Sun♦Lab SnapShot

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Solar Trough Systems

These systems provide large-scale power generation from the sun and, because of their proven performance, are gaining acceptance in the energy marketplace.

Trough systems predominate among today's commercial solar power plants. All together, nine trough power plants, also called Solar Energy Generating Systems (SEGS), were built in the 1980s in the Mojave Desert near Barstow, California. These plants have a combined capacity of 354 megawatts (MW) and today generate enough electricity to meet the needs of approximately 500,000 people.

Trough systems convert the heat from the sun into electricity. Because of their parabolical shape, troughs can focus the sun at 30–60 times its normal intensity on a receiver pipe located along the focal line of the trough. Synthetic oil captures this heat as the oil circulates through the pipe, reaching temperatures as high as 390°C (735°F). The hot oil is pumped to a generating station and routed through a heat exchanger to produce steam. Finally, electricity is produced in a conventional steam turbine.

In addition to operating on solar energy, the SEGS plants are configured as hybrids to operate on natural gas on cloudy days or after dark. Natural gas provides 25% of the output of the SEGS plants.

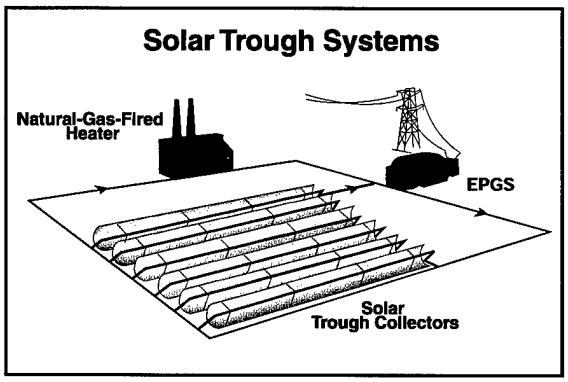
Reducing Costs

The levelized cost of energy from trough systems has declined over the years as the operators of the SEGS plants have gained field experience and improved the technology. The levelized cost of energy from the SEGS plants has decreased from greater than 25¢ per kilowatt–hour (kWh) in 1984 to 10¢-12¢ per kWh today.

Plant availability to produce power when the sun shines is greater than 93%, a statistic that rivals utility-scale power plants of any type. The plants operate for nearly 100% of the on-peak hours of the Southern

NREL/PIX 00033

Nine trough power plants in California's Mojave Desert provide the world's largest generating capacity of solar electricity, with a combined output of 354 megawatts.



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On sunny days, oil in the receiver tubes collects the concentrated solar energy as heat, and on cloudy days it is heated with natural gas. The hot oil is then pumped to an electric power generation system (EPGS) where the heat energy is converted to electricity.

Concentrating Solar Power Program

California Edison Company of Irwindale, California, thus providing power when it is most valuable to the utility.

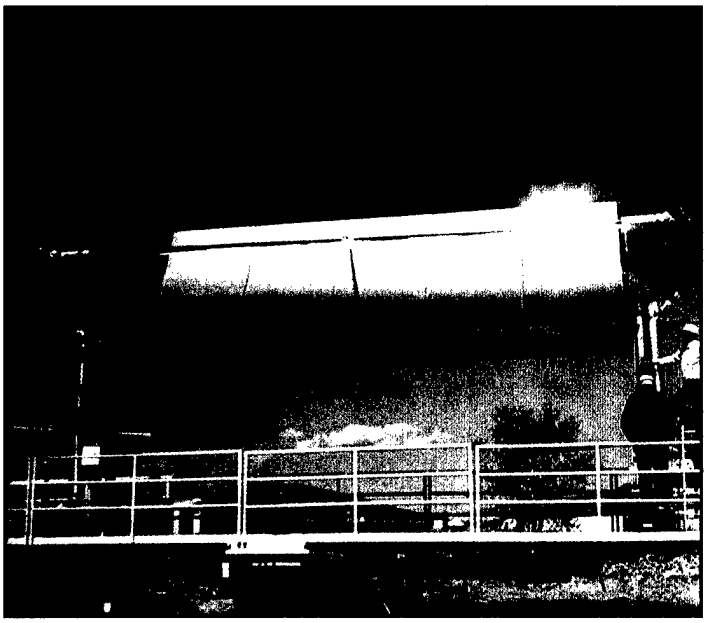
Part of the cost reduction at the SEGS plants is the direct result of a project designed to reduce operation and maintenance (O&M) costs and improve plant efficiency. The project, which ran from 1992 to 1997, was carried out as a partnership between DOE's Concentrating Solar Power Program and KJC Operating Company of Kramer Junction, California, the operator of five of the SEGS plants. Engineers from KJC and DOE's Sandia National Laboratories of Albuquerque, New Mexico, developed cost-reduction strategies for optimizing O&M planning, automating subsystems, and aligning and cleaning collectors. They also worked to improve the reliability of components that are subjected to cyclic (e.g., daytime only) operation and to improve subsystem efficiencies.

KJC Operating Company estimated that the project resulted in a 30% reduction in O&M costs. Its analysis of the most cost-effective improvements indicated a net present value of $42 million in O&M cost savings over the next 20 years of plant operation. In addition, results indicate that many of the cost-reduction activities improve the performance of the plants. The company reported record solar output at its plants during the summer of 1997, crediting the O&M cost-reduction program as a key contributing factor. Furthermore, many of the cost-reduction strategies developed for the SEGS plants are applicable to other solar power technologies, such as dish/engine systems and solar power towers.

Focusing on the Future

Today, DOE continues to provide technical support for existing SEGS projects, to further improve solar technology, and to assess the market potential for trough systems. Sun♦Lab scientists are developing durable, light-weight, and low-cost reflectors for improved energy collection for solar power systems, including troughs. They also are evaluating the use of hybrid trough systems that can take advantage of the higher conversion efficiencies of combined-cycle gas turbines.

Working with their counterparts in industry, Sun♦Lab staff are evaluating the market potential for trough systems and the technical advances necessary to achieve greater market penetration. They are identifying the locations where the best direct normal solar resources exist and are characterizing operational and economic performance at those locations. The Department believes that this continued public-private partnership will allow the United States to maintain its leadership role in solar trough technology.



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Sun♦Lab engineers use a rotating test platform to characterize trough performance independently of the rest of the power plant, allowing optimization of trough components.

For on-line information about the U.S. Department of Energy's Concentrating Solar Power Program, please visit its web site: **http://www.eren.doe.gov/sunlab**

For more information on renewable energy or for additional copies of this brochure, contact the Energy Efficiency and Renewable Energy Clearinghouse (EREC): **1-800-DOE-EREC (363-3732)**

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