Solar Energy Technologies

Solutions for Today's Energy Needs

Overview

Solar energy is the cleanest, most abundant renewable energy source available. The U.S. has some of the world's richest solar resources. Today's technology allows us to harness this resource in several ways, giving the public and commercial entities flexible ways to employ both the light and heat of the sun.

There are three primary technologies by which solar energy is commonly harnessed: photovoltaics (PV), which directly convert light to electricity; concentrating solar power (CSP), which uses heat from the sun (thermal energy) to drive utility-scale, electric turbines; and heating and cooling systems, which collect thermal energy to provide hot water and air conditioning.

Solar energy can be deployed through distributed generation, whereby the equipment is located on rooftops or ground-mounted arrays close to where the energy is used. Some technologies can be further expanded into utility-scale applications to produce energy as a central power plant.

Workers mount PV modules on a private home. These modules use sunlight to generate clean, pollution-free electricity and can reduce or eliminate monthly electricity bills. In 2010, 260 megawatts (MW) of PV were installed on over 48,000 homes.

Source: NREL

Photovoltaic Technology

Photovoltaic (PV) technologies directly convert energy from sunlight into electricity. When sunlight strikes the PV module, made of a semiconductor material, electrons are stripped from their atomic bonds. This flow of electrons produces an electric current. PV modules contain no moving parts and generally last thirty years or more with minimal maintenance.

The Copper Mountain Solar Project in Boulder, Nev.is the largest operating PV facility in the U.S.. Already at 58 MW, the facility is scheduled to add an additional 92 MW of capacity by the end of 2012.

Source: First Solar

PV electricity output peaks mid-day when the sun is at its highest point in the sky, and can offset the most expensive electricity when daily demand is greatest. Homeowners can install a few dozen PV panels to reduce or eliminate their monthly electricity bills, and utilities can build large "farms" of PV panels to provide pollution-free electricity to their customers.

Semiconductors are used in most electronic products, including computer chips, audio amplifiers, temperature sensors and solar cells. Traditionally, PV modules are made using various forms of silicon (Si), but many companies are also manufacturing modules that employ other semiconductor materials often referred to as thin-film PV. Each of the various PV technologies have unique cost and performance characteristics that drive competition within the industry. Cost and performance can be further affected by the PV application and specific configuration of a PV system.

Concentrating Solar Power

Concentrating solar power (CSP) plants use mirrors or lenses to concentrate the sun's thermal energy, creating high enough temperatures to generate electricity by driving traditional steam turbines, heating engines or increasing output of high-efficiency PV cells. Most CSP plants are cost-effective when scaled at hundreds of megawatts (MW), making them attractive as wholesale energy suppliers to utilities. Today, over 545 MW of CSP plants operate in the U.S., and over 4,000 MW of CSP projects are under development.

The most common CSP technologies are Power Tower, Parabolic Trough, Compact Linear Fresnel Reflector (CLFR) and Dish Engine. CSP requires specific conditions to produce power, such as areas where direct sunlight is most intense (e.g., the U.S. Southwest) and contiguous parcels of dry, flat land.

In the above Parabolic Trough system, one of the four main CSP technologies, rows of curved mirrors focus the sun's energy onto a receiver tube filled with a heat transfer fluid that runs down the center of the trough. The heated fluid produces steam that drives a conventional turbine, creating electricity.

Source: Abengoa Solar

Solar Heating and Cooling

A residential solar water heating system.

Source: EnerWorks

Solar heating and cooling technologies collect thermal energy from the sun and use this heat to provide hot water and space heating and cooling for residential, commercial and industrial applications. There are several types of collectors: flat plate, evacuated tube, Integral Collector Storage (ICS), thermosiphon and concentrating. These technologies provide a return on investment in 3-6 years.

Water heating, space heating and space cooling accounted for 69 percent of the energy used in an average U.S. household in 2005 – representing significant market potential for solar heating and cooling technologies. For example, solar water heating systems can be installed on every home in the U.S., and a properly designed and installed system can provide 40 to 80 percent of a building's hot water needs. Similarly, solar space heating and cooling systems circulate conditioned air or liquid throughout a building using existing HVAC systems, without using electricity.

About the Solar Energy Industries Association®

Established in 1974, the Solar Energy Industries Association is the national trade association of the U.S. solar energy industry. Through advocacy and education, SEIA® and its 1,100 member companies are building a strong solar industry to power America. As the voice of the industry, SEIA works to make solar a mainstream and significant energy source by expanding markets, removing market barriers, strengthening the industry and educating the public on the benefits of solar energy.

For more information, please visit www.seia.org.