AN ORENDA WHITEPAPER

Wind Turbine Investments:

Determining Real-World Financial Returns

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ENERGY SOLUTIONS

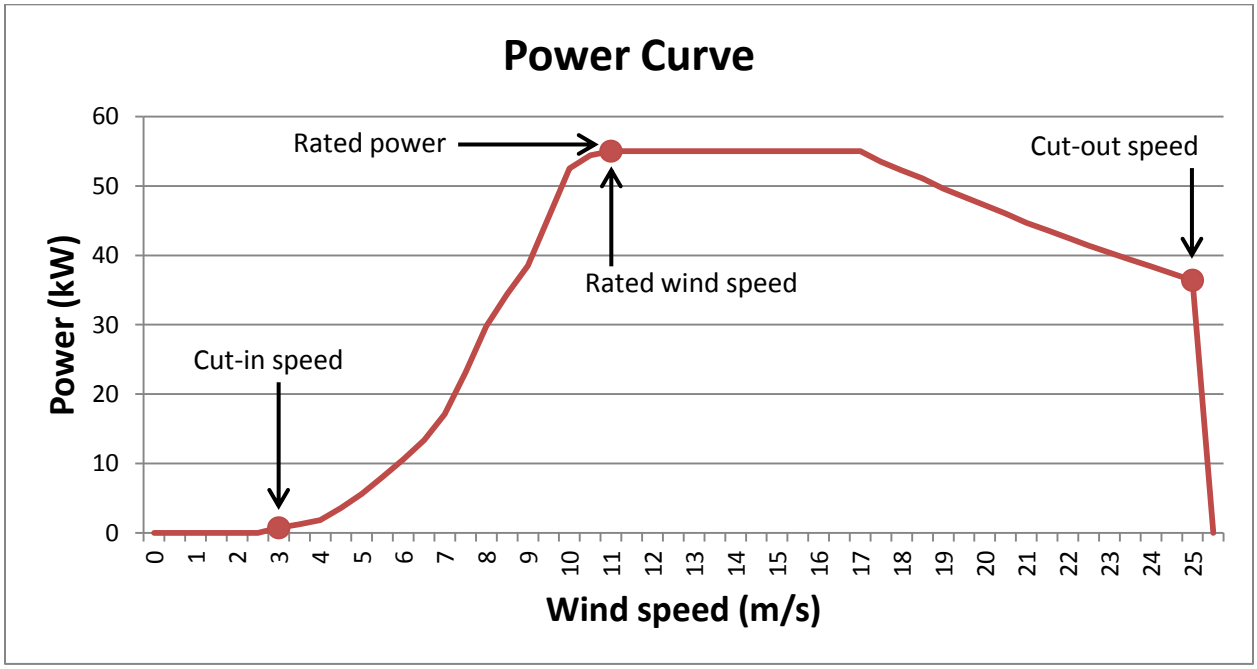
Wind Turbine Investments: Determining Real-World Financial Returns

Expected financial returns from a wind turbine investment can only be determined by using a realistic estimation of energy production over time. This requires realistic projections of wind speeds at the site of the wind turbine and information about the amount of power generated by the turbine at each wind speed. In addition to determining expected revenue from energy production, potential investors must also analyze all costs incurred from owning and maintaining a wind turbine.

Power versus energy

The amount of power that a wind turbine generates, measured in kilowatts (kW), is often used in advertising, but is actually a poor measure of wind turbine performance. Rated power is the value most often quoted, which refers to the maximum power output that can be achieved by the turbine at optimal wind speeds. Since wind conditions are never constant and power generation varies greatly with small wind changes, it is not useful to measure wind turbine performance in terms of kW.

Below is an example of a typical power curve for a small wind turbine. It shows the rated power of the turbine and the wind speed (in meters/second) at which it is achieved. It also shows the cut-in speed, where the turbine begins generating power, and the cut-out speed, where the turbine is automatically shut down to avoid sustaining damage from the high force of the wind.

