

ACRONYMS & GLOSSARY OF TERMS

AEP	Annual Energy Production, the calculated or measured energy delivered by a SWT.	kWh/y
Airfoil	The shape of the blade cross section, which is designed to (i) enhance the lift force and reduce the drag force for normal operation, and (ii) generally improve the turbine performance and safety (e.g. easy starting in weak winds, loss of lift force in strong winds).	
Alternating current (AC)	An electrical current whose direction reverses periodically, usually many times per second. The World households electrical systems use AC current rated at 120 V and 60 cycles per second (North America and others) or 230 V and 50 Hz, (Europe and others).	A
Ampere-hour	A unit for quantity of electricity supplied or used at some fixed (usually dc) voltage. Obtained by integrating current flow in amperes over time in hours. Multiplying by the voltage gives the energy exchanged. Used as a measure of battery capacity.	Ah
AMWS	Annual mean wind speed. The average (i.e. mathematical mean) wind speed measured at a specified height and position (often at 10 m height in open surroundings with short ground cover) over a period of one year. Usually calculated as the average of short period averages, e.g. 10 minutes averages.	m/s
Average wind speed	The mean wind speed over a specified period of time. For example, for assessing a horizontal-axis Wind Turbine power curve, (i) the unperturbed wind speed is measured at hub height and then averaged within successive periods of 10 minutes, (ii) the wind turbine power is similarly averaged within concurrent periods.	m/s
Battery	Two or more electrochemical cells, electrically interconnected in an appropriate series/parallel arrangement to provide the required voltage and capacity .	
Cell, of an electrical battery	The simplest operating unit in an electrical storage battery. It consists of one or more electrodes or plates, electrolyte that permits ionic conduction, one or more negative electrodes, or plates, separators between plates of opposite polarity, a container for all the above, and terminals ('posts') for electrical connection. [Note: the word 'cell' is used for many other entities, e.g. photovoltaic cell, prison].	
Betz limit	A theoretical maximum amount of energy that a perfect wind turbine can extract from the wind approaching its rotor, which Betz calculated as 59% of wind kinetic energy. In practice, efficient wind turbines have efficiencies about 70% of this Betz criterium.	
Brake	A device capable of reducing the rotor speed, usually to zero (i.e. stopped). Each turbine must have a distinct mechanical brake as a safety feature, that prevents the turbine turning, even in strong winds.	

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Capacity factor	The ratio of a wind turbine's AEP to the energy the generator would have delivered if continuously operating at rated power.	
Converter	=> Inverter.	
Cut-in wind speed	Least wind speed at hub height at which a wind turbine starts to produce power.	
Cut-out wind speed	Maximum wind speed at hub height for which the turbine is designed to produce power. The design power for continuous operation is the 'rated' power.	
Direct current (DC)	An electrical current flowing in one direction only (i.e. not AC), defined as from positive to negative voltage.. Typical sources of DC current are batteries of electrochemical cells, photovoltaic cells, and rectifiers of AC. DC current has to be transformed to AC at mains voltage through an inverter for most conventional household appliances.	
Direct drive	A wind turbine whose rotor shaft is directly connected to the electrical generator shaft, i.e. without an intermediate gearbox..	
Downwind	The direction <i>to</i> which the wind is blowing, e.g. the leeside is downwind.	
Fan tail	A historic mechanical device for yaw control of a wind rotor, e.g. in historic wind mills and in some early (to about 1980) electricity generating wind turbines... On each side of the nacelle are placed two multi-bladed rotors with opposite rotational direction. Their equilibrium position is when their rotation planes are in the wind direction. If not, they rotate to come back to this equilibrium position, thus driving the rotor perpendicular to the wind by gearing that turns the nacelle.	
Free wheeling mode	Condition of a wind turbine that is rotating a little over its rated rpm and not generating shaft power. This is only achieved with performing controlled feathering or stalling regulation systems.	
Furling	A passive protection for horizontal axis wind turbines, where, typically, the rotor is turned out of the wind by the mechanical action of a tail vane.	
Direct drive	A wind turbine whose rotor shaft is directly connected to the electrical generator shaft, i.e. without an intermediate gearbox..	
Gust	Sudden, brief and relatively large increase of the wind speed. NOTE - The rise-time, amplitude and duration characterize a gust. For instance, wind speed in gusts of 3 seconds length is 1.3 to 1.5 times higher than 10 minutes average wind speed.	
kW	Kilowatt (i.e. 1000 Watt), a measure of power (energy per unit time), very often used for electrical power.	kW
kWh	Kilowatt-hour (i.e.1000 Watt for one hour), energy unit (energy per unit time, multiplied by time = energy). The energy dissipated by using one kW in one hour.	kWh

