

# GLOSSARY

## A

### **ABSORBED GLASS MAT (AGM)**

VRLA batteries with thin glass mat felt that holds the electrolyte in place like a sponge.

### **ALTERNATING CURRENT (AC)**

Electric current in which the direction of flow is reversed at frequent intervals – 230 VAC/50 Hz.

### **ALTITUDE**

The angle between the horizon and the sun's position in the sky.

### **AMORPHOUS SILICON**

A non-crystalline semiconductor material, often used in thin film photovoltaic modules.

### **AMPERE**

A unit of electric current in the meter-kilo-gram-second system. It is the steady current that when flowing in straight parallel wires of infinite length and negligible cross section, separated by a distance of one meter in free space, produces a force between the wires of  $2 \times 10^{-7}$  newtons per meter of length.

### **AMPERE-HOUR (AH)**

The Amp-hour (Ah) Capacity of a battery tries to quantify the amount of usable energy it can store at a nominal voltage. All things equal, the greater the physical volume of a battery, the larger its total storage capacity. Storage capacity is additive when batteries are wired in parallel but not if they are wired in series.

### **ARE**

Alliance for Rural Electrification.

### **ARPU**

Average Revenue per user.

### **AZIMUTH**

Angle between south and the point directly below the location of the sun. Measured in degrees east or west of true south in northern latitudes.

## B

### **BALANCE OF SYSTEM (BOS)**

All system components and costs other than the PV modules.

### **BATTERY**

Two or more primary cells connected together, usually in series, to provide a source of electric current.

### **BATTERY CAPACITY**

The total number of ampere-hours that can be withdrawn from a fully charged cell or battery.

### **BATTERY CELL**

See „cell“.

### **BC**

Battery current

### **BATTERY CYCLE LIFE**

The number of cycles, to a specified depth of discharge, that a cell or battery can undergo before failing to meet its specified capacity or efficiency performance criteria. Battery manufacturers specify Cycle Life as a function of discharge rate and temperature.

## **BATTERY SELF-DISCHARGE**

The self-discharge rate is a measure of how much batteries discharge on their own. The Self-Discharge rate is governed by the construction of the battery and the metallurgy of the lead used inside.

## **BATTERY STATE OF CHARGE**

Percentage of full charge or 100 percent minus the depth of discharge.

## **BOS**

Balance of System.

## **BOSS**

Business Opportunities with Solar Systems: Solar Systems that can be used for income generation in non electrified areas.

## **BLOCKING DIODE**

A diode used to prevent undesired current flow. In a PV array the diode is used to prevent current flow towards a failed module or from the battery to the PV array during periods of darkness or low current production.

## **BTS**

Base Transceiver Station (the name for the antenna and radio equipment necessary to provide mobile service in an area).

## **BYPASS DIODE**

A diode connected across one or more solar cells in a photovoltaic module such that the diode will conduct if the cell(s) become reverse biased. Alternatively, a diode connected anti-parallel across a part of the solar cells of a PV module. It protects these solar cells from thermal destruction in case of total or partial shading of individual solar cells while other cells are exposed to full light.

## **C**

### **CATHODIC PROTECTION**

Cathodic protection (CP) is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. The simplest method to apply CP is by connecting the metal to be protected with another more easily corroded metal to act as the anode of the electrochemical cell. Cathodic protection systems are used to protect a wide range of metallic structures in various environments. Common applications are; steel water or fuel pipelines and storage tanks; steel pier piles; ships and boats; offshore oil platforms and onshore oil well casings and metal reinforcement bars in concrete buildings and structures.

### **CELL**

Battery cells are the most basic individual component of a battery. They consist of a container in which the electrolyte and the lead plates can interact. Each lead-acid cell fluctuates in voltage from about 2.

### **CHARGE CONTROLLER**

A device that controls the charging rate and/or state of charge for batteries.

### **CHARGE RATE**

The current applied to a cell or battery to restore is available capacity.

### **CIS/CIGS SOLAR CELL**

Copper, Indium and (gallium) selenium amorphous solar cells

### **CLUB ER**

Club of Renewable Electrification Agencies.

### **CONCENTRATOR**

A PV module that uses optical elements to increase the amount of sunlight incident on a PV

cell. Concentrating arrays must track the sun and use only the direct sunlight because the diffuse portion cannot be focused onto the PV cells.

