



## Terms and Definitions for Small Wind Site Assessor

**AEO/ AEP:** Annual energy output, also known as AEP, annual energy production of the wind electric system.

**Alpha:** Surface friction coefficient, used to mathematically describe wind shear at a given site based on surface roughness.

**Anemometer:** A device for measuring wind speed; frequently includes the recording and display components of the measuring system.

**Availability:** the percentage of time that a wind turbine is available for operation divided by the hours in the monitoring period.

**Average annual wind speed:** the mean wind speed calculated over a one year period.

**Avoided cost:** the cost a utility escapes by purchasing energy from other sources, such as distributed generators, instead of building a new power plant. It consists of capital cost and operating cost of the foregone plant.

**Balance of system (BOS):** the system components, other than the wind turbine and tower, that comprise a complete small wind system.

**Capacity factor:** the quotient of the actual energy generated to that possible if the turbine ran at 100% capacity for the period, typically one year (8,760 hours).

**Clinometer:** The clinometer is an optical device for measuring elevation angles above horizontal, used for determining the height of obstacles at a wind site.

**Cost of energy:** the cost per kWh produced by a wind turbine during its service life, accounting for all installation, financing and O&M cost.

**Coriolis effect:** the Earth's rotation causing winds to follow a curved path across its surface.

**Decibel (dB):** a unit of measure based on powers of 10 to provide a relative measure of sound intensity; the Decibel scale is based on human hearing.

**Demand charge:** a charge paid by commercial and industrial utility customers that compensates the utility for maintaining sufficient reserve to meet instantaneous demand.

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**Displacement height:** is the height difference between the actual ground level and the newly established "effective ground level" caused by the upward movement of the wind as it passes over buildings or groves of trees.

**Distributed generation:** decentralized power producers, such as small wind turbines, spread out across the power grid, as opposed to centralized power plants.

**Diurnal variation of wind speed:** variation of wind speed between night and day.

**Energy conservation:** load reduction from changes in energy usage behavior.

**Environmental indicators:** the effect of wind on vegetation, soil and structures; flagging.

**Fetch:** the distance the wind flows with no obstructions.

**Flagging:** vegetation deformity caused by wind; see *Griggs-Putnam index*.

**Freestanding tower:** a self supporting tower not dependant on guy wires.

**Fuel Switching:** switching an electrical load to another fuel source, such as heating loads to gas, oil or solar thermal.

**Grid connected:** wind turbines that are connected to the utility grid, typically for net metering purposes.

**Griggs-Putnam index:** a system developed by Robert Griggs and Palmer Putnam that uses deformity in vegetation as an indicator of long term wind speed.

**Ground drag:** the friction that occurs between the earth's surface and wind flowing over it. The rougher the landscape (trees, buildings, etc) the greater the friction.

**Guyed tower:** a tower that requires guy wires attached to ground anchors for its stability.

**Horizontal axis wind turbine (HAWT):** a wind turbine rotor that spins on a horizontal shaft or drive train. Most wind turbines in use today are of this type.

**Hybrid system:** a combination of two or more power sources such as wind, PV, hydro and fossil fuel generators, working together in a single power system.

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**Hub height:** the distance from ground level at the tower base to the center of the turbine rotor hub.

**Installed capacity:** the rated capacity of a wind turbine at a specific wind speed; also known as nameplate capacity.

**Installed cost:** the total "turnkey" price of a completed wind turbine system, including all components, labor cost and fees.

**Inverter:** an electronic device which converts direct current (DC) to alternating current (AC). Inverters used for utility interconnection are known as synchronous inverters.

**Investor owned utility:** utility companies that are "for profit" entities.

**Islanding:** the condition of a utility interconnected wind turbine ( inverter based or induction type) that continues to produce power to the grid in a utility outage.

**Kilowatt:** a unit of power, 1,000 watts.

**Kilowatt hour:** a unit of energy, 1,000 watts measured over a one hour period.

**Laminar wind:** straight line, undisturbed wind flow; non-turbulent wind.

**Land-sea breeze:** onshore and offshore breezes caused by differential heating and cooling of the land and ocean or lakes.

**Lateral thrust:** the sideways force exerted on a tower from an operating wind turbine. This force increases exponentially as wind speed increases.

**Lattice tower:** a self supporting tower that uses crisscrossed (lattice) support braces for rigidity.

**Leeward:** downwind, or facing away from the wind.

**Life cycle cost:** the total cost of a wind turbine from installation to decommissioning. Includes installed cost, as well as O&M and decommissioning cost. Can sometimes be reduced if the system components have salvage value.

**MTBF:** mean time between failure. A measure of reliability of a device or component.

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**Micro climate:** refers to climate and long term wind characteristics in the immediate vicinity of the wind turbine.

**Municipal owned utility:** a utility owned by a municipality and therefore its residents.

**Net metering:** the process by which the owner of a grid connected wind turbine receives full retail value for most or all energy produced. Excess generation is applied as a reduction to any energy purchased from the utility, with the customer paying only for "net" usage.

**NIMBY:** Not in My Back Yard. People that object to the installation of wind turbines.

**O & M:** operation and maintenance.

**Obstruction:** ground clutter such as trees, buildings, or other structures that impede the flow of the wind.

**Off peak:** the period of time that utility electric consumption is at its lowest point. Can also refer to a discounted kWh rate offered to rate payers by some utilities for energy consumed during off peak hours.

