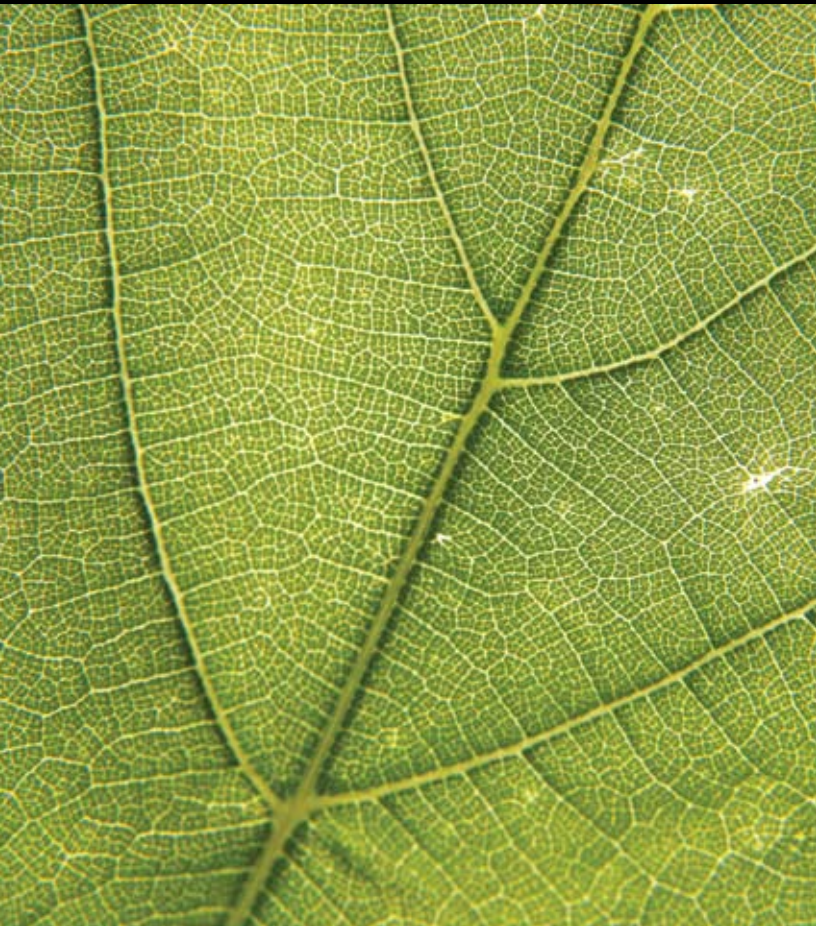




# Solar Industry Report:

A Trend Towards Solar Thermal



### ➤ Solar Technology

Solar thermal (Concentrated Solar Power) is a technology that utilizes heliostats (optical mirrors) to focus sunlight on electronic receivers. This heats up the transfer fluid, which then generates steam to drive a conventional turbine engine.

### ➤ Market for Solar Thermal

United States solar energy market has seen fantastic growth over the last five years. There have been an increasing number of solar thermal orders in the last few months. Companies are turning towards solar thermal energy as a cost-effective way to reduce dependence on increasing fossil fuel prices, as well as to meet the renewal portfolio standards (RPS) that call for a certain percentage of renewable energy by a certain time. Upon comparison with Photovoltaic technology, solar thermal is more scalable and tends to be at a lower cost.

### ➤ Utilities Companies Highly-Demanded CSP

Utilities firms are looking at concentrated solar power (CSP) as the preferred alternative energy technology. Among the solar thermal players is eSolar's "power tower" technology that uses its patent-pending heliostats design to effectively focus solar heat to thermal receivers. eSolar has signed a Power Purchase Agreement (PPA) with Southern California Edison to construct 245mW solar thermal complex in the Antelope Valley, California. This project could represent USA's first new solar tower technology.

### ➤ Installed Capacity of Solar Thermal Can Reach 45-50 GW by 2020

European Solar Thermal Electricity Association (ESTELA) estimated that solar thermal installations in the EU would reach 30GW by 2020. At the same time, Solar Millennium believes that the US market, alone, expects its solar thermal installed capacity to rise to 15-20GW by 2020. Installations of CSP plants on less than 0.3 percent of the desert areas of North Africa and the Middle East could generate enough electricity to meet the needs of these two regions plus the European Union.

