Solar Energy Technologies Program

Technology Overview

The Office of Solar Energy Technologies sponsors specific research and development that improves the performance and reduces the cost of solar technologies. The component programs of Photovoltaics, Solar Buildings, and Concentrating Solar Power support research activities of world-class scientists and engineers as private researchers or with industry, universities, and the national laboratories.

The Photovoltaic (PV) Program develops the technology that uses semiconductor materials to convert sunlight directly into electricity. The conversion is instantaneous, quiet and uses no moving parts.

The Solar Buildings Programs develops solar technologies that supply buildings with their electrical and thermal needs while using purchased energy in a more efficient manner. The Program aids industry in developing low-cost solar technologies for hot water and space heating, and supports development of zero energy buildings through optimally integrating solar technologies with highly energy-efficient construction methods.

The Concentrating Solar Power Program develops parabolic troughs and solar dish/engine systems which use concentrated sunlight to achieve high temperatures and drive steam/electric generators. The Program works with industry to achieve the necessary technical advances that will lead to reliable, cost-competitive solar trough and dish/engine systems.

Warren Gretz, NREL/PIX06282

These thin-film PV shingles mount directly on to the roof structure and take the place of asphalt shingles, and generate electricity. This technology received an award from R&D Magazine for one of 1998's 100 most significant technological innovations.

U.S. Department of Energy Program

To meet the changing needs of the global energy industry, three of the U.S. Department of Energy's (DOE) solar technology programs are under one umbrella: the Office of Solar Technologies. The solar programs of photovoltaics, concentrating solar power, and solar buildings have all made dramatic technology improvements since the 1970s.

The purpose of the U.S. Department of Energy (DOE) PV Program is twofold: to accelerate the development of PV as a national and global energy option, and to ensure U.S technology and global market leadership. The program has helped to build a national effort, supporting partnerships that span the range from basic and applied research to manufacturing technology, product development, and commercialization.

The mission of the DOE Solar Buildings Program is to develop zero energy buildings (ZEB's) which combine solar energy technologies with very energy-efficient building design and appliances, to create a new generation of cost-effective buildings that have a zero net need for offsite energy. The DOE Solar Buildings Program focuses on public-private partnerships to realize this vision, while continuing to support research and development of solar buildings technologies that contribute to a zero energy building.

The DOE works with industry partners to develop concentrating solar power technologies. This collaboration has produced significant results. Parabolic troughs provide the cheapest solar electricity currently available, and utility-scale trough systems have been in operation since 1984. Parabolic dish systems have now demonstrated thousands of hours of trouble-free operation in preparation for distributed energy applications. Power towers are moving forward as U.S. industry prepares to build a third-generation prototype plant in Spain.

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PVMat

As part of its commitment to bring new technologies to market, the DOE PV Program works with U.S companies in a variety of joint research and development programs. One of these partnerships, the Photovoltaic Manufacturing Technology (PVMaT) initiative, focuses on optimizing commercial manufacturing processes to reduce costs and boost production capacity. More than two-dozen PV companies have been involved in this program. Since 1992, PVMaT has helped cut module manufacturing costs for industry partners by more than 36%. It has also helped to increase production capacity more than seven fold.

Siemens Solar Industries/PIX06142

Under PVMat, DOE is working with the U.S. PV industry to cut manufacturing costs and raise output.

Market Potential

In high-value niche markets, such as remote, stand-alone power for telecommunications, PV is the most cost-effective option. The international market continues to show strong growth for applications ranging from water pumping, communications, and lighting, to village power. As manufacturing costs fall, PV is increasingly used for homes and other buildings already connected to the grid. In a deregulated domestic electricity market, distributed power may represent a significant niche for photovoltaic systems. For the international market, PV is already the power of choice for applications ranging from water pumping, communications, and lighting, to village power. This is a fast-growing market, as there are more than two billion people in developing countries who are without electricity.

Today's buildings use a third of the energy currently consumed in the United States and are responsible for two-thirds of peak electrical demand. Because of this, the potential for using solar thermal technologies to reduce utility peak loads in place of conventional gas- or electric-based technologies is substantial. Key markets for solar water heaters include California, Arizona, Nevada, Hawaii, and Florida. The market for solar pool-heating systems has been strong over the years, with approximately 25,000 systems sold in the United States in 1999. Ventilation air preheating is a universal need in cold climates, as well as a major user of energy. Transpired air collectors have been employed at many locations, including apartment buildings, warehouses, large manufacturing plants, and airplane maintenance hangers.

Like all solar generating technologies, electricity from concentrating solar power systems is currently too expensive to compete in U.S. bulk power markets. The levelized energy cost from trough plants (using natural gas as a backup power source) is currently 12¢/kWh to 14¢/kWh. With the help of federal R&D, industry hopes to achieve 6¢/kWh by 2010. The technology can, however, be competitive now in certain peak (dispatchable) power applications and other high-value markets. In a deregulated domestic electricity market, for example, distributed power represents a significant niche for concentrating solar power systems. The use of concentrating solar power will provide an additional energy option for homeowners and businesses as well as helping reduce greenhouse gas emissions in the United States.

For More Information:

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DOE Solar Buildings Program
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DOE Concentrating Solar Power Program
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