Solar Energy

Solar energy is among the cleanest forms of renewable energy on the planet. This important resource is being used across the Commonwealth.

What Is Solar Power?

Virtually all of the earth's energy resources, including both fossil fuels and renewables, originate from the sun. Today, solar energy not only takes the form of the more basic passive solar design, but is also applied through highly advanced, cost-effective photovoltaic cells and other solar energy technologies. Solar energy can be divided into three major categories - passive solar, solar-thermal and photovoltaic.

Passive Solar

Passive solar design takes advantage of a building's structure to capture the sun's heat, either storing or distributing it, reducing the need for conventional heating, cooling and/or lighting. Examples of passive solar design include large, south-facing windows, dark colored tile floors, stone fireplaces, brick interior walls, "sunspaces" (or greenhouses) and super-insulation. Passive solar buildings are often equipped with features, such as overhangs and ventilation systems, which keep them cool in the summer months and warm in the winter months. Commercial buildings present a different type of challenge than residential ones because of the heavy lighting and equipment use. The most crucial aspect of passive solar design for commercial buildings is the building orientation relative to the solar path. Other aspects of passive solar design, such as shade trees and indoor atriums, coupled with energy efficiency measures, can help increase the overall efficiency of a commercial building.

Solar-Thermal

Power plants often use fossil fuels as a heat source to boil water. The steam from the boiling water then rotates a large turbine, activating a generator that produces electricity. Solar-thermal concentrating systems use sunlight as the heat source, eliminating the need for fossil fuels. There are three types of solar-thermal concentrating systems & parabolic troughs, parabolic dishes and central receivers. Parabolic troughs, primarily used for industrial purposes, are curved reflectors that focus sunlight into a line receiver in which fluid is heated. Parabolic dishes, also used in industrial applications, are bowl-shaped reflectors that focus sunlight into a small receiver through which passes a heat-transfer fluid. Central receivers, which have traditionally dominated the U.S. Department of Energy's solar thermal program, are sun-tracking mirrors that focus sunlight onto a large receiver.

Photovoltaic Cells

Photovoltaic (PV) cells, or solar cells, convert sunlight directly into electricity. As the sun strikes a PV cell, the semi-conducting materials within the cell absorb the sunlight, producing electricity. Solar cells are often used as simple systems that power small calculators and wristwatches. More complicated systems provide electricity for pumping water, powering communications equipment, lighting homes, and running appliances. A series of solar cells form a PV array or "solar panel." Between 10 and 50 solar panels are needed to power an average household. PV panels are installed on buildings in places of maximum sun and minimal shade in order to take full advantage of the sun's power. There is very little maintenance required to sustain solar equipment. So long as panels are kept clean, they can last approximately 20 to 30 years.

Solar power can be used in a grid-tied system or in a distributed system. A solar grid-tied system links a series of solar panels through a power inverter to the utility's electric grid. The solar panels generate a direct current (DC) by drawing on energy from the sun. The inverter then converts that direct current to an alternating current (AC), which electronic devices and appliances can use. Batteries are not necessary to supplement the system and any excess electricity generated by the solar panels is redirected by the inverter back into the grid where it can be used on other premises.

Distributed systems work independently from a utility's electric grid, using batteries to store the power. Similar to a grid-tied system, distributed solar panels typically use a power inverter to convert the direct current from the sun into an alternating current, to be used on location. However, some systems function without an inverter and run only DC appliances.

What are the Costs and Benefits of Solar Power?

The Environment: Few environmental issues arise in regard to solar power development. As with wind power, the use of solar power eliminates air emissions, such as carbon dioxide, sulfur dioxide, nitrogen oxides and mercury that result from the use of traditional fossil fuel energy sources. The manufacturing, transportation and set-up of solar power equipment may contribute to small quantities of air emissions, particularly when fossil fuels are used. The manufacturing of PV cells involves the generation of small quantities of hazardous materials. However, with proper handling, these materials pose little risk to humans or the environment. Certain applications of solar energy, such as central power stations, require large amounts of land, raising issues of wildlife protection and land use. Five acres of land are often needed for each megawatt of capacity. In previously developed urban areas, however, rooftop solar systems are a much more practical application, and can even help save on cooling costs by absorbing energy that would otherwise be transferred to the building's interior.