### **CONVERSION EFFICIENCY**

The ratio of the electric energy produced by a photovoltaic device (under full sun conditions) to the energy from sunlight incident upon the cell.

### **CRYSTALLINE SILICON**

A type of PV cell made from a single crystal or polycrystalline slice of silicon.

### **CURRENT**

Current is a measure of how many electrons are flowing through a conductor. Current is usually measured in amperes (A). Current flow over time is defined as ampere-hours (a.k.a. amp-hours or Ah), a product of the average current and the amount of time it flowed.

### **CYCLE LIFE**

Number of discharge-charge cycles that a battery can tolerate under specified conditions before it fails to meet specified criteria as to performance (e.g., capacity decreases to 80-percent of the nominal capacity).

## **D**

### **DAYS OF AUTONOMY**

The number of consecutive days a stand-alone system battery bank will meet a defined load without solar energy input.

### **DC TO DC CONVERTER**

Electronic circuit to convert DC voltages (e.g., PV module voltage) into other levels (e.g., load voltage). Can be part of a maximum power point tracker (MPPT).

### **DEEP CYCLE BATTERY**

Type of battery that can be discharged to a large fraction of capacity many times without damaging the battery.

### **DEPTH OF DISCHARGE (DOD)**

The Depth of Discharge (DOD) is a measure of how deeply a battery is discharged. When a battery is 100% full, then the DOD is 0%. Conversely, when a battery is 100% empty, the DOD is 100%. The deeper batteries are discharged on average, the shorter their so-called cycle life.

### **DIRECT CURRENT (DC)**

Electric current in which electrons flow in one direction only.

### **DISCHARGE RATE**

The rate, usually expressed in amperes over time, at which electrical current is taken from the battery.

### **DUAL-AXIS TRACKING**

A system capable of rotating independently about two axes and following the sun's orientation and height in the sky (e.g., vertical and horizontal).

### **DUTY CYCLE**

The ratio of active time to total time. Used to describe the operating regime of appliances or loads.

## **E**

### **EFFICIENCY**

The ratio of output power to input power. Expressed as a percent.

### **ELECTRIC CURRENT**

A flow of electrons electricity.

### **ELECTROLYTE**

A liquid conductor of electricity in which flow of

current takes place by migration of ions. The electrolyte for a lead-acid storage cell is an aqueous solution of sulfuric acid.

## **ENERGY**

The ability to do work. Stored energy becomes working energy when we use it.

## **EQUALIZATION**

Sulphation layers form barrier coats on the lead plates in batteries that inhibit their ability to store and dispense energy. The equalization step is a last resort to break up the Sulphate layers using a controlled overcharge. The process will cause the battery electrolyte to boil and gas, so it should be only done under strict supervision and with the proper precautions.

## **F**

### **FCL**

Fluorescent Compact Lamp

### **FLOAT CHARGE**

Float charge is the voltage required to counteract the selfdischarge of the battery at a certain temperature.

## **G**

### **GASSING CURRENT**

Portion of charge current that goes into electrolytical production of hydrogen and oxygen from the electrolytic liquid in the battery. This current increases with increasing voltage and temperature.

### **GEL-TYPE BATTERY**

Lead-acid battery in which the electrolyte is composed of a silica gel matrix.

### **GIGAWATT (GW)**

One billion watts. One million kilowatts. One

thousand megawatts.

## **GLOBAL IRRADIATION**

Global irradiation is the sum of direct and diffuse components of radiation.

## **GSM**

Global system for mobile communications.

## **H**

### **HYBRID SYSTEM**

A PV system that includes other sources of electricity generation, such as wind or fossil fuel generators.

## **I**

### **IEA**

International Energy Agency.

### **INSOLATION**

Sunlight, direct or diffuse; from incident solar radiation: Usually expressed in watts per square meter. Not to be confused with „insulation“.

### **INTERCONNECT**

A conductor within a module or other means of connection which provides an electrical interconnection between the solar cells.

### **INVERTERS**

Devices that convert DC electricity into AC electricity (single or multiphase), either for stand-alone systems (not connected to the grid) or for utility-interactive systems.

### **IRENA**

International Agency for Renewable Energy.

## **IP**

Ingress Protection.

