# Photovoltaics

The U.S. Department of Energy (DOE) is supporting the advancement of solar energy by aggressively funding diverse photovoltaic (PV) technologies that can potentially meet the energy needs of a range of energy users. These efforts focus on making the cost of generating electricity using PV technology more comparable to, and competitive with, conventional utility-grid electricity prices—in other words, a "levelized" cost of electricity (LCOE).

PV technology is an adaptable and modular form of renewable energy. As continuing advancements are made and renewable electricity becomes equal to or lower in cost than power from the utility grid, demand for PV technology systems will grow rapidly, dramatically increasing its significance as part of the national energy supply.

Credit: SunPower PIX/14594

This 675-kW PV array graces the roof of the Moscone Center in downtown San Francisco, California, and covers 30,000 square feet of rooftop.

## Challenges and Goals

DOE believes that the widespread use of solar energy as a clean, carbon-free, cost-effective electricity source will occur through the development of a variety of PV technologies. These technologies seek to meet the different requirements of a number of energy systems, including distributed residential systems (where the energy is produced locally) and centralized utility systems.

To achieve this, DOE is supporting approaches along the entire development pipeline, including new devices and processes, prototype design and pilot production, and systems development and manufacturing. All of these approaches help lower the LCOE of PV technology.

The DOE Solar Energy Technologies Program (SETP) is currently funding methods to advance all major PV cell technologies. These include wafer silicon (Si); amorphous and single-crystal, thin-film Si; high-efficiency (III-V) semiconductors; cadmium telluride (CdTe) and copper indium gallium diselenide (CIGS) thin films; and advanced organic and dye cells.

The national laboratories, start-up companies, universities, and integrated industry teams partner in these efforts. The ultimate goal is to achieve solar cost-competitiveness by 2015, which will lead to rapid and significant growth of PV electricity use in the United States.

## Competitive Awards

DOE is awarding the following funding opportunities in a number of PV areas to advance new technologies, move technologies from prototype into production, and improve the manufacturing capabilities of the technologies already being mass produced.

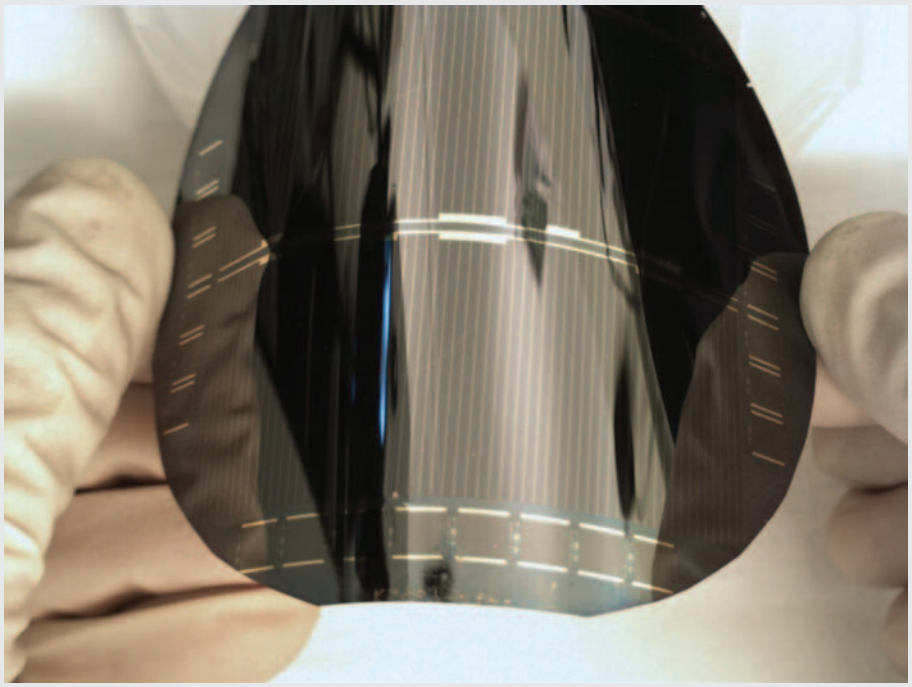
***New Devices and Processes.*** Next Generation PV Devices and Processes emphasizes exploratory research and development (R&D) of innovative next-generation PV technologies. These efforts are expected to produce prototype cells or processes by 2015, with full commercialization expected in 2020 to 2030. The PV Technology Pre-Incubator project helps small businesses bridge the gap between the concept verification stage of a PV technology and the development of a commercially viable prototype by 2015.

***Prototype Design and Pilot Production.*** The PV Technology Incubators projects explore the commercial potential of new manufacturing processes and products produced in pilot-scale operations. Prototypes must demonstrate cost, reliability, and performance advantages.

***Systems Development and Manufacturing.*** Technology Pathway Partnerships focus on PV component and system designs that are ready for mass production and capable of lowering the LCOE of PV-generated electricity to grid parity by 2015. The University Photovoltaic Product and Process Development effort targets materials science research and process engineering in support of industry-led teams developing new PV technologies for commercialization by 2010 to 2015. The PV Supply Chain and Cross-Cutting Technologies effort targets the reduction of manufacturing and product costs by improving common PV manufacturing processes and materials with the potential to impact the PV industry within 2 to 6 years.

## Supporting Cost Reduction

The PV Technology Incubators projects focus on developing prototype PV components and systems for commercialization in 2010. MicroLink Devices, a 2007 and 2008 PV Technology Incubators projects awardee, is developing high-efficiency, low-cost, multi-junction solar cells for use with a concentrator. PV concentrator technologies seek to focus more light onto a smaller solar cell to reduce cost. The technology and processes being implemented by MicroLink minimize the amount of gallium arsenide (which is very expensive) used in the solar cell, while also improving its ability to dissipate heat away from the cell. These improvements have the potential to enhance the functionality of the cell and reduce its cost by 50%, thus reducing the cost of the electricity it helps produce.



Credit: MicroLink Devices/PIX 16605

## Technology Analysis and Evaluation

DOE is directly investing in detailed analysis and evaluation activities that support industry-wide PV system improvements and value enhancements. The three primary areas of focus are as follows:

***Modeling and Analysis.*** The Solar Advisory Model (SAM) is used by the national laboratories as a standardized tool for assessing PV system effects on the LCOE. SAM is also used within the SETP and in industry, which provides input on the model, to analyze different energy scenarios and assess the impact of technology improvements. Other DOE analysis activities are designed to explore the impacts of increased market penetration, changes in policy, and technology progress.

***Reliability R&D***. DOE-supported activities help the solar industry develop more reliable PV systems and make increasingly confident predictions about performance, lifetime, and system operations and maintenance costs. National laboratories develop, validate, and provide the industry with techniques for failure analyses, accelerated tests correlated with field failure mode observations, and predictive performance models based on extensive laboratory and field data.

***Test and Evaluation R&D***. DOE has supported the laboratory and field testing of industry-supplied products through the national laboratories in conjunction with the development of an extensive test database, test methods in laboratories and in the field, and standards. During the past year, DOE tested products from more than 60 solar companies for this purpose.

## Solar Program Priorities

PV is one of four subprograms in the DOE Solar Energy Technologies Program (SETP), along with Concentrating Solar Power, Systems Integration, and Market Transformation. The SETP subprograms focus on accelerating the advancement of solar energy technologies to make solar electricity cost competitive with conventional forms of electricity by 2015. To learn about SETP activities, visit *www.solar.energy.gov.*

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