Parabolic Trough Solar Thermal Electric Power Plants

Parabolic trough solar collector technology offers an environmentally sound and increasingly cost-effective energy source for the future.

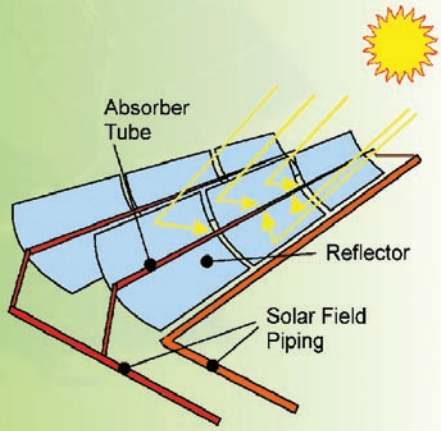
U.S. Energy Supply and Solar Resource Potential

Each year the United States is becoming more dependent on foreign sources of energy. Already more than 50% of the oil consumed in the United States is imported. Environmental pressures to improve air quality and reduce CO_2 generation are driving a shift from coal to natural gas for new electric generation plants. Domestic sources of natural gas are not able to keep up with growing demand, causing supplies of this key energy source to become increasingly dependent on foreign imports as well. The use of natural gas as a source of hydrogen could further aggravate this situation in the future.

Solar energy represents a huge domestic energy resource for the United States, particularly in the Southwest where the deserts have some of the best solar resource levels in the world. For example, an area approximately 12% the size of Nevada (15% of Federal lands in Nevada) has the potential to supply all of the electric needs of the United States. In addition, solar power is often complementary to other renewable power sources such as hydroelectric and wind power. The solar resource is typically higher during poor hydroelectric periods and solar output peaks during the summer whereas wind power typically peaks in the winter. Solar can be complementary to fossil power sources as well. Eskom, the coal dominated power utility in South Africa with one of the lowest power costs in the world, has identified large-scale solar power technologies as a good intermediate load power source for its grid. Although some renewable power technologies provide an intermittent energy supply, large-scale thermal electric solar technologies can provide firm dispatchable power through the integration of thermal energy storage. Thermal energy storage allows solar thermal energy collected during the day to be used to generate solar electricity to meet the utility's peak loads, whether during the summer afternoons or the winter evenings. Although solar energy is abundant and free, it is a diffuse energy source so the cost to harness (or harvest) it with solar collectors can be significant. As a result, electricity generated from solar energy is currently more expensive than power from conventional fossil power plants. However, studies indicate that even at moderate levels of deployment, large-scale solar power can potentially compete directly with conventional fossil generation.

Parabolic Trough Solar Power Technology

Although many solar technologies have been demonstrated, parabolic trough solar thermal electric power plant technology represents one of the major renewable energy success stories of the last two decades. Parabolic troughs are one of the lowest cost solar electric power options available today and have significant potential for further cost reduction. Nine parabolic trough plants, totaling over 350 MWe of electric generation, have been in daily operation in the California Mojave Desert for up to 18 years. These plants provide enough solar electricity to meet the residential needs of a city with 250,000 people. They have demonstrated excellent availabilities and have reliably delivered power to help California to meet its peak electric loads, especially during the California energy crisis of 2000-2001 (near 100% availability during solar hours). Although no new parabolic trough plants have been built in the last 10 years, growing interest for green power and CO_2 reducing power



How parabolic trough power plants work

Parabolic trough power plants use concentrated sunlight, in place of fossil fuels, to provide the thermal energy required to drive a conventional power plant. These plants use a large field of parabolic trough collectors which track the sun during the day and concentrate the solar radiation on a receiver tube located at the focus of the parabolic shaped mirrors. A heat transfer fluid passes through the receiver and is heated to temperatures required to generate steam and drive a conventional Rankine cycle steam power plant.

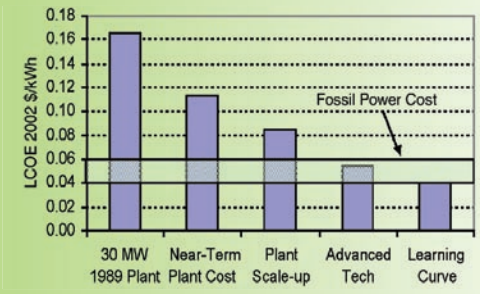
Bringing you a prosperous future where energy is clean, abundant, reliable and affordable

Concentrating Solar Power

Solar Energy Technology Program

A 30 MWe parabolic trough power plant located at Kramer Junction, California.

technologies have helped to increase interest in this technology around the world. New parabolic trough plants are currently under development in support of solar portfolio standards in Nevada and Arizona, and a solar tariff premium in Spain. Although parabolic trough technology is the least cost solar power option, it is still more than twice as expensive as power from conventional fossil fueled power plants at today's fossil energy prices in the United States.



Cost reduction potential of parabolic trough solar power

Reducing the Cost of Parabolic Trough Solar Power

Parabolic trough technology has continued to advance in recent years due to R&D efforts by the operators of the existing trough plants, the parabolic trough industry, and government sponsored research and development in laboratories around the world. Key advances during the last 10 years include:

- A reduction in operation and maintenance costs
- Development of improved trough receivers
- Development of improved parabolic trough concentrators
- Reduced solar field pumping parasites
- Development of a thermal energy storage technology for parabolic trough plants.

Cost Reduction Potential: At current fossil energy prices, large-scale central solar generation must achieve costs in the range of $0.04–$0.06/kWh to directly compete with fossil power alternatives. A recent study has shown that a significant reduction in the cost of energy is possible for parabolic trough solar power. Major cost reductions are possible through the following:

- Plant scale-up: increasing the size of plants to 200 MWe or larger
- Development of advanced technologies: improved thermal storage, concentrator and receiver designs
- Learning curve: cost reductions through plant deployments.

Based on these studies, parabolic trough technology appears to have the potential to begin competing directly with conventional power technologies within the next 5 to 10 years.

A Solar Vision for the Future

Solar technologies have the potential to be major contributors to the global energy supply. The ability to dispatch power allows large-scale central solar technologies to provide 50% or more of the energy needs in sunny regions around the world. In addition, because parabolic trough technology is built from commodity materials such as glass, steel, and concrete, and standard utility power generation equipment, it is possible to scale-up and rapidly deploy new trough power plants. Large-scale solar technologies can provide energy price stability as well as quality jobs to the local community. Solar energy has the potential to become the major new domestic energy resource in the 21st century.

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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.