



# The Power of The Sun

Solar power is by far the Earth's most available energy source, easily capable of providing many times the total current energy demand. Infact, the sun provides more energy to the earth in one day than the cumulative annual requirements of six billion people on the planet!

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## A-Z Glossary of Solar Terms

### Absorbers

Dark-colored objects that soak up heat in thermal solar power collectors used to produce heat energy.

### Air Mass

A measure of how far light travels through the Earth's atmosphere. One air mass, or AM1, is the thickness of the Earth's atmosphere. Air mass zero (AM0) describes solar irradiance in space, where it is unaffected by the atmosphere. The power density of AM1.5 light is about 1,000 W/m<sup>2</sup>; the power density of AM0 light about 1,360 W/m<sup>2</sup>.

### Ampere

A unit of electrical current. A potential of one volt across a resistance of one ohm causes a current of one ampere (6.25 X 10<sup>18</sup> electrons per second) to flow.

### Ampere-hour

A unit of energy, typically referring to battery capacity. One ampere of current flowing for one hour.

### Angle of incidence

The angle between a ray of sunlight striking a surface and a line perpendicular to that surface. Rays perpendicular to a surface have a zero angle of incidence.

### Array

A number of solar modules electrically connected to produce a single electrical output.

### Azimuth

The angular measure between due south and the point on the horizon directly below the sun.

### Balance-of-Systems (BOS) components

All the components in a power system other than the photovoltaic array.

### Battery

Two or more electrochemical cells connected to provide energy storage. Also commonly used to designate one cell.

### Blocking diode

A diode which prevents reverse current flow in a circuit, commonly used to prevent a battery from discharging through the array at night.





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### Charge controller

The PV system component which controls the battery's state of charge. It may also provide other system control functions.

### Charge rate

The current applied to a battery to restore its energy capacity. The rate is typically normalized with respect to the battery's full capacity and a designated time period. Thus, the current necessary to nominally charge a 100-ampere-hour battery from zero to full charge in five hours (20 amperes) is referred to as the battery's C/5 rate. The term is also applied to discharge rate.

### Concentrator array

A photovoltaic (PV) array which uses concentrating devices (reflectors, lenses) to increase the intensity of the sunlight striking the array.

### DC – direct current

The type of current provided by a battery or solar cell, which flows in one direction.

### Deep discharge

Discharging a battery to 20-percent or less of its full charge.

### Depth of discharge

A measure of how much energy has been withdrawn from a battery, expressed as a percentage of full capacity. A 100 Ah battery from which 30 Ah has been withdrawn has undergone a 30% depth of discharge (DOD). This term is the inverse of state of charge (SOC); the example battery would be at 70% SOC.

### Diffuse radiation

The sunlight received indirectly, as a result of scattering due to clouds, fog, dust, moisture vapour or other substances in the atmosphere.

### Diffusion

The wafers are given a negative characteristic by exposure to a phosphorus source at high temperature.

### Direct radiation

Sunlight received directly, which has travelled in a straight path from the sun, also referred to as beam radiation.





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### Efficiency

With respect to solar cells, the percentage of light energy that is converted to electricity by the cell. Depending on cell technology and production technique, this ranges from as low as 5% to as high as 30%.

### Elevation (solar)

The sun's angle above the horizon.

### Equalizing charge

A controlled overcharge of a battery bank for the purpose of restoring equality of charge in all cells.

### Finishing charge

That part of the charging process which restores the final segment of a battery's charge, roughly between 90% and 100% SOC.

### Flat-plate array

A photovoltaic (PV) array which does not use concentration.

### Frequency

The rate at which a periodic event occurs. In electricity, the rate at which current reverses direction in an alternating current system. In the US and some other countries, alternating current systems use a frequency of 60 cycles per second (60 Hz); in Europe and remaining countries, the standard is 50 Hz.

### Global radiation

Total solar radiant energy impinging on a surface, equal to the sum of direct and diffuse radiation.

### Grid-connected

A power system interconnected with the grid (or mains) of the local electric utility. Also referred to as utility-interactive.

### Grid parity

The point at which the cost of renewable electricity is equal to the cost of conventionally generated power/ electricity.

### Hole

An atom that has lost an electron.





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### I-V curve

A current/voltage curve, which expresses the possible combinations of current and voltage output of a photovoltaic device.

### Insolation

The solar energy received at a place over a given period. This may be expressed as peak sun-hours per day or kilowatt hours per square metre.

### Inverter

A device which converts DC electricity to AC.

### Isolation diode

A diode which prevents one segment of a photovoltaic (PV) array from interacting with another array segment. Usually used to prevent array energy from flowing backwards through a sub-voltage series string. May also serve the function of blocking diode.

### Maximum power

Also referred to as peak power. The point on a device's I-V curve where the product of I and V ( $P_{max}$ , measured in Watts) is maximized. The points on the I and V scales which describe this curve point are named  $I_{mp}$  (current @ max power) and  $V_{mp}$  (voltage @ max power.)

### Module

A number of solar cells electrically connected, protected from environmental stresses, self-contained and not sub-dividable, providing a single electrical output.