### ➤ US Investment Tax Credit (ITC)

As part of the Emergency Economic Stabilization Act of 2008, the US government provides an 8-year extension of the commercial and residential solar investment credit. This plays a critical role in the demand for solar thermal as it reduces the overall tax liability for individuals or businesses by 30% of the installed cost with no monetary cap. Trends in solar thermal revolve more around mandates and financing than technology; thus the ITC provides the necessary financial support to ensure the growth of this emerging technology.

### ➤ The Three Popular Solar Thermal Technology Structures:

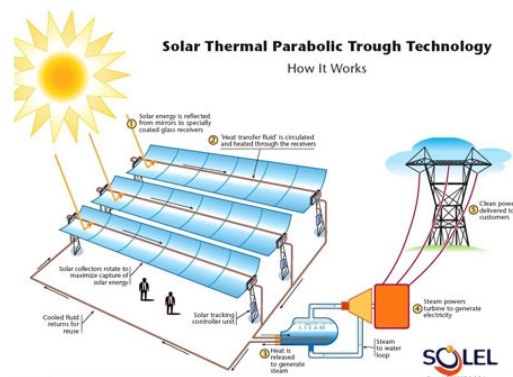
✓ **Dish Concentrator System:** utilizes parabolic dishes to concentrate sunlight on a thermal receiver/absorber at up to 60 times the sun's normal intensity. Using hydrogen or helium as a transfer gas, the receiver sends the heated gas to a Stirling engine generator, which transforms the heat energy into electricity. Dish concentrators do not utilize

any tracking system to follow the sun, as they are designed to collect both direct and diffuse light.

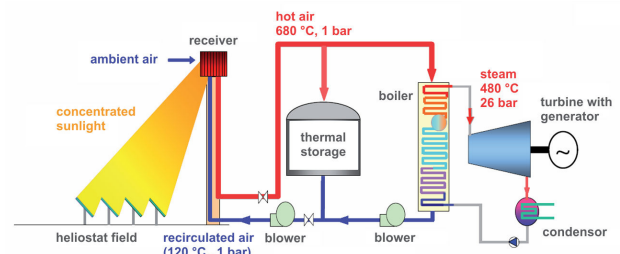
✓ **Parabolic Trough System:** uses curved mirrors as solar collectors to reflect sunlight onto a pipe running along inside of the curved mirror surfaces. A transfer fluid, typically oil, flowing through the pipes is heated along focal lines or focal points, and then sent to a gas turbine where electricity is generated.

✓ **Solar Power system:** uses heliostats to focus sunlight on a receiver located at the top of a tower. The receiver contains a fluid (molten nitrate sulfate) that transfers heat to drive a steam turbine, and has enough excess heat left over to store for a few days, if necessary.

### Basic concept of parabolic trough



### Basic concept of power tower technology

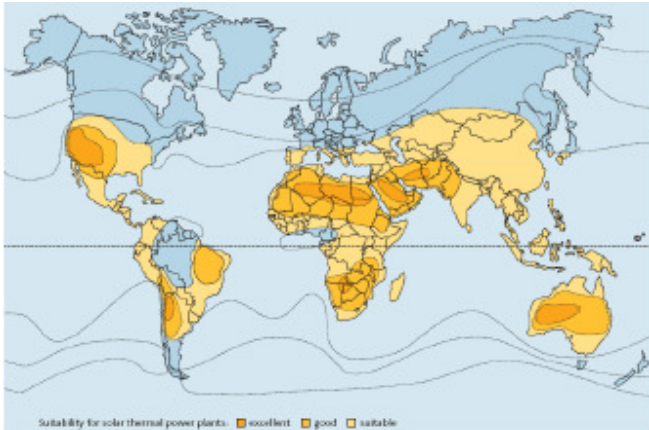


### Major Opportunities in the US Southwest

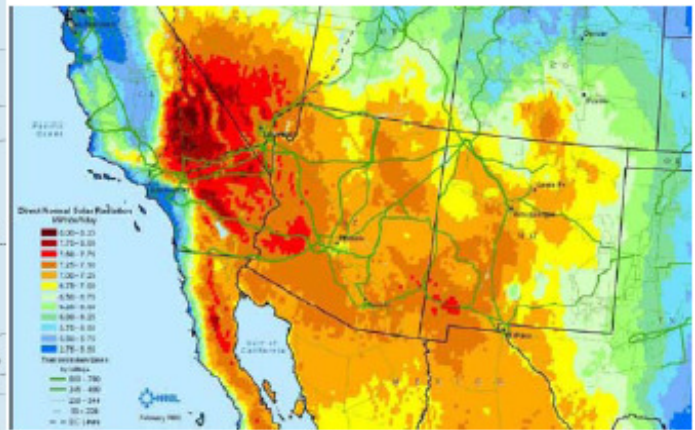
U.S. Southwest has the highest amount of sunshine and open land, resulting in numerous suitable sites for solar thermal power plants. According to Abengoa Solar, U.S. southwest can support over 11TW of solar thermal, which is enough to support a capacity of more than 6 times the current electrical demand in the United States.

