW | 49 square feet | 3,335 kWh |
| #2 | 10 kW | 27 mph | 8.0 kW | 415 square feet | 12,700 kWh |
| #3 | 11 kW | 21.25 mph | 13.9 kW | 1425 square feet | 29,127 kWh |

I once saw a lawn tractor with a speedometer that went up to 60 mph. Of course it was a joke: Lawn tractors don't actually do 60 mph. But the salesperson confided that it was their best-selling model. As consumers, we're impressed with what we perceive as power, regardless of what is actually delivered. Sales and marketing people know how to capitalize on this infatuation. But is the top speedometer number what you're actually buying? Of course not.

So, why do potential wind turbine customers look at the generator power rating of the wind turbines they're interested in? It's easy to use for comparison purposes, and we think we understand it. While most wind turbines are marketed this way, unfortunately, few people understand the power ratings of wind turbines. And fewer people realize that their wind turbine will reach its rated power only at a relatively high, and very infrequent, wind speed.

The rated power of a wind turbine is the generator power that a wind turbine will hit at a certain wind speed. Therein is one of the problems; until recently, there was no standard wind speed that marketers adhere to when rating their products. Two years back, the American Wind Energy Association (AWEA) developed the Small Wind Turbine Performance and Safety Standard, patterned after an international standard, and adopted a rated wind speed of 25 mph. But what does this really mean?

Let's look at three different wind turbines on the market today, whose names we don't need to know. A few statistics of each turbine are listed:

Two of the turbines are advertised at 10 kilowatts (kW) while the third is 11 kW, close enough. What's interesting about the marketing of the power ratings of these turbines is that turbine No. 1 is represented as nearly equal to turbine No. 3 — after all, they're both 10-kW generators (11 is close enough for this discussion). However, if all three turbines are rated at 25 mph per the AWEA standard, turbine No. 1 is really only a 2.4-kW generator while turbine No. 3 is nearly a 14-kW generator.

What's even more impressive is the annual energy output of each model. I picked an 11-mph average annual wind speed, which makes a respectable small wind turbine site. Turbine No. 3 produces more than eight times the electricity annually as turbine No. 1 at this site, even though their generator power ratings are nearly identical.

Why the large discrepancy? For one thing, turbine No. 1 will see 40 mph less than 0.01 percent of the year. The first graphic above depicts the amount of time that the wind blows at various wind speeds. From this graph, we can see that lighter winds dominate, with less and less blow time as wind speed increases.

What's really important in generating energy with a small wind turbine is the swept area of the rotor, not the size of the generator. Think of the swept area of a wind turbine like the sail on a boat. The bigger your sail, the more power you can capture to push the boat. The circles at left depict the swept areas of these three turbines. Any idea which is which?

Bottom line: The power rating of the generator is the wrong metric to use when comparing wind turbines. What you want to know is how many kilowatt-hours (kWh) of electricity the wind turbine will generate at your site per year. After all, isn't that why you're buying a wind turbine? ST