### Monocrystalline

A silicon wafer with single crystal grain structure (isotropic) made using a CZ or float zone method.

### Multicrystalline

A silicon wafer which has multiple grain orientations. Often made using a modified directional solidification method.

### n-type

Silicon which has been doped, often with phosphorus, to have electrons as the majority electrical carriers.







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### **NOCT**

Nominal Operating Cell Temperature; the temperature at which cells in a module operate under Standard Operating Conditions (SOC), which are: irradiance of 0.8 kW/m<sup>2</sup>, 20°C ambient temperature, and average windspeed of 1 m/s, with the wind oriented parallel to the plane of the array, and all sides of the array fully exposed to the wind.

### **Open-circuit voltage**

Abbreviated Voc, refers to a photovoltaic device's voltage potential when it is providing no current.

### **p-n junction**

The junction at the interface between two differently doped layers of semiconductor material, one layer doped with a positive-type dopant, the other layer with a negative-type dopant. An electrical field is established at the p-n junction which gives direction to the flow of light-stimulated electrons.

### **p-type**

Silicon which has been doped, often with boron or aluminium, to have positive charges as the majority electrical carriers.

### **Parallel connection**

Electrical connection where the positive terminals of a number of devices are connected together, as are their negative terminals. The output voltage of the paralleled devices is equal to the average of the devices, and the total current is the sum of the current of all the devices.

### **Peak power**

Power generated by a utility unit that operates at a very low capacity factor; generally used to meet short-lived and variable high demand periods.

### **Photovoltaic**

This is a term used to describe the solar electric effect.

### **Plasma enhanced chemical vapour deposition (PECVD)**

Method used to apply anti-reflection coating which enhances the electronic properties of the wafer.

### **Polycrystalline**

A silicon wafer which has multiple grain orientations. Often made using a modified directional solidification method.





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### Self-discharge

Batteries lose charge even when not in use. For many batteries, self-discharge rate increases as the battery ages.

### Series connection

Electrical connection where the positive terminal of one device is attached to the negative terminal of the next in a series string; in this connection, the string voltage is the sum of the device voltages and the string current is limited to the current of the least productive device in the string.

### Short-circuit current

Abbreviated  $I_{sc}$ , refers to a photovoltaic (PV) device's current output when short-circuited.

### Shunting path

A short circuit path within a solar cell that will lead to efficiency loss.

### Solar cell

The smallest semiconductor device that can convert sunlight into electrical energy. Each silicon cell produces approximately half a volt, so many are wired in series to increase the voltage to significant levels.

### Solar module

An assembly of solar cells in series or parallel to augment voltage and/or current.

### Solar panel

A group of solar modules mechanically mounted on a single frame or structure.

### Solar spectrum

The total distribution of electromagnetic radiant energy over the band of wavelengths present in solar radiation. The total energy received on a given surface, and how that energy is distributed among various wavelengths, depends on how much of the Earth's atmosphere light has traversed.

### Standalone system

A power system not connected to the utility grid (mains.) Sometimes referred to as an autonomous system.





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### Standard operating conditions

Abbreviated SOC, a set of reference PV device measurement conditions consisting of irradiance of 0.8 kW/m<sup>2</sup>, 20°C ambient temperature, and average windspeed of 1 m/s, with the wind oriented parallel to the plane of the array, and all sides of the array fully exposed to the wind.

### Standard test conditions

Abbreviated STC, a set of reference PV device measurement conditions consisting of irradiance of 1 kW/m<sup>2</sup>, AM 1.5, and 25°C cell temperature.

### Standoff mount

A mounting system which supports a PV array above a roof surface.

### State of charge

Abbreviated SOC, the percentage of energy in a battery referenced to its nominal full capacity.

### Sulfation

The formation of lead sulfate crystals on the plates of a lead-acid battery. Normally used to refer to large sulfate crystals, rather than small crystals formed in normal battery operation, formed as a result of temperature cycling while the battery is in a partially charged state.

### Texturing

Part of the monocrystalline cell production process which helps to reduce the reflection of sunlight.

### Thin-film cell

A solar cell formed by depositing thin layers of conductive and semiconductive materials, usually using a chemical vapour deposition (CVD) process. Also referred to as amorphous cells because they have no crystalline structure. Such cells use less material than cells sawn from crystalline ingots.

### Two-axis tracking

A tracking system which follows the sun's azimuth and elevation.

### Utility-interactive

A power system which interacts with the utility grid (mains), taking power from the grid to satisfy its loads as necessary, and returning power to the grid when not required by the loads.







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### Voltage

Measured in volts (V), the electrical potential between two points. One volt of potential causes one ampere of current to flow through a resistance of one ohm. The open-circuit voltage of a silicon solar cell is about half a volt; the operating voltage of a lead-acid cell is about two volts.

### Wafer

A slice of silicon brick used to make a solar cell.

### Watt (W)

The unit of electric power, or amount of work (J), done in a unit of time. One ampere of current flowing at a potential of one volt produces one watt of power.

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