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Solar Energy Basics

Sunlight—solar energy—can be used to generate electricity, provide hot water, or to heat, cool, and light buildings.

Photovoltaic (solar cell) systems convert sunlight directly into electricity. A solar PV cell consists of semiconducting material that absorbs the sunlight. The solar energy knocks electrons loose from their atoms, allowing the electrons to flow through the material to produce electricity. PV cells are typically combined into modules that hold about 40 cells. About 10 of these modules are mounted in PV *arrays*. PV arrays can be used to generate electricity for a single building or, in large numbers, for a power plant. A power plant can also use a *concentrating solar power system*, which uses the sun's heat to generate electricity. The sunlight is collected and focused with mirrors to create a high-intensity heat source. This heat source produces steam or mechanical power to run a generator that creates electricity.

Solar water heating systems for buildings have two main parts: a solar collector and a storage tank. Typically, a *flat-plate collector*—a thin, flat, rectangular box with transparent cover—is mounted on the roof, facing the sun. The sun heats an *absorber plate* in the collector, which, in turn, heats the fluid running through tubes within the collector. To move the heated fluid between the collector and the storage tank, a system either uses a pump or gravity, as water has a tendency to naturally circulate as it is heated. Systems that use fluids other than water in the collector tubes usually heat the water by passing it through a coil of tubing in the tank.

Many large commercial buildings can use solar collectors to provide more than just hot water. Solar process heating systems can be used to heat these buildings. A ventilation system can be used in cold climates to preheat air as it enters a building. And the heat from a solar collector can even be used to provide energy for cooling a building.

A solar collector is not always needed when using sunlight to heat a building. Some buildings can be designed for *passive solar* heating. These buildings usually have large, south-facing windows. Materials that absorb and store the sun's heat can be built into the sunlit floors and walls. The floors and walls will then heat up during the day and slowly release heat at night—a process called *direct gain*. Many of the passive solar heating design features also provide *daylighting*. Daylighting is simply the use of natural sunlight to brighten up a building's interior.

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