**1/7 power law:** outdated rule of thumb where the alpha used in calculating the wind speed with increasing height was one seventh (1/7). This resulted in an alpha of .14.

**Orography:** the effect of mountains and hills on wind flow.

**Parallel generation:** small wind turbines and other small distributed generators are always connected in parallel with the utility grid.

**Peak power:** the absolute highest power a turbine can produce. Not to be confused with rated power.

**Piers:** concrete and/ or steel columns, installed below ground level, that form the foundation for some wind turbine towers. Self supporting lattice towers frequently use piers.

**Porosity:** refers to the density of trees, such as in a hedgerow.

**Power conditioning:** the processing of electrical power to make it compatible with utility or other voltage and frequency requirements. Wind turbine controllers and inverters are considered power conditioning equipment. See IEEE 1547 and UL 1741 standards.

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**Power curve:** a chart, expressed as a curve, that shows a wind turbine's instantaneous power output over a range of wind speeds.

**Power density:** the amount of energy contained in the wind, expressed as  $W/m^2$

**Prevailing wind:** the wind that occurs most of the time at a given site. Prevailing winds are not always the wind that contains the most energy, stronger but less frequent winds may have a higher energy content.

**Purpa:** Public Utility Regulatory Policies Act. Enacted in 1978, requires electrical utilities to share their networks with small power producers.

**Rated power:** a wind turbine's power output when running at its rated wind speed, not always verified, sometimes misleading.

**Rayleigh distribution:** a Weibull distribution that uses a shape factor of 2 is called Rayleigh distribution. *See Weibull distribution.*

**Rotor diameter:** the diameter of the circle formed by a spinning airfoil on a horizontal axis wind turbine. Rotor diameter is a good indicator of turbine rated power.

**Roughness:** surface roughness; increased roughness equals increased ground drag.

**REA:** Rural Electrification Administration. Created in 1935 to bring electricity to rural America.

**Self supporting tower:** *see freestanding tower.*

**Set back:** the distance that a wind turbine is installed from roads, power lines, dwellings and property lines. Often required for public safety reasons.

**Single phase:** alternating current that has only one waveform and is typically found in residential electrical services in the US. Most small wind turbines rated under 50 kW that are made for utility interconnection are configured for single phase output.

**Site survey:** an assessment of a potential wind site to determine wind resource, accessibility, physical and regulatory impediments to construction and economic viability.

**Swept area:** the area contained within the spinning wind turbine rotor; capture area.

**Terrain enhancement:** mountain passes, ridges and other terrain features that have the ability to increase wind velocity.

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**30/500 rule:** a general rule of thumb for determining the minimum acceptable tower height for a wind turbine. The bottom of the rotor swept area (lowest blade tip) must be 30 feet higher than any obstructions to the wind within 500 feet.

**Three phase:** alternating current that has three waveforms, 120 degrees out of phase with each other and typically found in commercial and industrial electrical services. Many small wind turbines rated at 50kW and up are configured for three phase output.

**Throwing:** an extreme type of flagging, where the high winds cause the entire tree to lean.

**Tilting tower:** a tower that can be raised and lowered without the use of a crane, allowing turbine installation, inspection and maintenance to be performed at ground level.

**Turbulence:** rapid changes in wind speed and direction, caused by wind flowing around obstacles.

**Turbulence intensity:** Mathematical relationship between the standard deviation of wind speeds and the average wind speed; gustiness.

**Upwind rotor:** a horizontal axis wind turbine with the rotor on the upwind side of the tower. This is the most common rotor configuration in use today.

**Utility interconnection:** grid interconnected; the bureaucratic process of connecting a wind turbine system to the utility grid

**Variable pitch:** a means of rotor control that uses changing blade pitch for power regulation and/ or over speed protection

**VAWT:** See vertical axis wind turbine

**Vector:** a visual representation of a force, showing quantity and direction

**Vertical axis wind turbine:** (VAWT) a wind turbine rotor that spins on a vertical shaft or drive train, such as a Darrieus or Savonius rotor.

**Weibull distribution:** a statistical tool that shows how often winds of different speeds will be seen at a particular location with a certain average wind speed. Once the probability of a particular wind speed is known, wind turbine energy production can be estimated.

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**Wind diesel system:** wind turbines used in conjunction with diesel generators to form an independent mini grid, typically used for remote applications.

**Wind profile:** a graph that utilizes vectors to represent the changes in wind speed with increasing height above the ground.

**Wind regime:** the characteristics of the wind resource at a regional level.

**Wind rose:** a circular graph representing the points of the compass, that shows the percentage of time the wind occurs from each direction. Some wind roses also show the percentage of energy available from each direction.

**Wind shear:** wind speed increasing with height; this varies according to surface roughness.

**Wind shear exponent:** see *Alpha*.

**Wind vane:** indicates wind direction, such as a weather vane. Typically used in conjunction with an anemometer and connected to a wind data acquisition system.

**Wind window:** what the wind turbine sees in the way of obstructions to the wind resource and what a wind site assessor must also look for during a site assessment. Ground clutter, terrain, area topography are all considered; similar to a solar window.

**Windward:** upwind or facing into the wind.