In the southwestern United States, the cost of electricity from CSP plants (including ITC) is about 13–17¢ per kilowatt-hour, meaning that CSP with thermal storage is competitive today with simple-cycle natural gas-fired power plants. The U.S. Department of Energy aims to reduce CSP costs to 7–10¢ per kilowatt-hour by 2015 and to 5–7¢ per kilowatt-hour by 2020, making CSP a competitive alternative to fossil-fuel-based power sources.

## Suitable Locations for Solar Installations



Source: Solar Millennium



National Renewable Energy Lab

## Solar Thermal Companies

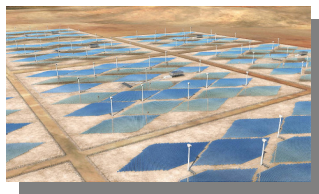
### eSolar (Pasadena, California USA) – Private

Privately held company based in Pasadena, who has received \$130 million from investors including google.org, Idealab, and Oak Investment Partners. eSolar has patent-pending small, mass-manufactured, and pre-fabricated heliostats design that can be installed faster than any competitive CSP solutions while using minimal skilled labor. Its **46MW module power unit design (requires only 160 acres)** consists of 16 towers (with two heliostats field for each tower), a turbine and a steam condenser.



To build a 100MW power plant, it would occupy around 350 acres of land. eSolar's small, mass-manufactured

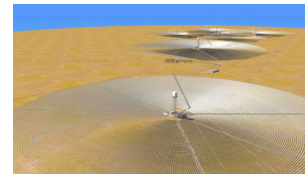
heliostats (1 square meter design vs. competitors' much larger design) and its modular layout enable low-cost installation, with minimal use of concrete and steel. eSolar can construct multiple 46 MW units to scale to any size to meet customer needs. Its advanced software and high precision flux targeting enable 40% solar conversion efficiency, which is significantly higher than the competitors' average. At the same time, eSolar offers the only global development platform for the lowest installed cost of concentrated solar energy system. The firm signed a PPA with Southern California Edison to build a 245MW power plant in the Antelope Valley. This could be the nation's first new power tower solar technology.



### BrightSource Energy (Oakland, CA USA) – Private

BrightSource is a privately held company based in California. The company raised \$160 in investments from VantagePoint Venture Partners, Google.org, BP Alternative Energy, Chevron

Technology Ventures, StatoilHydro, Draper Fisher Jurvetson, DBL Investors, and Black River. Similar to eSolar, the firm utilizes power tower technology to generate electricity. However, its heliostats are relatively larger than eSolar's. Each solar power cluster generate about 33MW. A typical BrightSource power plant, generating 100MW, will consist of 3 solar power clusters and occupy between 600-800 acres. BrightSource signed PPAs with Pacific Gas & Electric company (PG&E). The first three contracts are for a total of 500 megawatts (MW) to be supplied from three solar thermal electric generating projects. PG&E may sign two options for an additional 400 MW, which will bring the total amount of power purchased under these five agreements to 900 MW.



### Ausra (Palo Alto, CA USA) – Private

Private manufacturer and developer of solar thermal technology based in the US. It was funded by Khosla Ventures and Kleiner Perkins Caufield & Byers. Ausra's Compact Linear Fresnel Reflector (CLFR) focus sunlight onto a tube, which heats up water into steam that drives the turbine generators. Ausra signed a PPA of one square mile (640 acres) 177MW power plant (361acres/ 100MW) in San Luis Obispo, Ca. The firm claims that its technology is the lowest cost with widest supply of available components.



### Abengoa (Spain) – Public

Public renewable firm, with focus on solar, biogas, water and waste management, telecommunication, and transportation, listed in Spain. It has both photovoltaic and concentrated solar power technology. As for its solar thermal (CSP) technology, Abengoa utilizes both parabolic trough and power tower system. Abengoa has solar thermal projects in Spain, the US,

and Africa. Its power tower technology faces a big disadvantage due to its requirement of level surface and a large water source. With high temperature and good yield, Abengoa's technology has 25% solar conversion efficiency.



