

SOLAR ENERGY

Summary:

The possibilities for using solar energy are limitless. At a basic level, solar energy can passively heat and provide light for buildings, distill water, and cook food. Active strategies, incorporating photovoltaics, pumps, and fans to change energy outputs, generate electricity, heat water, heat and cool buildings, and power cars, boats, and even planes.

Solar Electric:

Solar electric is one of the most common forms of solar energy. Solar electricity is produced by converting sunlight into power using the photovoltaic effect where an electrical current flows through a solar cell when the cell is exposed to sunlight.¹ A solar panel is a combination of many solar cells together into a unit. A collection of these units makes a solar array, and multiple arrays make up a solar electric system.

Panels:

There are two types of solar panels: crystalline silicon and thin film. Crystalline silicon photovoltaics are rigid panels that perform well in low light conditions and are very efficient. Thin film, though less efficient, are also less expensive to produce than crystalline panels. Thin film is a flexible, thin layer of silicon spread over a plate of glass or ceramic. Film is ideal for building integrated photovoltaics such as solar tiles and shingles and PV glass.

Solar Electric Systems:

A solar electric system usually consists of solar panels, an inverter, a battery, a charge controller, and wiring. The inverter is used to convert electricity produced from direct current (DC) to alternating current (AC) power. A battery collects excess electricity and stores it for use during power outages, cloudy days, or night use and is protected from overcharging by the charge controller.

Systems can be connected to the grid, connected to the grid with battery backup, or off-grid. A grid-connected system is used to decrease the normal power supply from the utility company and does not include a battery to store excess power. This system relies on a normal power supply for cloudy days, night use, and periods of high electricity use. Excess electricity is not stored but can be sold back to the utility company for credit.

A grid-connected system with battery backup is like the grid-connected system though an storage battery pack is included to store excess energy. The stored electricity is used when the system is not generating enough electricity. The system is still connected to the grid to supplement the system when additional power is needed.

Off-grid systems are usually found in remote areas where it is more expensive to connect to the utility grid. These systems are completely independent from power lines and are often the main power source for the home. Batteries are used to store excess power and are often supplemented by wind turbines, generators, and/or backup fuel sources.²

1 US Department of Energy: Energy Efficiency and Renewable Energy, "Your Own Power: A Consumer Guide to Solar Electricity for the Home," <http://www1.eere.energy.gov/solar/pdfs/43844.pdf>.

2 Ibid.

Resources:

Books:

Solar Power Your Home For Dummies

by Rik DeGunther

http://www.amazon.com/Solar-Power-Your-Dummies-Garden/dp/0470175699/ref=sr_1_1?ie=UTF8&s=books&qid=1250087694&sr=1-1

Got Sun? Go Solar: Get Free Renewable Energy to Power Your Grid-Tied Home

by Rex A. Ewing; Doug Pratt

http://www.amazon.com/Got-Sun-Solar-Renewable-Grid-Tied/dp/0965809870/ref=sr_1_2?ie=UTF8&s=books&qid=1250087694&sr=1-2

Photovoltaics: Design and Installation Manual

by Solar Energy International

http://www.amazon.com/Photovoltaics-Installation-Solar-Energy-International/dp/0865715203/ref=sr_1_4?ie=UTF8&s=books&qid=1250087694&sr=1-4

The Renewable Energy Handbook: A Guide to Rural Energy Independence, Off-Grid and Sustainable Living (Paperback)

by William H. Kemp

http://www.amazon.com/Renewable-Energy-Handbook-Independence-Sustainable/dp/0973323329/ref=sr_1_6?ie=UTF8&s=books&qid=1250087694&sr=1-6

Solar Revolution: The Economic Transformation of the Global Energy Industry (Paperback)

by Travis Bradford

http://www.amazon.com/Solar-Revolution-Economic-Transformation-Industry/dp/0262524945/ref=sr_1_7?ie=UTF8&s=books&qid=1250087694&sr=1-7

Solar Engineering of Thermal Processes (Hardcover)

by John A. Duffie, William A. Beckman

http://www.amazon.com/Solar-Engineering-Thermal-Processes-Duffie/dp/0471698679/ref=sr_1_8?ie=UTF8&s=books&qid=1250087694&sr=1-8

Practical Photovoltaics: Electricity from Solar Cells (Paperback)

by Richard J. Komp

http://www.amazon.com/Practical-Photovoltaics-Electricity-Solar-Cells/dp/093794811X/ref=sr_1_9?ie=UTF8&s=books&qid=1250087694&sr=1-9

The Homeowner's Guide to Renewable Energy: Achieving Energy Independence through Solar, Wind, Biomass and Hydropower

by Dan Chiras

http://www.amazon.com/Homeowners-Guide-Renewable-Energy-Independence/dp/086571536X/ref=sr_1_10?ie=UTF8&s=books&qid=1250087694&sr=1-10

Products:

Suntech Power

Suntech Power, founded in 2001, is an international manufacturer of photovoltaic modules with sales offices and installation partners in North America, Europe, Asia, and Australia. Suntech's America is located in San Francisco, CA and their corporate headquarters is located in China. Suntech has developed a range of photovoltaic options including their monocrystalline solar panels, polycrystalline solar panels, semi-transparent modules, and building integrated photovoltaic (BIPV) panels.

Sharp Solar

Sharp Solar, located in Huntington Beach, CA, began researching solar cells in 1959. "By the end of 2007, Sharp reached 2 gigawatts of cumulative solar cell production volume, more than any other company in the world." Sharp has developed a range of options of photovoltaic panels including off grid modules, residential modules, commercial modules, utility scale modules, and a new line of thin film photovoltaic modules.

Case Studies:

Exelon Pavilions, Millennium Park

Located in downtown Chicago, IL, the four Exelon Pavilions are an integral part of Millennium Park, with two located on the south side of the park and two on the north. The south side pavilions, designed by Renzo Piano, provide access to the parking garage below while incorporating solar technology: twenty-four PV modules are located on the roof of the southeast pavilion and 16 PV modules are located on the roof of the southwest pavilion.

McDonald's Cycle Center, Millennium Park

The cycle center is located in downtown Chicago's Millennium Park and "is another step toward Mayor Daley's goal to make Chicago the most bicycle-friendly city in the country." The center provides 300 secure, heated, indoor bike parking spaces, showers and lockers, bike rentals, and a repair shop. The center is also partially powered by the photovoltaic system on the roof including 80 75-watt modules and 40 37-watt modules. The system is rated at 7.48 kW, will generate 8,815 kilowatt-hours per year, and meet 6.5% of the center's electrical requirements.

Chicago Center for Green Technology

CCGT, located west of Chicago's Loop, acts as a model for green construction, houses green businesses and organizations, and provides a place to learn about sustainability. It is only the third building in the United States to be designed with the highest standards of green technology, LEED Platinum, though it is the first LEED Platinum building to reuse an existing structure and provide public transportation. The building that houses CCGT was built in 1952 and was most recently owned by Sacramento Crushing.

References:

US Department of Energy. *Energy Efficiency and Renewable Energy*, "Your Own Power: A Consumer Guide to Solar Electricity for the Home," <http://www1.eere.energy.gov/solar/pdfs/43844.pdf>.