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Hub	The central fixture of a HAWT rotor, to which the blades of a wind turbine are attached. If the blades are firmly bolted to the hub; the rotor is called "fixed pitch". However, blades can have a degree of freedom to turn (pitch) along their longitudinal axis by interposing of a rotating device, ball bearings, slewing ring or turntables. The rotor is then called "variable pitch".	
Gear-box	A mechanical assembly, with an input and an output shaft, to house gears (either spur or planetary type). The gearbox is positioned between the main shaft and the electrical generator, so matching the rotor speed (say 60 rpm) to the recommended speed of the generator (say 1 500 rpm).	
Idling	(of wind turbines) Condition of a wind turbine that is rotating slowly and not producing power.	
Induction generator	An electromechanical machine that may operate as a motor or a generator. For instance, a standard, 3 phases, AC motor, may be powered from the 50 Hz grid, with the motor speed 'slipping' at less than for 50 Hz synchronism. If this motor is itself forced to rotate at more than for 50Hz synchronism by a rotating power source, (e.g. a diesel engine or wind turbine), while connected to the grid, it delivers current to the grid as a generator. The current flow is proportional to the slip, i.e. the small difference, ~ 3%, between synchronised rpm and the actual rpm. This slip is too small to notice as a speed change of a wind turbine rotor, so induction generators are classed, somewhat erroneously, as 'fixed speed' generators. This type of generator is very simple, rugged and relatively cheap. Usually it is 'excited' into operation by the grid-connected electricity, however for autonomous, stand-alone, operation self-excitation is possible by electrical capacitors.	
Inverter	An electronic device that converts direct current (DC) to alternating current (AC) at the required frequency (e.g. 50Hz for grid electricity in Europe).	
Main shaft	The shaft connecting the rotor hub to the gearbox or, with direct drive, to the generator	
Nacelle	The body (including frame and cover) that contains the main bearings, brakes, gearbox, generator, pitch controllers, hydraulic equipment etc of a wind turbine..	
PMG	Permanent Magnet Generator. A synchronous AC electrical generator where excitation is produced by pairs of permanent magnets, with each north and south pole pair forming a 'pole-pair'. By having a generator with a relatively large ring of, say, 10 to 60 pole-pairs, the rotor can be connected directly to the generator to produce, say, around 50 Hz electricity without an intermediate gearbox. Most SWTs are fitted with PMGs nowadays.	
Power coefficient	The ratio of the power extracted by a wind turbine to the power available in the wind stream ahead of the rotor area at a specified wind speed; notation: C_p (See Betz limit). Values of C_p of 30 to 40% can be expected in optimum conditions.	