Dollars and Cents: Economically, the solar industry still faces several barriers to its development such as low fossil fuel energy prices; financial subsidies, incentives, and taxes that are biased toward the fossil fuel industry; and the failure of the economic marketplace to account for the environmental impacts of traditional energy sources. However, within the past three decades, solar power has dropped in price from $.80 per kilowatt-hour to $.20 per kilowatt-hour. Today, solar power remains an economically viable alternative energy source, and the many financing programs and incentives available make it even more attractive to both home and business owners. Solar power is particularly economical when the electricity generated from photovoltaics is used to offset peak demand for electricity from conventional sources. Especially during the summer months, solar resources are the greatest in the middle of the day, coinciding with peak electricity demand to run air conditioners and other cooling devices.

Legal Mandates: In addition, thanks to the Alternative Energy Portfolio Standard Act of 2004, 18% of electricity sold at retail in the Commonwealth of Pennsylvania in 2021 will be required to be generated by alternative energy sources. This includes 800 MW from solar energy, known as the "Solar Share." See this Solar Share Fact Sheet (.pdf file) for more information.

Learning Tool for Low-Income Providers: This online training course was developed as a learning tool for low-income renovation contractors and weatherization providers in Pennsylvania. It is designed to help users understand solar energy strategies and technologies appropriate for residential applications, specifically solar electric (photovoltaics) and solar water heating, including siting, sizing, and installation. The PASolar webpage is available by clicking this link.

Where are There Existing Demonstrations of Solar Power?

DEP's Cambria Office Building

This green building is one of several operated by the state. The building features a 15 kilowatt photovoltaic system (excess power is sold to Green Mountain) and takes full advantage of passive solar lighting and heating through the use of light shelves and solar shades on the southern elevation (pictured to the right).

Ortho-McNeil Pharmaceutical in Spring House, PA

The largest solar array in the Commonwealth is the 75 kilowatt system located on the roof of Ortho-McNeil Pharmaceutical's facility in Spring House, PA. The array will provide about 79,000 kilowatt-hours of electricity to the facility. The flat rooftop system also provides an insulation value of R-20. Ortho-McNeil is a Johnson & Johnson Company and participates in the national Green Power Partnership.

Green Mountain Solar at Pittsburgh

This 30 kilowatt array sits atop the Ikea store located in Pittsburgh and is the result of a partnership between Green Mountain Energy Company, a residential provider of renewable electricity, and Sun Power Electric, a renewable energy developer.

Tom Ridge Center at Presque Isle

Construction on the Tom Ridge Center at Presque Isle, which began in October 2002, is expected to be completed in early 2004. The two-story building will be constructed according to "green building" design principles. The elongated design along an east-west axis and significant glass with a southern exposure will optimize passive solar performance. A 70-foot observation tower overlooking the park, Presque Isle Bay and Lake Erie will serve as a solar collector and ventilator, distributing air through the building. Presque Isle is a major recreational landmark for about four million visitors each year.

Fort Washington Residential

A rooftop 3.0 kilowatt array provides 20 percent of the electricity needs of this home (see picture to the right) in Fort Washington. The panels were installed as part of Philadelphia's

Million solar Roofs Program.

More Information

Pa. Solar Manual (Word)

The Pennsylvania Solar Manual provides a practical look at the benefits of both solar thermal and solar electric projects.

Solar Working Group

The Solar Working Group consists of members from the solar industry, local government officials, and state agency representatives. The purpose of the meetings are to provide a forum for the industry members and local government officials to discuss potential issues that may arise as solar installations become more prevalent statewide. The meetings will stimulate information sharing and possible development of tools and resources to facilitate the deployment of solar installations.