How Solar Thermal Power Plants Work

Power from the Sun

A solar thermal power plant in principle works no differently than a conventional steam power plant. However, there is one important difference. No harm is done to the environment by burning coal, oil, natural gas or by splitting uranium to produce steam. It is produced solely by the energy that comes from the sun.

In order to achieve the high temperatures required, solar radiation must be concentrated. Parabolic trough collectors represent the most advanced technology for use in doing this. These troughs are more than 1,300 feet (400 meters) in length and are made up of parabolically shaped mirror segments. The troughs track the sun over the course of the day and focus the resulting radiation along the caustic line of the mirrors onto specially coated, evacuated absorber tube receivers.

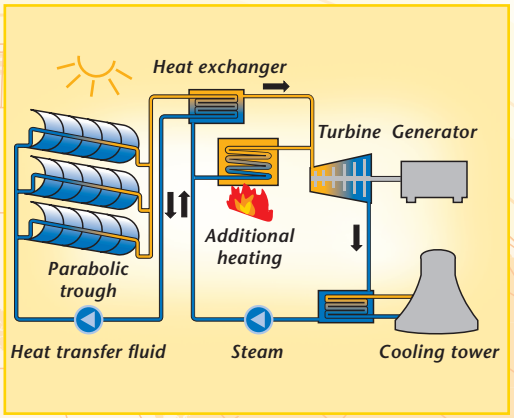
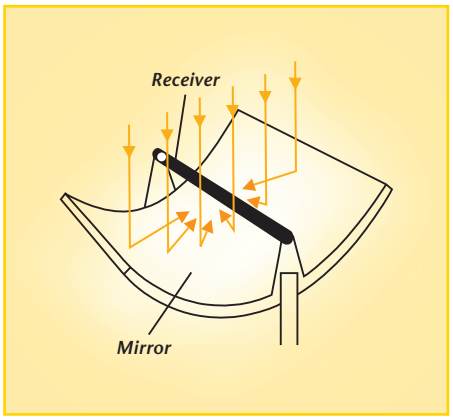


Diagram of a parabolic trough power plant



Parabolic mirrors focus the sun's rays onto the receivers

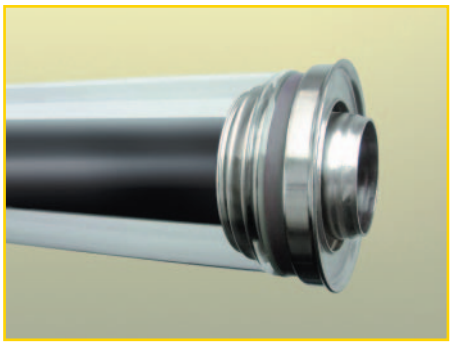
Electricity Can Be Stored

Solar radiation heats up the thermo-oil that flows trough the receiver to a temperature of 400° Celsius so that a downstream heat exchanger is able to generate steam. As in a conventional power plant, the steam is pressurized inside the turbine that drives the generator. Heat storage systems can allow electricity output even if the sun isn't shining.

SCHOTT
glass made of ideas

Receivers as Key Components

In addition to the role that precision optical mirrors play, the evacuated receivers, which are approximately 13 feet (4 meters) in length and are protected by glass covers, also contribute considerably towards the efficiency of parabolic trough power plants. In fact, they convert solar radiation into heat. The envelope tube consists of coated, highly-transparent and robust borosilicate glass.



SCHOTT's new receiver is at the technical forefront

High Energy Efficiency

The weak point with most coatings is that they cease to adhere to borosilicate glass over time. However, SCHOTT's PTR 70 receiver contains a unique, anti-reflective coating that resists abrasion for a longer period of time. At the same time, the coating allows more than 96% of solar radiation to penetrate.

Parabolic trough with receivers

Parabolic trough power plant in Nevada (photo rendering), which is scheduled to begin providing energy to the grid in 2007

The absorber tube, which is made of steel and is located on the inside, must be capable of absorbing a lot of solar radiation without emitting significant amounts of heat. To achieve this, SCHOTT developed a coating that offers an absorption rate of 95%. At a temperature of approximately 400° Celsius, only a maximum of 14% of the total heat is emitted.

The junction between the absorber and the glass envelope tube that keeps the vacuum represents the critical spot on the receiver. Differences in the thermal expansion of the steel tube and the glass envelope tube are compensated by bellows made of metal. In order to seal the glass to the metal, SCHOTT developed a new borosilicate glass that offers the same expansion coefficient as the melted down metal. This seal is now able to stand up to the severe shifts in temperature that result when cool evenings become hot days.

In addition, with these receivers from SCHOTT, the glass-to-metal seals and the bellows are positioned on top of each other rather than after each other, as is usually the case. This enables 96% of the length of the SCHOTT receivers to be put to use, which is 2% more efficient than competitive products. Comparative results obtained by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt – DLR) at the testing site of the Plataforma Solar de Almería in southern Spain have confirmed that the receivers from SCHOTT deliver a 2% increase in efficiency.

Solar
SCHOTT-Rohrglas GmbH
Erich-Schott-Strasse 14
95660 Mitterteich
Germany
Phone: +49 (0)9633/80-291
Fax: +49 (0)9633/80-757
E-mail: info.solarthermal@schott.com
www.schott.com/solar

SCHOTT
glass made of ideas