PV Array

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. By their modularity, they are able to be configured to supply most loads.

A photovoltaic array is a linked assembly of PV modules.

The cells convert solar energy into direct current electricity via the photovoltaic effect. The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can plug into the existing infrastructure to power lights, motors, and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage; the individual strings are then connected in parallel to allow the system to produce more current. Solar arrays are typically measured by the peak electrical power they produce, in watts, kilowatts, or even megawatts.

Timber framed house with a photovoltaic array

Costs of production have been reduced in recent years for more widespread use through production and technological advances. One source claims the cost in February 2006 ranged \$3–10/watt while a similar size is said to have cost \$8–10/watt in February 1996, depending on type. For example, crystal silicon solar cells have largely been replaced by less expensive multicrystalline silicon solar cells, and thin film silicon solar cells have also been developed recently at lower costs of production yet. Although they are reduced in energy conversion efficiency from single crystalline "siwafers", they are also much easier to produce at comparably lower costs.

Applications

The solar panels on this small yacht at sea can charge the 12 volt batteries at up to 9 amperes in full, direct sunlight.

Urban uses

In urban and suburban areas, photovoltaic arrays are commonly used on rooftops to supplement power use; often the building will have a connection to the power grid, in which case the energy produced by the PV array can be sold back to the utility in some sort of net metering agreement. Solar trees are arrays that, as the name implies, mimic the look of trees, provide shade, and at night can function as street lights. In agricultural settings, the array may be used to directly power DC pumps, without the need for an inverter. In remote settings such as mountainous areas, islands, or other places where a power grid is unavailable, solar arrays can be used as the sole source of electricity, usually by charging a storage battery.

There is financial support available for people wishing to install PV arrays. In the UK, households are paid a 'Feedback Fee' to buy excess electricity at a flat rate per kWh. This is up to 44.3p/kWh which can allow a home to earn double their usual annual domestic electricity bill.

Note that the current UK feed in tarriff system is due for review on 31st March 2012, after this date the current scheme may be no longer available.

Performance

A solar panel on top of a parking meter. Note that this particular installation is shaded, and may not perform as desired.

At high noon on a cloudless day at the equator, the power of the sun is about 1 kW/m², on the Earth's surface, to a plane that is perpendicular to the sun's rays. As such, PV arrays can track the sun through each day to greatly enhance energy collection. However, tracking devices add cost, and require maintenance, so it is more common for PV arrays to have fixed mounts that tilt the array and face due South in the Northern Hemisphere (in the Southern Hemisphere, they should point due North). The tilt angle, from horizontal, can be varied for season, but if fixed, should be set to give optimal array output during the peak electrical demand portion of a typical year.

Trackers and sensors to optimise the performance are often seen as optional, but tracking systems can increase viable output by up to 100%. PV arrays that approach or exceed one megawatt often use solar trackers. Accounting for clouds, and the fact that most of the world is not on the equator, and that the sun sets in the evening, the correct measure of solar power is insolation – the average number of kilowatt-hours per square meter per day. For the weather and latitudes of the United States and Europe, typical insolation ranges from 4kWh/m²/day in northern climes to 6.5 kWh/m²/day in the sunniest regions.

In 2010, solar panels available for customers can have a yield of up to 19%, while commercially available panels can go as far as 27%. Thus, a photovoltaic installation in the southern latitudes of Europe or the United States may expect to produce 1 kWh/m²/day. A typical "150 watt" solar panel is about a square meter in size. Such a panel may be expected to produce 1 kWh every day, on average, after taking into account the weather and the latitude.

In the Sahara desert, with less cloud cover and a better solar angle, one can obtain closer

to 8.3 kWh/m²/day.
The unpopulated area of the Sahara desert is over 9 million km², which if covered with solar panels would provide 630 terawatts total power. The Earth's current energy consumption rate is around 13.5 TW at any given moment (including oil, gas, coal, nuclear, and hydroelectric).

Other factors affect PV performance. Many Photovoltaic cells' electrical output is extremely sensitive to shading. There are some non-traditional solar cell manufacturers, thin-film a:Si, that have installed bypass diodes between each cell that minimize the effects of shading and only lose the power of the shaded portion of the array. When even a small portion of a cell, module, or array is shaded, while the remainder is in sunlight, the output falls dramatically due to internal 'short-circuiting' (the electrons reversing course through the shaded portion of the p-n junction). Therefore it is extremely important that a PV installation is not shaded at all by trees, architectural features, flag poles, or other obstructions like continuously parked cars. Sunlight can be absorbed by dust, fallout, or other impurities at the surface of the module. This can cut down the amount of light that actually strikes the cells by as much as half. Maintaining a clean module surface will increase output performance over the life of the module. Module output and life are also degraded by increased temperature. Allowing ambient air to flow over, and if possible behind, PV modules reduces this problem.
Effective module lives are typically 25 years or more.

Source: http://electrical-all.blogspot.in/2010/08/pv-array.html