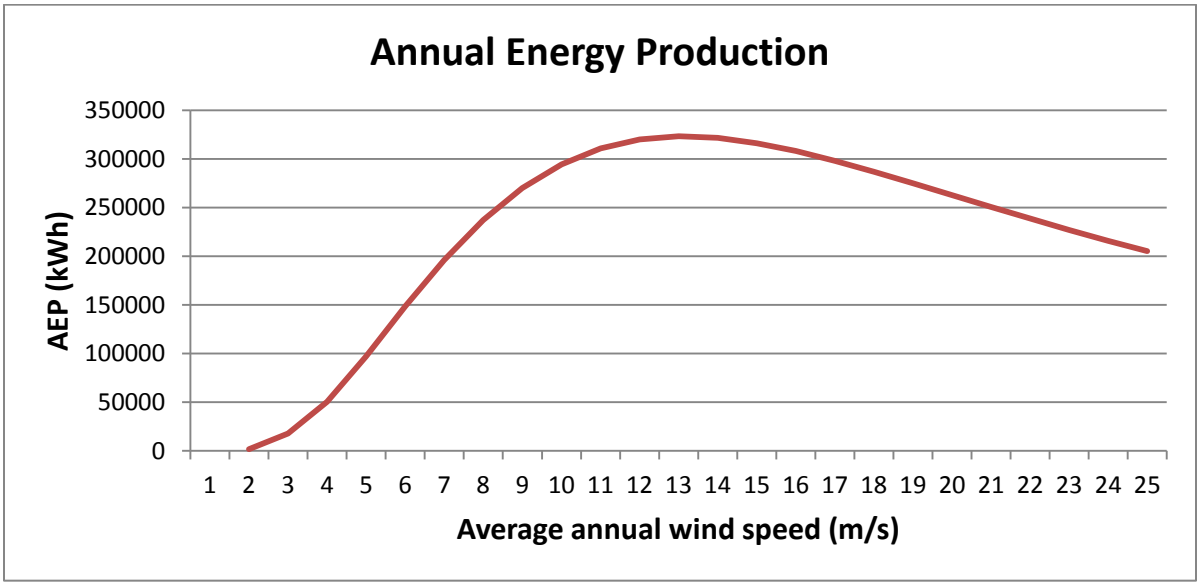


It is easy to see that while there will be times when the wind turbine generates the rated amount of power, there will also be times when it will produce less than the rated power or none at all. This is why power measured in kW cannot be used to evaluate wind turbine performance.

Fluctuating wind conditions make it necessary to talk about annual energy production (AEP), measured in kilowatt hours (kWh), instead of power measured in kW. A kilowatt hour is the unit of power or energy, which is equal to 1000 watts operating for one hour. An estimate of AEP must take into consideration wind conditions over time to project the usable amount of energy produced in a year.

There are several different ways to calculate AEP: using the average wind speed at the location, monitoring actual wind conditions to determine wind bins (the amount of time in a year that the turbine will be exposed to each wind speed), or using a Rayleigh distribution, which combines the other two methods. The Rayleigh distribution model allows wind bins to be estimated using the average wind speed for the location, and it uses the turbine's power curve to make a realistic estimation of AEP.

The following graph shows a projection of AEP, using a Rayleigh distribution, for the wind turbine detailed in the previous power curve graph. This information provides investors with a realistic estimation of annual energy production in kWh, which they can use to project revenue for the wind turbine.



Total cost of ownership

In addition to projecting expected revenue, determining financial returns for a wind turbine investment requires analyzing all costs that will be incurred. Beyond the initial purchase, investors must estimate future costs associated with maintenance and

repairs. There may also be scenarios were revenue is lost, either directly from the wind turbine being down for repair or indirectly from loss of agricultural land. Most of these costs are highly dependent on how the wind turbine was designed, what level of service is provided by the dealer, and where the wind turbine is located.

It is important to thoroughly review the wind turbine warranty before making an investment. Most repairs are typically covered by the warranty, while general maintenance is provided under a secondary service agreement through dealers. It is important to understand exactly what is covered, what time period the warranty covers, and what options there are for ongoing coverage after the warranty ends. If an extended warranty or additional service agreement needs to be purchased at some point in the future, this cost should also be considered. Warranties typically do not include guaranteed uptime. However, insurance coverage for a manufacturer's product can include loss of income, which minimizes the amount of revenue lost due to downtime from repairs. If guaranteed uptime is not provided, expected downtime for repairs and maintenance should be estimated and included in financial projections.

There is also an opportunity cost if agricultural revenue would have otherwise been generated from the land used to operate the wind turbine; this loss should be considered in determining overall revenue gains. For wind turbines that require cranes to lower the turbine for maintenance and repairs, more space is needed for roads, and there may be larger losses of agricultural revenue.

Make an informed investment

Orenda is committed to ensuring clients make informed investments. Wind conditions are critical to the financial success of a wind energy project, and not all locations are good candidates for wind turbines.

Orenda wind turbines use hydraulic towers; no cranes or special equipment are needed to lower the turbines for maintenance and repairs, and no additional roads that interfere with agricultural activities (and revenue generation) are required. This single design element provides an opportunity for higher financial returns.

Additionally, Orenda qualifies for product insurance, so even in times of repair, there is no loss of income to the end customer.

To learn more about determining the financial feasibility and benefits of a wind turbine project, contact Orenda:

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