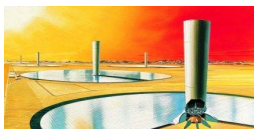
### Solel (Israel) – Private

A privately held company based in Israel who focuses parabolic trough technology. The firm is a solar thermal power plant developer in Spain and the US. In July 2007, Solel signed a PPA agreement with Pacific Gas and Electric (PG&E) to build a 553MW solar power plant in the Mojave Desert. The power plant would occupy 9 square miles (5760 acres) and would cost the firm about \$2 billion, which is somewhat high when compared to conventional power plants. The company also develops water heating for industries, residential, pools, and hospitals.



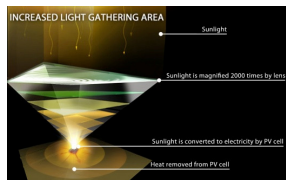
### Solar Millennium (Germany) – Public

Solar Millennium is a German solar power plant developer with a \$500 million market cap. It focuses on 2 technologies for solar thermal: **parabolic trough** and **solar chimney**. The company covers different business sectors of solar thermal power plants, including project development, technology, construction, operation and ownership. On November 2007, Flagsol, a technological subsidiary of Solar Millennium, received a contract for the design and supply of the solar field for 150MW hybrid power plant in Egypt.



### Sunrgi (Los Angeles, CA) – Private

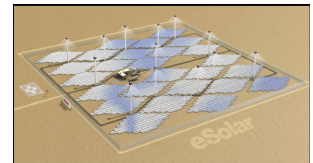
A US based designer and developer of solar thermal system. It leads the development of the "Xtreme Concentrated Photovoltaics™", which utilizes the concept of using a magnifying glass to concentrate sunlight down to a small, bright, hot spot of light. By doing so, Sunrgi is able to concentrate sunlight that is 1600 times brighter than the sun. It has 37% solar conversion efficiency. Sunrgi's extreme concentrated solar, heat removal system and solar tracking capability lead to the firm's claim that it is possible to produce large amounts of electricity from sunlight at the cost of 5¢ per kilowatt-hour. Sunrgi is still in the process of conducting field tests on this "Xtreme Concentrated Photovoltaics™" technology.



### eSolar's Competitive Advantage

➤ Patent-pending heliostats design (small, mass-manufactured, and prefabricated) that can be deploy and install faster than any competitive CSP solutions.

- Has 46MW module power unit design – 16 towers with 2 heliostats field each, a turbine, and a steam condenser.
- Module field layout gives the ability to stack power units side by side and scalable up to any size.
- Requires less land – 350 acres of land per 100 MW power plant.
- Minimal use of skilled labor required for installations.
- Reduce dependence on expensive concrete and steel.
- Higher solar conversion efficiency (40%) than the average in the industry.
- Focus mirrors using advanced computer software, elegant algorithms, and dual-axis sun-tracking control.
- Offers the only global development platform for lowest installed cost of concentrated solar energy system.



### Southern California Edison Contracts with eSolar for Solar Power Tower

#### 245 Megawatt Project is USA's First for New Solar Tower

ROSEMEAD, Calif., June 3, 2008 — Southern California Edison (SCE) today signed a contract to procure an additional 245 megawatts of solar power for its customers with Pasadena,



Calif.-based eSolar in the nation's first commercial effort using power tower solar thermal technology. The project, which will be built in the

Lancaster area of California, is expected to begin delivering energy in 2011, with a total of 105 megawatts of renewable solar power by 2012, ramping up to 245 megawatts by 2013. SCE is currently the nation's leading purchaser of solar energy, buying more than 90 percent of U.S. production.

"Solar is the great untapped energy resource for California — it's renewable and plentiful," said Stuart Hemphill, SCE vice president, Renewable and Alternative Power. "We rely on innovative companies such as eSolar to help expand our industry-leading portfolio and to secure access to the most promising technology solutions."

#### SCE leads the nation in renewable

SCE buys for its customers more than 90 percent of all solar energy produced. In 2007, the utility procured about 12.5 billion kilowatt-hours of renewable energy, more than any other utility or state. Renewable energy comprises about 16 percent of SCE's total energy portfolio. SCE currently has sufficient contracts in place that, when delivering, will meet 20 percent or more of its customers' energy needs with renewable energy. The current portfolio includes:

- 1,025 megawatts from wind.
- 906 megawatts from geothermal.
- 354 megawatts from solar.
- 174 megawatts from biomass.
- 226 megawatts from small hydro.

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