OFFICE OF POWER TECHNOLOGIES

Success Stories

Power Towers

Proving the technical feasibility and cost potential of generating large-scale electric power from the sun when it is needed, day or night

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

Power towers convert the thermal energy of the sun to electricity. They are large-scale power plants producing clean energy and suited for operation in sunny, semi-arid regions of the world.

Large-scale solar power technology did not exist until the eighties. From 1982 to 1988, the U.S. Department of Energy, with the support of private industry, constructed and operated Solar One. This country's first power tower, Solar One proved power towers are technically feasible.

Today, Solar Two advances power tower technology one step further. Located at the Solar One site (near Barstow, California), Solar Two can produce enough electricity for 10,000 homes. It is operated by the Solar Two Consortium (see list under "Project Partners"), headed by Southern California Edison Company of Irwindale, California, in partnership with DOE.

Solar Two is essentially a large research facility, meant to investigate the technical and operational issues of combining a power tower with energy storage. The 10-megawatt power plant began generating power in June 1996 and is scheduled to operate through 1999. It features a 300-foot tower rising from the center of a 95-acre field of sun-tracking mirrors, called heliostats. The 2000 heliostats capture the sun's heat and reflect it onto the tower. The heat equivalent of up to 800 suns is focused on the receiver at the top of the tower. An essential aspect of Solar Two is to test the efficiency and performance of this receiver, which was newly designed for Solar Two.

Highlights

- ***Built and tested Solar One, this country's first power tower***
- ***Built Solar Two, the world's most advanced power tower—energy storage enables the plant to continue producing power during cloudy periods or after dark***
- ***Can be integrated with new power plants running on fossil fuel***
- ***Can be scaled up to 100– to 200–megawatt capacity, positioning industry to build commercial-scale plants in the next decade***
- ***Highlights environmental and economic benefits of solar energy.***

NREL/PIX 02175

Two thousand sun-tracking mirrors surround the central receiver tower at the Solar Two site. During daylight hours, the mirrors continuously direct sunlight on the receiver—the black cylinder located at the top of the tower.

Power Towers

Project Partners

The Solar Two Consortium

Participants:
Arizona Public Service Company

Bechtel Corporation

California Energy Commission

Electric Power Research Institute

Idaho Power Company

Los Angeles Department of Water and Power

PacifiCorp

Sacramento Municipal Utility District

Salt River Project

Southern California Edison Company

Contributors:
Chilean Nitrate (A New York Corporation)

Nevada Power Company

South Coast Air Quality Management District

Industrial Cost Share:
ABB Lummus

Goulde Pumps

General Process Controls

Pitt-Des Moines

Raychem

Rockwell International Corporation

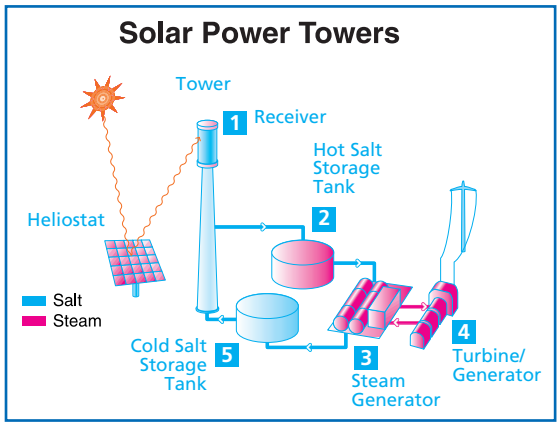
The Industrial Company

Government Partners:
U.S. Department of Energy

Sandia National Laboratories

National Renewable Energy Laboratory

Molten salt flows through tubes in the receiver, absorbing the sun's heat and warming to temperatures as high as 565°C (1050°F). The hot salt then flows to the base of the tower, where it is stored in a "hot" salt storage tank (see diagram). When power production is needed, hot salt is pumped from the hot storage tank through a steam-generating system, and electricity is produced by a conventional steam turbine. After the molten salt has cooled to about 285°C (550°F), it is stored in a second, "cold" salt storage tank until it is again pumped to the top of the tower to be reheated.



Schematic of electricity generation using molten-salt storage:

1) ***Sun heats salt in receiver***
2) ***Salt stored in hot salt storage tank***
3) ***Hot salt pumped through steam generator***
4) ***Steam drives turbine/generator***
5) ***Salt returns to cold salt storage tank***

Because Solar Two can store hot salt for extended periods of time, it tests the ability to store solar energy and produce electricity on demand to meet peak utility loads. The power plant stores enough energy in the hot tank to generate electricity at its rated capacity for up to 3 hours during cloudy periods or after dark. Although many problems and issues are still being solved, Solar Two has demonstrated the feasibility of this approach. Eventually, engineers hope solar power towers can be built large enough to produce anywhere from 30 to 200 megawatts of power.

For More Information:

Visit the Web site of the CSP Program at:
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www.eren.doe.gov/sunlab

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Publications:
Solar Two: Utility-Scale Power from the Sun. DOE/GO-10096-249, July 1997.

Solar Thermal Electric Program Snapshot; Solar Two. DOE/GO-10096-394, August 1997.

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