Photovoltaics

The U.S. Department of Energy (DOE) is aggressively funding a diverse set of photovoltaic (PV) technologies that will have potential application in a range of market segments. These efforts are all focused on minimizing effective life-cycle system cost to allow direct comparison to, and competition with, conventional utility-grid electricity prices.

The diversity, adaptability, and modularity of PV technology make it distinct from other renewable sources. Even now, although electricity from PV systems is still more expensive than electricity from the utility grid, these features make PV systems attractive to a range of energy users. As additional advancements are made and grid parity is reached, demand from PV technology systems has the potential to expand rapidly and become a significant part of the national energy supply.

Credit: SunPower (PowerLight)

This 675-kW PV array graces the roof of the Moscone Center in downtown San Francisco, Calif., 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 that meet diverse requirements of a number of market segments including both distributed residential and utility-scale centralized systems. To meet these requirements, the PV subprogram is investing in approaches across the development pipeline—from basic cell technologies to manufacturing scale-up to total system development—that demonstrate progress toward minimizing the effective life-cycle cost of solar energy.

The program is currently investing in all major PV cell technologies including wafer silicon (Si); amorphous and single-crystal, thin-film Si; high-efficiency (III-V) semiconductors; cadmium telluride (CdTe) and copper indium diselenide (CIGS) thin films; and advanced organic and dye cells.

The DOE PV subprogram is implemented through a diverse set of partnerships that include the national laboratories, start-up companies, universities, and integrated industry teams. The goal of all programs is for PV technology to achieve grid parity by 2015. Achieving this goal will lead to rapid and significant growth of PV electricity in the United States.

Competitive Awards

Commercializing Systems

Technology Pathway Partnerships. Eleven of these industry-led, public-private partnerships were awarded in March 2007. These programs bring together system integrators, critical component suppliers, and others across the supply chain to focus on innovations that can achieve the DOE system-cost goal of grid parity. The awards require a minimum cost-share investment of 50%. The second round of competition and awards is expected in 2010.

Improving Prototype Components and Systems

PV Incubators. DOE supports 10 small PV companies to accelerate the manufacturing scaleup of promising technologies that have been demonstrated on a small scale. These PV Incubators must have a proof-of-principle prototype, a minimum 20% cost share, and quantifiable hardware milestones with associated delivery dates. To receive the full DOE funding of $3 million during the entire 18-month performance period, projects must deliver hardware milestones on time and pass a robust evaluation after 9 months. The application period opens every 12 months, and DOE evaluates new applicants against currently funded programs.

Process and Product Development. As announced in March 2008, DOE is partnering with universities and other early development groups to leverage their fundamental understanding of materials and PV devices to accelerate the transition of technology from laboratory to marketplace. The awardees will receive project funding of up to $1.5 million over 3 years. DOE requires a minimum 20% cost share.

Developing New Ideas

Next-Generation Research. As announced in November 2007, this research effort teams with universities and companies to investigate high-risk/high-payoff PV device and material concepts. These technologies are not expected to reach commercialization before 2015. DOE requires partners in this initiative to commit to a minimum 20% cost share.

Technology Analysis and Evaluation

DOE is directly investing in detailed analysis and evaluation activities that support industry-wide PV system improvements and value enhancements. These are the four primary areas of focus:

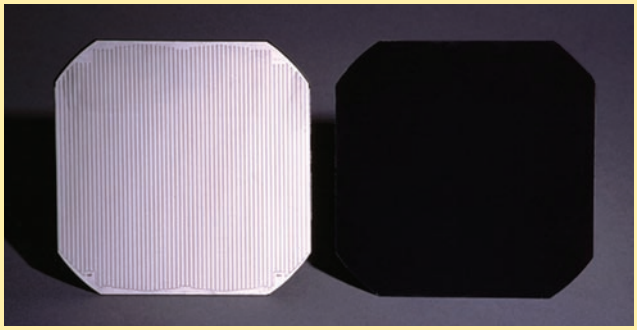
Modeling and Analysis. The Solar Advisory Model (SAM) has been developed by the national laboratories to provide a standardized tool for assessing PV system performance through a levelized cost of energy (LCOE) metric. SAM is used within the program to perform scenario analysis and assess the impact of technology improvements. Industry input on SAM development and future enhancements can be provided through a user forum. Other DOE analysis activities are designed to understand the impacts of increased market penetration, changes in policy, unique benefits of solar electricity, and technology progress.

Reliability R&D. DOE-supported activities help the industry develop more reliable PV systems and make increasingly confident predictions of performance, lifetime, and associated costs for system operation and maintenance. Engineers at national labs, in conjunction with industry, 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 lab and field data.

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

Systems Engineering and Manufacturing. This DOE-sponsored activity focuses on helping the industry via various consortiums to address interface standards and other industry-wide issues.

Reaching a Record

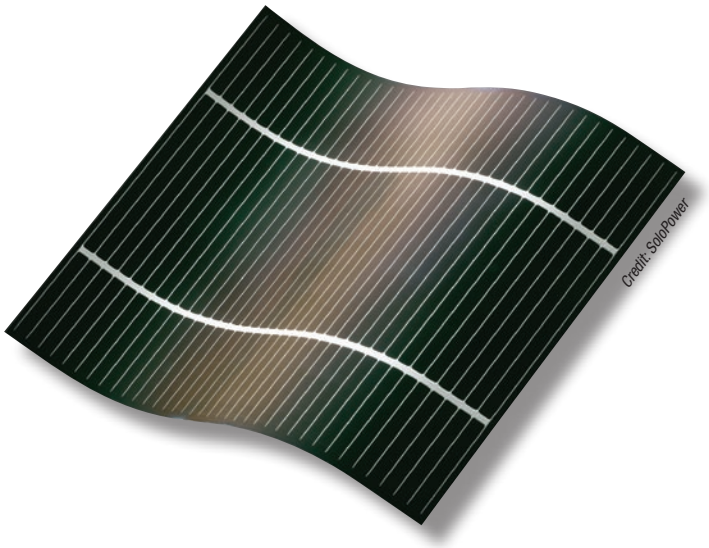


Credit: SunPower

SunPower Corporation, a DOE Technology Pathway Partner, produced a full-scale, 5-inch prototype solar cell in 2008 with an efficiency of 23.4%—a world record for a large-area solar cell. SunPower expects this high-efficiency solar cell to be commercially available in about 2 years. This solar cell is a key component of SunPower's plan to reduce PV system cost by 50% by 2012. SunPower designs, manufactures, and delivers solar electric systems worldwide for residential, commercial, and utility-scale power plant customers.

Solar Program Priorities

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



Credit: SoloPower

SoloPower, a PV Incubator awardee, features its copper indium gallium diselenide (CIGS) photovoltaics cell.

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