

Photovoltaic Manufacturing Technologies

The government and industry are successfully partnering to improve and expand domestic photovoltaic manufacturing processes and products

Many people consider photovoltaic (PV) energy systems to be ideal for producing electric power because they convert sunlight directly to electricity without polluting the air. But these energy systems, which make use of semiconductor materials, have been expensive to produce. So, ever since the first "solar cells" were invented at Bell Laboratories in 1954, government researchers and PV manufacturers have been seeking ways to make this elegant technology less expensive.

The Photovoltaic Manufacturing Technology (PVMaT) Project was initiated in 1990 to reduce costs and, in the process, to extend the U.S. PV industry's world leadership role in manufacturing and in developing commercial PV modules and systems. The project is designed to help the industry improve manufacturing processes, accelerate the

reduction of manufacturing costs for PV modules, improve the performance of commercial products, and lay the groundwork for substantially scaling up the capacity of U.S.-based PV manufacturing plants.

PVMaT is a research and development (R&D) partnership between the U.S. Department of Energy (DOE) and members of the U.S. PV industry. The project is being conducted in five phases, each aimed at achieving PVMaT's goals and each coordinated to support the specific needs of the PV industry as it works toward reducing module cost and scaling up production capacity.

The Office of Power Technologies is part of the Office of Energy Efficiency and Renewable Energy

Highlights

- **Increased U.S. market share from 31% in 1992 to 42% in 1996**
- **Through recent improvements in such areas as materials processing and waste reduction, use of new PV materials, and automation, U.S. manufacturing costs have been reduced by an average 56% from 1992 to 1996.**
- **Increased U.S. production capacities by more than sixfold from 1992 to 1996**
- **Shared cost by U.S. PV industry at an average of 43%.**



NREL/PIX 01534

Spire Corporation, a PVMaT participant, developed an automated module assembly unit that resulted in a fivefold reduction in the cost of assembling PV modules.

Project Partners

U.S. Department of Energy:
Office of Photovoltaic Technology

National Renewable Energy Laboratory

Sandia National Laboratories

Advanced Photovoltaic Systems

Ascension Technology, Inc.

ASE Americas, Inc. (formerly Mobil Solar Energy Corporation)

AstroPower, Inc.

Energy Conversion Devices

ENTECH, Inc.

Evergreen Solar, Inc.

Golden Photon, Inc.

Iowa Thin-Film Technologies

Omnion Power Engineering Corporation

Photovoltaics International

Siemens Solar Industries

Solar Cells Inc.

Solar Design Associates, Inc.

Solar Electric Specialties Company

Solarex Corporation

Spire Corporation

Springborn Laboratories

Texas Instruments

Trace Engineering Company

Utility Power Group

John Wohlgemuth, Solarex

The results of this multiphased, cost-shared project have been impressive. An analysis in 1996 shows a reduction of 56% in module manufacturing costs from 1992 to 1996. During this same period, the manufacturing capacity for U.S. modules has increased by more than a factor of six. Cost sharing by industry was about 43%. Finally, U.S. share of the world market has increased from 31% in 1992 to about 42% in 1996.



Using a process developed under PVMaT to make a larger brick of silicon doubled Solarex's PV production capacity.

“Through the year 2000, Solarex will save \$5 for every dollar invested in PVMaT, and our customers will save approximately \$7 for every dollar invested.”

—John Wohlgemuth, Solarex Corporation

Continuing on this course could bring module-manufacturing costs down to almost \$1.50 per watt by the turn of the century. This would help U.S. companies meet the growing market demand for PV and retain the nation's current position as the leader in global PV markets. And it will bring us several steps closer to the three-fold promise of photovoltaics: energy security, economic growth, and a cleaner environment.

For More Information:

For more on the PV Manufacturing Technology Project, see the Web site at:
<http://www.nrel.gov/nepv/pvmat.html>

U.S. DOE Photovoltaics Program:
<http://www.eren.doe.gov/pv>

National Renewable Energy Laboratory
Photovoltaics Home Page:
<http://www.nrel.gov/pv>

Sandia National Laboratories
Photovoltaics Home Page:
<http://www.sandia.gov/pv>

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