Solar energy panels

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A solar panel is a device that converts sunlight into electricity by using photovoltaic (PV) cells. PV cells are made of materials that produce excited electrons when exposed to light. The electrons flow through a circuit and produce direct current (DC) electricity, which can be used to power various devices or be stored in batteries. Solar panels are also known as solar cell panels, solar electric panels, or PV modules.

Solar panels are usually arranged in groups called arrays or systems. A photovoltaic system consists of one or more solar panels, an inverter that converts DC electricity to alternating current (AC) electricity, and sometimes other components such as controllers, meters, and trackers. Most panels are in solar farms or rooftop solar panels which supply the electricity grid

Some advantages of solar panels are that they use a renewable and clean source of energy, reduce greenhouse gas emissions, and lower electricity bills. Some disadvantages are that they depend on the availability and intensity of sunlight, require cleaning, and have high initial costs. Solar panels are widely used for residential, commercial, and industrial purposes, as well as in space, often together with batteries.

In 1839, the ability of some materials to create an electrical charge from light exposure was first observed by the French physicist Edmond Becquerel.[1] Though these initial solar panels were too inefficient for even simple electric devices, they were used as an instrument to measure light.[2]

The observation by Becquerel was not replicated again until 1873, when the English electrical engineer Willoughby Smith discovered that the charge could be caused by light hitting selenium. After this discovery, William Grylls Adams and Richard Evans Day published "The action of light on selenium" in 1876, describing the experiment they used to replicate Smith"s results.[1][3]

In 1881, the American inventor Charles Fritts created the first commercial solar panel, which was reported by Fritts as "continuous, constant and of considerable force not only by exposure to sunlight but also to dim, diffused daylight".[4] However, these solar panels were very inefficient, especially compared to coal-fired power plants.

In 1939, Russell Ohl created the solar cell design that is used in many modern solar panels. He patented his design in 1941.[5] In 1954, this design was first used by Bell Labs to create the first commercially viable silicon solar cell.[1]

Solar panel installers saw significant growth between 2008 and 2013.[6] Due to that growth many installers had projects that were not "ideal" solar roof tops to work with and had to find solutions to shaded roofs and orientation difficulties.[7] This challenge was initially addressed by the re-popularization of micro-inverters and later the invention of power optimizers.

Solar panel manufacturers partnered with micro-inverter companies to create AC modules and power optimizer companies partnered with module manufacturers to create smart modules.[8] In 2013 many solar panel manufacturers announced and began shipping their smart module solutions.[9]

A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. A USB power interface can also be used.[11] Solar panels also use metal frames consisting of racking components, brackets, reflector shapes, and troughs to better support the panel structure.[citation needed]

Solar modular cells need to be connected together to form the module, with front electrodes blocking the solar cell front optical surface area slightly. To maximize frontal surface area available for sunlight and improve solar cell efficiency, manufacturers use varying rear electrode solar cell connection techniques:

A single solar module can produce only a limited amount of power; most installations contain multiple modules adding their voltages or currents. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for energy storage, a charge controller, interconnection wiring, circuit breakers, fuses, disconnect switches, voltage meters, and optionally a solar tracking mechanism. Equipment is carefully selected to optimize energy output and storage, reduce power transmission losses, and convert from direct current to alternating current.