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Power curve	A graph showing a wind turbine's power output as a function of wind speed.	
Rated output capacity	The output power of wind machine operating at the rated wind speed. Most designers arrange that this rated power is also the rated power of the generator and gearbox.	kW
Rayleigh distribution	A probability distribution function often used for wind regime presentation, i.e. the probability in a year that the wind speed will have a certain value. The shape of the distribution depends on one variable parameter - the scale parameter, which is a function of the average wind speed. The Rayleigh distribution is a simple form of a Weibull distribution.	
Reference wind speed (V_{ref})	Basic parameter signifying the wind speed that characterises a wind turbine, most often used for classes SWT. Other design related climatic parameters and other basic SWT class parameters are derived from the reference wind speed. NOTE - A turbine designed for a SWT class with a reference wind speed, V_{ref} , is designed to withstand climates for which the extreme 10 min average wind speed with a recurrence period of 50 years at turbine hub height is less than or equal to V_{ref}	m/s
Rotor	The main rotating drive mechanism of a wind turbine that includes the blades and blade hub. Turbines with multipole direct drive synchronous generators may include the rotating part of the generator within the hub.	
Rotor diameter	The outer diameter of the rotor. That is approximately twice the blade length.	m
Rotor speed	The rotational frequency (usually called the 'speed') of the turbine rotor. The unit of measurement may be revolutions per minute (rpm) or per second (rad/s)	rad/s rpm
Slip ring assembly	A device for making electrical connection between stationary and rotating parts, e.g as in generators or for connecting monitoring sensors to a rotor or for connecting mains cables from a rotating nacelle to within a tower. Usually it includes a bronze or other conducting alloy circular component over which carbon conducting brushes move with minimal friction.	
Start-up wind speed	The wind speed at which a wind turbine rotor will begin to turn and power begins to be produced..	m/s
Survival wind speed	The maximum wind speed (e.g the 50 year maximum expected) that a wind turbine, or other construction, is designed to withstand.	m/s
Swept area	The area swept by the turbine rotor, for common HAWT, $A=\pi R^2$ where R is the radius of the rotor.	m ²

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SWT	Small Wind Turbine. According to the IEC 61400 standard, SWTs are wind turbines of swept area less than 200 m ² , i.e. HAWT less than 16 m in diameter. However, this definition is not universal.	
Tail vane	A mechanism very often used to yaw a horizontal axis SWT.. A horizontal boom, connected to the nacelle, holds a vertical plane, the vane, at a distance behind the vertical yaw axis. The vane is perpendicular to the rotation plane of the turbine. The equilibrium status of the vane is parallel to the wind direction, so the rotor is held perpendicular to the wind. If not, the aero-dynamical force exerted on the vane related to the yaw axis, creates a torque to return the rotor to face the wind.	
Tilting (mechanism)	Some SWT use a form of furling so the rotor turns upward to reduce the wind force. This becomes a passive protection as for the turbine where typically the rotor swings around a horizontal axis => furling.	
Tip speed ratio	The ratio of the speed of the tip of the rotating blade to the oncoming wind speed. If this ratio remains constant (usually about 6 to 10), then the blades are most efficient. Therefore tip speed ratio is a non-dimensional design characteristic of the turbine. Hence, if tip speed ratio is λ , rotor angular speed Ω and blade radius R, oncoming wind speed V ; then $\lambda = \Omega R / V$.	
Turbulence	Change in wind speed and direction over periods of seconds. Turbulence is an intrinsic property of wind that is increased by obstacles.	
Turbulence intensity	Ratio of the standard deviation of the wind speed to the mean wind speed, as determined from the same set of measured data of wind speed for a specified period of time	
Upwind	On the same side as the direction from which the wind is blowing => windward.	
VAWT	Vertical axis wind turbine. Two common types are the SAVONIUS and DARRIEUS designs.	
Weibull distribution	A probability distribution function often used for wind regime presentation. This is the probability of the wind having a specified speed in a certain period, e.g. a year. This distribution function depends on two parameters, the shape parameter, which controls the width of the distribution and the scale parameter, which depends on the average wind speed. The probability of wind occurrence over each year remains similar, hence annual power production of turbines is reasonably predictable. (See wind speed distribution, Rayleigh distribution)	
Wind shear	The increase of wind speed above the ground as a function of height. A logarithmic expression is often used to characterise wind shear.	

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Wind speed	At a specified position, the wind speed is the speed (i.e. the velocity component in a specified direction) of a small amount of air passing the specified point. In practice, wind speed is measured as the 'length of wind' passing through the measurement area of an instrument, e.g. a cup anemometer, in unit time. (see wind velocity).	m/s
Wind speed distribution	Probability distribution function, used to describe the distribution of wind speeds over an extended period of time, see Rayleigh, Weibull.	
Wind velocity	Vector in the direction of motion of a small amount of air surrounding the point of consideration, the magnitude of the vector being equal to the speed of motion of this air "parcel" (i.e. the local wind speed) NOTE - The vector at any point is thus the time derivative of the position vector of the air "parcel" moving through the point.	m/s
Yaw	The movement of the tower top (nacelle) of a HAWT that turns the turbine rotor with respect to the oncoming wind.	