Solar Two: Utility-Scale Power from the Sun

Solar Two and the Power Tower Design

Solar Two, a solar-powered electric generating plant east of Barstow, California, is what engineers refer to as a power tower or central-receiver system. In a power tower design, thousands of sun-tracking mirrors, called heliostats, reflect the sun's energy to a single receiver atop a centrally located tower. The enormous amount of energy focused on the receiver generates temperatures greater than 1000° Fahrenheit. This thermal energy is captured by the receiver, stored, and used when needed to create steam, which drives a conventional electricity-generating turbine.

The 10-megawatt (MW) Solar Two prototype plant is demonstrating that clean solar energy is a reliable and economical way to produce large quantities of power. The project is sponsored by the Solar Two Consortium (see below) in partnership with the U.S. Department of Energy. Started in 1993, Solar Two began producing electricity in early 1996 and will operate under the consortium through January, 1999. The plant is designed to operate commercially for 25-30 years.

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 Partner:

- U.S. Department of Energy

The Solar Two site.

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From Solar One to Solar Two

Solar Two is a follow-on to the successful Solar One project, which operated at the same site between 1982 and 1988. Solar One proved the power tower design was technically feasible and reliable. Solar Two takes the technology one step further by demonstrating that solar-derived energy can be efficiently stored for use during periods of peak demand.

Engineers are using much of the hardware from Solar One, including the 300-foot central tower, the field of heliostats, the steam turbine, and the generator. In refurbishing the existing system, project engineers have incorporated a state-of-the-art receiver, new energy storage technology, and have updated the master control system.

Storing the Sun's Energy in Salt

Solar Two's most important design feature is its innovative energy collection and storage system, which uses molten nitrate salt—a substance that has excellent heat retention qualities—as the heat transfer medium.

In the Solar Two design, concentrated sunlight heats molten salt in the receiver. The heated salt can be used immediately to generate steam, or it can be stored and subsequently used during cloudy periods or after the sun goes down. Power generation is, therefore, decoupled from the collection of solar energy. From the perspective of the local utility, this storage capability is crucial—energy can be collected when the sun shines and electricity dispatched during periods when it is most needed.

The schematic at the right shows the plant's basic configuration. The salt is heated to 1050°F in the central receiver and stored in the hot salt storage tank, where enough salt can be reserved to generate electricity for up to three hours. When electricity is needed, the hot salt is pumped through a steam generator where the steam that drives the system's turbine/generator is produced. The salt exiting the steam generator is then pumped to the cold salt storage tank and back through the receiver to begin the cycle again.

MASTER

Beyond Solar Two

Solar Two is validating molten-salt technology as a cost-competitive method to collect and store solar energy in power tower plants. By the time the project comes to a close in 1999, the perceived technical and economic risks associated with power tower technology will have been greatly reduced.

The Solar Two prototype will serve as the final stepping stone to full-scale, commercial power tower generating plants. Such plants, in the 100 to 200 MW range, could be operational early in the next decade. Engineers estimate that—when the environmental benefits are factored in—these next-generation plants will produce power at rates competitive with power derived from conventional sources of energy.

Power tower plants could soon be a common sight in the sun-saturated regions of the American West as well as in developing countries in the world's sunbelt. They will generate thousands of megawatts of electricity from clean solar energy, improving our environmental quality, and reducing our dependency on imported fossil fuels.

Schematic of electricity generation using molten-salt storage: 1) sun heats salt in receiver; 2) salt stored in hot storage tank; 3) hot salt pumped through steam generator; 4) steam drives turbine/generator; 5) salt returns to cold storage tank.

Solar Two, the largest solar power plant of its kind in the world, is producing electricity for 10,000 homes attached to the utility grid in Southern California. In addition to generating electricity while the sun shines during the day, Solar Two can actually produce power for up to 3 hours after the sun goes down, greatly increasing the plant's value to Southern California Edison, the local utility company.

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Cover Photos:

Solar Two's field of 2000 sun-tracking heliostats
continuously directs sunlight onto the central receiver,
inset, where solar radiation is converted to thermal
energy for use in electricity generation.