

## Photovoltaic Basics

**The Definition of Photovoltaic** Photovoltaic energy or a solar electric system generates electricity naturally and efficiently. To understand how photovoltaic power harnesses electricity one must first understand the basic underlying physics and the design of a photovoltaic device. This is a fully functional system that can be used as a renewable resource in generating electric power. The DOE or the Solar Energy Technologies Program of the United States Department of Energy is constantly adding to the expertise and knowledge of the field of photovoltaic energy. As improvements are made in technology, in the field of solar energy, there is an abundance of power derived from the energy of the sun. Photovoltaic technology studies how the sun's energy can essentially work for us as a power source.

**Information on Photovoltaic Physics** Literally, photovoltaic is translated to mean light-electricity. This is exactly what photovoltaic devices and materials do. These types of devices and materials are responsible for converting light energy into an electrical power resource. This type of energy system was first developed in the year 1839. Solar cells or photovoltaic cells (PV cells) are considered to be a device that produces electricity. Semiconductor material is what PV cells are made from. The PV cells range in size from smaller than a postage stamp to several feet long. Different sized PV arrays can be connected to modules in order to create power output. The factors that determine how much electricity is generated depends on the consumer's needs and the amount of sunlight that is made available in a specific location. A Photovoltaic system consists of mounting hardware, electrical connections, batteries and power conditioning equipment. The batteries are used for the storing of solar energy so the power source produces electricity when the sun is not shining. There are numerous items that a PV system is a power source for. Some of the smaller items powered by solar power are wristwatches and calculators. Other items that can be powered through this energy source are appliances, water pumps, lights and communication satellites. In recent year's traffic and road signs have been powered by photovoltaic energy. This is a very inexpensive form of electricity. To understand the physics of photovoltaic energy one must know that crystalline silicon is a very common material used as a conductor. The crystalline material is the chief material that converts the sun's rays in to solar energy. The solar energy is created at an atomic level. As the material captures the sun's rays energy is converted into cells. These cells are used to generate electricity to be either used right away or stored for later use when there is a demand.

**Photovoltaic Devices** There are several different semiconductor materials that Photovoltaic devices can be made from. The devices can be put in different structures in order to achieve the optimal performance of solar cells. The four basic photovoltaic devices are homojunction, multijunction, heterojunction and p-i-n/n-i-p. These four devices are responsible for creating solar power.

**Energy Payback Time for Photovoltaic Technologies** The length of deployment that is required for a photovoltaic system is measured by the length of energy payback time. This means that a photovoltaic system must generate a total amount of energy that is equal to the amount of energy that is used to produce the electricity. According to engineer studies a low energy payback time is found with a roof mounted photovoltaic system. Energy payback time is valued according to three different factors. The first factor is the amount of illumination or sunlight the system receives. The second factor is the way in which the photovoltaic system converts efficiency. The third factor deals with the type of manufacturing technology that is utilized to make solar or photovoltaic cells. There are three approaches to the manufacturing of solar cells, commercially, according to developments in manufacturing technology. The most popular approach to processing discrete cells is by using silicon ingots in the form of wafers. The conductors or ingots is what develops the highly intensive energy process. The conductors are usually either multi or single crystalline. A recent development in the approach of saving energy is the processing of discrete cells that originate from the multicrystalline ribbons. Another approach that has been developed is to deposit layers of silicon materials that are non-crystalline on a substrate that is inexpensive. The last mentioned approach is considered to be the least energy intensive of all of the manufacturing approaches for photovoltaic devices used for commercial purposes. Another form of technology that is used in solar or photovoltaic energy uses amorphous silicon cells. The silicon cells are then deposited on ribbon made from stainless steel. Cells consisting of cadmium telluride is deposited onto glass. Then alloy cells made from copper indium gallium are deposited on stainless steel substrates or glass. These are some of the latest ways in which photovoltaic devices generate electricity. There have been recent studies that have established grid-tied EPBT systems, battery-free that are used when creating new and improved photovoltaic module technologies.

**The Potential of Photovoltaic Energy** Each day that we walk the earth the sun is occupied with the task of delivering free energy to the earth and its inhabitants. Many people are realizing that this free energy or the technology of photovoltaic is able to generate electricity from the sun's energy. The power of photovoltaic is phenomenal as this form of technology has the ability to harness and store an unlimited amount, from the Sun, of electrical energy. The most awe-inspiring statistic is that there is enough solar radiation available in locations around the globe that can meet the need of the consumers increased demands for energy. Experts have proposed that the sun creates an amount of energy reaching the surface of the earth that can provide enough electricity to take care of the needs of annual energy consumption worldwide ten thousand times over. To create the amount of energy needed to supply the globe's energy needs the electricity generated by a photovoltaic system would use a modest electricity output per square meter of 100kWh. This means that the solar area that would be required in order to capture the energy would take up 150 x 150 km. The largest part of the photovoltaic capture area would have to be located on the walls or roofs of buildings. This is an advantage of photovoltaic energy because a capture area would not use extra land.

**The Advantages of Using a Photovoltaic System** There are many unique advantages to using a photovoltaic system instead of a conventional power source. A photovoltaic system can be designed to be used in various applications. Some of the applications consist of operational requirements. A modular photovoltaic system is both transportable and expandable. Two attractive features of the photovoltaic system is environmental compatibility and energy independence. Another advantage of using the photovoltaic system is that there is no noise or pollution created when the system is in operation.

The biggest advantage of installing a fully operational photovoltaic source is that sunlight is free energy. On top of all of the advantages, once installed, photovoltaic systems have reliable long service lifetimes that require a minimal amount of maintenance. This is a perfect energy resource that people all around the globe can use for all of their energy needs.

**The Benefit of Renewable Energy Credits** The United States has several companies that are currently developing new renewable energy projects that include the study of photovoltaic or solar power. These projects are financed from renewable energy credits. The definition of a renewable energy credit is a tradable unit that is a representative of a commodity. The commodity represented is a form of environmental attributes of a unit of renewable energy or a generated unit of electricity. There are many benefits to collecting renewable energy credits. One of the major benefits of earning renewable energy credits is that this is a tradable commodity. Renewable energy credits can be traded in order to reduce projects from fossil fuel sources. The REC's or renewable energy credits can be used in order to host an environmental friendly event. An event that was created from these credits is the "Carbon Neutral" conference. The renewable energy credits are used by participants to pay for their travel expenses. Renewable energy credits are used with mandated programs such as renewable energy portfolio standards. What this entails is that a percentage from energy sales must be derived from a natural, renewable resource. An example of a practice of the renewable energy portfolio is understood when discussing energy practices in the state of Maine. In Maine thirty percent of the amount of electricity generated must be from a renewable source such as solar energy. The United States government along with governments around the world have been finding out that renewable resources are essential to ensuring a future energy resource. Our energy resources become more and more depleted each day. Fossil fuels are quickly disappearing. It is very important to start using and rewarding the use of renewable sources of energy such as a photovoltaic system. A photovoltaic system can generate enough energy for the whole world. This type of system is a valuable resource for our energy demands and the energy demands of our children. We must choose energy sources, like photovoltaic systems, that are not only natural but renewable. These are the energy sources of the future.