American Energy

The Renewable Path to Energy Security

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Desert Solar Power

Large desert-based power plants concentrate the sun's energy to produce high-temperature heat for industrial processes or convert it into electricity that is available when demand is greatest. Resource calculations show that just seven states in the U.S. Southwest could provide more than 7 million MW of solar generating capacity—roughly 10 times the total U.S. generating capacity from all sources today.

Solar power facility at Kramer Junction, California.

Four concentrating solar technologies are being developed. To date, parabolic trough technology provides the best performance and lowest cost of all types of solar power plants. Nine plants, totaling 354 MW, have operated reliably in California's Mojave Desert since the mid-1980s. Dish-engine and power tower systems are in earlier stages of prototype and commercial development. Natural gas and other fuels can provide supplementary heating when the sun is inadequate, allowing solar power plants to generate electricity whenever it is needed. In addition, heat-storing technologies are being developed to extend the operating times of solar power plants.

Since the first 14 MW trough plant was installed in California in the early 1980s, generating costs have dropped from 45 cents/kWh (in 2005 dollars) to 9–12 cents/kWh (competitive with peak power). Costs are expected to drop to 4–7 cents/kWh by 2020.

Several solar power plants are now being planned in the U.S. Southwest, spurred by state requirements that a minimum share of electricity come from solar technologies. Renewed federal support and rising natural gas prices have also stoked new interest in concentrating solar power. Solargenix is constructing a 64 MW trough plant in Nevada that should be operational in early 2009. While earlier trough plants needed a 25 percent natural gas-fired backup, this plant will require only 2 percent backup. Stirling Energy Systems has signed power purchase agreements with two California utilities totaling 1,750 MW and plans to begin constructing a 1 MW pilot plant in California by the end of 2006.

Utilities in states with large solar resources (Arizona, California, Nevada, and New Mexico) are considering installation of solar dish systems as well. No commercial central receiver or tower plants have been built to date, but an 11 MW generator is under construction in Spain. According to the Western Governors' Association Solar Task Force report, within the next decade, 4,000 MW of central solar plants could be installed in the United States, generating thousands of new jobs.

For solar energy to achieve its potential, plant construction costs will have to be further reduced via technology improvements, economies of scale, and streamlined assembly techniques. Development of economic storage technologies can also lower costs significantly.

The U.S. Southwest has some of the most valuable solar resources in the world, with much of this potential close to major urban areas and on land that has few if any alternative economic uses. According to the National Renewable Energy Laboratory, a solar plant covering 10 square miles of desert would produce as much power as the Hoover Dam. Desert-based power plants could well provide a large share of the nation's commercial energy.

Concentrating Solar Technologies

Parabolic trough technologies track the sun with rows of mirrors that heat a fluid. The fluid then produces steam to drive a turbine.

Central receiver (tower) systems use large mirrors to direct the sun to a central tower, where fluid is heated to produce steam that drives a turbine. Parabolic trough and tower systems can provide large-scale, bulk power with heat storage (in the form of molten salt, or in hybrid systems that derive a small share of their power from natural gas).

Dish systems consist of a reflecting parabolic dish mirror system that concentrates sunlight onto a small area, where a receiver is heated and drives a small thermal engine.

Concentrating photovoltaic systems (CPV) use moving lenses or mirrors to track the sun and focus its light on high-efficiency silicon or multi-junction solar cells; they are potentially a lower-cost approach to utility-scale PV power. Dish and CPV systems are well suited for decentralized generation that is located close to the site of demand, or can be installed in large groups for central station power.