## I-V CURVE

A graphical presentation of the current versus the voltage from a photovoltaic device as the load is increased from the short circuit (no load) condition to the open circuit (maximum voltage) condition. Typically measured at 1000 watts per square meter of solar insolation at a specific cell temperature. The shape of the curve characterizes cell performance.

## J

### JOULE

The joule is the basic SI unit of energy. A joule is equal to the kinetic energy of a kilogram mass moving at the speed of one meter per second.

### JUNCTION BOX

An electrical box designed to be a safe enclosure in which to make proper electrical connections. On PV modules this is where PV strings are electrically connected.

## K

### KFW

Credite institute for reconstruction (development bank).

### KILOWATT (KW)

1000 watts.

### KILOWATT HOUR (KWH)

One thousand watt hours. The kWh is a unit of energy. 1 kWh = 3600 kJ.

### KILOWATT PEAK (KWP)

KWp is a measure of the nominal power of a photovoltaic solar energy device under laboratory illumination conditions (see STC). The power is measured while varying the resistive load on the module between open and closed circuit. The maximum power measured is the nominal power

of the module in „Wp“.

## L

### LEAD-ACID BATTERY

A lead-acid battery is an electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again.

### LIFE CYCLE COST

An estimate of the cost of owning and operating a system for the period of its useful life; usually expressed in terms of the present value of all lifetime costs.

### LICOO2

Lithium Cobalt Oxide.

### LIFEPO4

Lithium Iron Phosphate.

### LI-ION

Lithium Ion.

### LFP

See „LIFEPO4“

### LM

Lumen.

### LOAD

Anything in an electrical circuit that, when the circuit is turned on, draws power from that circuit.

## M

### MAXIMUM POWER POINT (MPP)

The point on the current-voltage (I-V) curve of a module under illumination, where the product

of current and voltage is maximum. For a typical silicon cell, this is at about 0,45 V.

### **MAXIMUM POWER POINT TRACKER (MPPT)**

Means of a power conditioning unit that automatically operates the PV generator at its MPP under all conditions.

### **MEGAWATT (MW)**

One million watts; 1000 kilowatts.

### **MODULE**

See „photovoltaic module“.

### **MONOCRYSTALLINE CELLS**

The manufacture of monocrystalline silicon cells requires high-purity semiconductor material. Single-crystal rods are drawn from molten silicon material and sawn into thin slices afterwards. This manufacturing method ensures a relatively high degree of efficiency.

### **MTN**

Mobile Technology Network.

### **MULTI-CRYSTALLINE**

See „poly-crystalline“.

## **N**

### **NEC**

An abbreviation for the National Electrical Code® which contains safety guidelines and required practices for all types of electrical installations.

### **NICD**

Nickel Cadmium.

### **NIMH**

Nickel Metal Hydrid.

### **NOMINAL OPERATING CELL TEMPERATURE (NOCT)**

The reference cell (module) operating temperature presented on manufacturers literature. Generally the NOCT is referenced at 25°C, 77°F.

### **NOMINAL VOLTAGE**

A reference voltage used to describe batteries, modules, or systems (ie. a 12-, 24- or 48-volt battery, module or system).

## **O**

### **OFF-GRID**

An autonomous photovoltaic or hybrid system not connected to the grid. Most Off-Grid systems require batteries or some other form of storage.

### **OHM**

The unit of resistance to the flow of an electric current.

### **OPEN-CIRCUIT VOLTAGE (VOC)**

The maximum possible voltage across a photovoltaic cell or module; the voltage across the cell in sunlight when no current is flowing.

### **OPZS**

Tubular plate with liquid electrolyte.

### **OPZV**

Tubular plate with gel.

### **ORIENTATION**

Placement according to the compass directions – north, south, east, west.

## **P**

### **P.L.**

Partial loss

## PARALLEL CONNECTION

A way of joining two or more electricity-producing devices such as PV cells or modules, or batteries by connecting positive leads together and negative leads together; such a configuration increases the current but the voltage is constant.

## PEAK LOAD; PEAK DEMAND

The maximum load, or usage, of electrical power occurring in a given period of time, typically a day.

## PEAK SUN HOURS

The equivalent number of hours per day when solar irradiance averages 1000 W/m<sup>2</sup> (full sun).

## PHOTOVOLTAIC (PV)

Pertaining to the direct conversion of photons of sunlight into electricity.

## PHOTOVOLTAIC ARRAY

An interconnected system of PV modules that function as a single electricity-producing unit. The modules are assembled as a discrete structure, with common support or mounting. In smaller systems, an array can consist of a single module.

## PHOTOVOLTAIC MODULE

The smallest environmentally protected, essentially planar assembly of solar cells and ancillary parts, such as interconnections, terminals, and protective devices such as diodes intended to generate DC power under unconcentrated sunlight. The structural (load carrying) member of a module can either be the top layer (superstrate) or the back layer (substrate).

## PHOTOVOLTAIC PEAK WATT

Maximum rated output of a cell, module, or system. Typical rating conditions are 0,645 watts per square inch (1000 watts per square meter) of sunlight, 68 degrees F (20 degrees C) ambient

air temperature and 6,2 x 10<sup>-3</sup> mi/s (1 m/s) wind speed.

## PHOTOVOLTAIC SYSTEM

A complete set of components for converting sunlight into electricity by the photovoltaic process, including the array and balance of system components.

## PICO PV SYSTEM

A PicoPV system is defined as a small Solar Home System with a power output of 1 – 10 W.

## POLY-CRYSTALLINE

Material that is solidified at such as rate that many small crystals (crystallites) form. The atoms within single crystallites are symmetrically arranged, whereas crystallites are jumbled together. These numerous grain boundaries reduce the device efficiency. A material composed of variously oriented, small individual crystals.

## POWER

Power is the product of voltage and current and is measured in Watts. Power over time is usually defined in Watt-hours (Wh), the product of the average number of watts and time. Your energy utility usually bills you per kiloWatt-hour (kWh), which is 1000 watt-hours.

## POWER FACTOR

The ratio of the average power and the apparent voltamperes.

Pulse-width-modulated wave inverter (PWM): PWM inverters are the most expensive, but produce a high quality of output signal at minimum current harmonics. The output voltage is very close to sinusoidal.

## PV

Abbreviation for photovoltaic.

## **PVPS**

SLM = Standard Litre per Minute.

## **PWM**

Pulse wide modulation.

## **R**

### **RESISTANCE R**

The property of a conductor which opposes the flow of an electric current resulting in the generation of heat in the conducting material. The unit of resistance is ohms.

## **RPM**

Revolutions per minute.

## **S**

### **SEMICONDUCTOR**

Any material that has a limited capacity for conducting an electric current. Certain semiconductors, including silicon, gallium arsenide, copper indium diselenide, and cadmium telluride, are uniquely.

### **SERIES CONNECTION**

A way of joining electrical equipment by connecting positive leads to negative leads; such a configuration increases the voltage while current remains the same.

### **SERIES REGULATOR**

Type of battery charge regulator where the charging current is controlled by a switch connected in series with the PV module or array.

### **SHORT-CIRCUIT CURRENT (ISC)**

The current flowing freely from a photovoltaic cell through an external circuit that has no load or resistance; the maximum current possible.

## **SHS**

Solar Home System.

### **SHUNT REGULATOR**

Type of a battery charge regulator where the charging current is controlled by a switch connected in parallel with the PV generator. Overcharging of the battery is prevented by shorting the PV generator.

## **SILICON**

Silicon is a chemical element with the symbol Si and atomic number 14. Very pure silicon is the base for most PV cells.

### **SINE WAVE INVERTER**

An inverter that produces utility-quality sine wave power forms.

## **SLA**

Sealed Lead Acid.

## **SM**

Solar module.

### **SOLAR GENERATOR**

The solar generator is the sum of the modules of a PV system.

### **SQUARE WAVE INVERTER**

The inverter consists of a DC source, four switches, and the load. The switches are power semiconductors that can carry a large current and withstand a high voltage rating. The switches are turned on and off at a correct sequence, at a certain frequency. The square wave inverter is the simplest and the least expensive to purchase, but it produces the lowest quality of power.

## **STAND-ALONE**

See „Off-Grid“.



## **STANDARD TEST CONDITIONS (STC)**

The conditions are specified in standards such as IEC 61215, IEC 61646 and UL 1703; specifically the light intensity is 1000 W/m<sup>2</sup>, with a spectrum similar to sunlight hitting the earth's surface at latitude 35°N in the summer (airmass 1,5) and temperature of the cells at 25°C.

## **STATE OF CHARGE (SOC)**

The State of Charge describes how full a battery is. The exact voltage to battery charge correlation is dependent on the temperature of the battery. Cold batteries will show a lower voltage when full than hot batteries. This is one of the reasons why quality alternator regulators or high-powered charging systems use temperature probes on batteries.

## **STRING**

A string are several solar modules connected in a row. By doing so the system voltage will be increased (sum of the voltage of each module).

## **SULFATION**

A condition that afflicts unused and discharged batteries; large crystals of lead sulfate grow on the plate, instead of the usual tiny crystals, making the battery extremely difficult to recharge.

## **SURGE**

The momentary start-up condition of a motor requiring a large amount of electrical current.

## **SURGE CAPACITY**

The ability of an inverter or generator to deliver high currents momentarily required when starting a motor.

## **SYSTEM INTEGRATOR**

A system integrator is a person or company that specializes in bringing together component subsystems into a whole and ensuring that those subsystems function together

## **T**

### **TEMPERATURE COEFFICIENT**

The temperature coefficient is the relative change of a physical property when the temperature is changed by 1 K. Voltage, electric current and therefore also the efficiency of a solar module vary with a change in temperature.

### **TEMPERATURE COMPENSATION**

An allowance made in charge controller set points for changing battery temperatures.

### **THIN FILM**

A layer of semiconductor material, such as copper indium diselenide, cadmium telluride, gallium arsenide, or amorphous silicon, a few microns or less in thickness, used to make photovoltaic cells.

### **TILT ANGLE**

Angle of inclination of collector as measured in degrees from the horizontal. For maximum performance solar collectors/modules should be set at a perpendicular to the sun.

### **TRACKING**

Free standing solar modules can be mounted on a tracking platform that can tilt the surface along one or two axis (with a motor) to follow the sun and increase the energy boost.

### **TRANSFORMER**

An electromagnetic device used to convert AC electricity, either to increase or decrease the voltage.

## **U**

### **UNINTERRUPTIBLE POWER SUPPLY (UPS)**

The designation of a power supply providing continuous uninterruptible service when a main power source is lost.

## **USB**

Universal Serial Bus

## **UTILITY-INTERACTIVE INVERTER**

An inverter that can function only when tied to the utility grid, and uses the prevailing line-voltage frequency on the utility line as a control parameter to ensure that the PV system's output is fully synchronized with the utility power.

## **V**

### **VA**

Volt Ampere.

### **VAC**

Volts AC.

### **VDC**

Volts DC.

### **VOC**

Open-circuit voltage.

## **VOLT (V)**

Voltage is an electrical measure which describes the potential to do work. The higher the voltage the greater its risk to you and your health. Systems that use voltages below 50 V are considered low-voltage and are not governed by an as strict (some might say arcane) set of rules as high-voltage systems.

## **VRLA**

VRLA batteries remain under constant pressure

of 1 – 4 psi. This pressure helps the recombination process under which 99+ % of the Hydrogen and Oxygen generated during charging are turned back into water. The two most common VRLA batteries used today are the Gel and Absorbed Glass Mat (AGM) variety.

## **W**

### **WATT (W)**

The unit of electric power, or amount of work. One ampere of current flowing at a potential of one volt produces one watt of power.

### **WATT-HOUR (WH)**

A quantity of electrical energy when one watt is used for one hour.

### **WATT PEAK (WP)**

Colloquial English sometimes conflates the quantity power and its unit by using the non-SI unit Watt-Peak and the non-SI symbol Wp prefixed as within the SI, e.g. kilowatt-peak (kWp), megawatt-peak (MWp), etc. As such a photovoltaic installation may for example be described as having „one kilowatt-peak“ in the meaning „one kilowatt of peak power“. Similarly outside the SI, the peak power is sometimes written as „P = 1 kWp“ as opposed to „P<sub>peak</sub> = 1 kW“. In the context of domestic PV installations, the kilowatt (kW) is the most common unit for peak power, sometimes stated as kWp.

### **WAVEFORM**

The shape of the curve graphically representing the change in the AC signal voltage and current amplitude, with respect to time.