technology today

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Concentrating Solar Power = Clean Inexpensive Electricity

If we can learn how to capture and store just a fraction of the 85,000 terawatts of energy that our sun provides us yearly, we could meet all our energy needs without ever using another drop of fossil fuel. That said, solar energy today supplies far less than 1% of the electricity that we now use.

To generate electricity using solar energy at a cost equal to or lower than that of coal, you need a paradigm shift. You need to use inexpensive components that can be quickly assembled, in weeks or months rather than years, into functional power plants that almost run themselves. The engineers and technologists at eSolar, and the company's key investor, Google, believe they are now ready to build rapidly deployable concentrating solar power (CSP) plants throughout the world. They expect their CSP plants to eventually produce electricity at coal-electricity-generated prices.

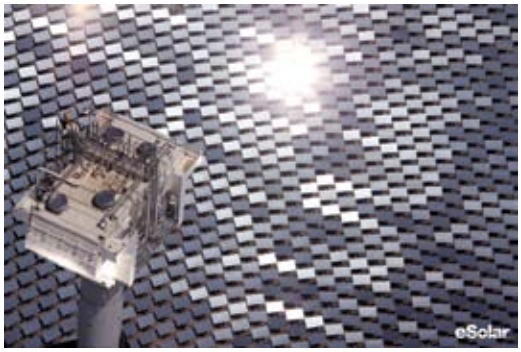

Photo 1 (left)—Mirrors focus solar heat on a boiler, generating steam that spins a generator.

Photo 2 (below)—Workers installing mirrors

Photos courtesy eSolar

A concentrating solar power plant uses relatively inexpensive components to generate electricity. The concept behind CSP is easy to understand: Mirrors are used to focus the sun's heat onto a boiler. This solar heating is intense enough to generate steam, which spins an electric generator to produce electricity. (See Photo 1.)

eSolar didn't originate the concentrating solar thermal (CST) power concept. What it has done is taken a 38-year-old technology and changed its name (from CST to CSP), and, most important, it removed CST's expensive components and high cost of construction. In the past, CST builders created very large towers that were surrounded by very large, stationary parabolic mirrors. The location of each mirror had to be carefully planned in relationship to the movement of the sun at the specific longitude and latitude of the construction site. Then, surveyors had to determine the exact location and angle of installation of each mirror. High-skilled labor was required to carry out each construction and installation task. If the mirrors were off just a couple of degrees, they would downgrade the amount of sunlight reflected to the tower and reduce the output of the entire system. Let's look at how eSolar spins CST technology into a CSP facility.

eSolar has designed its power plants so they can be mass-produced in robotic factories. At the end of the assembly lines, all prefabricated parts are packaged into containers for shipment to the final construction site. By mass-producing power plants, eSolar hopes to take advantage of what economists call *economy of scale*. In other words, the company hopes to drive down the fixed costs of building power plants by increasing the number of power plants that it builds and also by locating its factories in low-wage nations.

When an eSolar power plant arrives on site, it will only take a few months to erect its central tower and set up the entire facility. The racks

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that will hold the mirrors set up quickly and can be off location by a foot without reducing the effectiveness of the system.

The mirrors, which concentrate sunlight onto the central tower, are small enough that just two workers can install them on their special racks. (See Photo 2.) Each mirror's location doesn't have to be carefully plotted, since a special computer program tells the mirrors' power drive systems when to turn and how much to tilt to stay in proper alignment with the sun throughout the day. (See Photo 3.) The mirrors are called *heliostats* because computers control them to target and direct sunlight to their assigned central tower.

eSolar's first demonstration power plant is named Sierra SunTower. It is up and running in Lancaster, CA. It has 24,000 mirrors, two towers, and produces five megawatts of electricity. This is enough electricity to power 4,000 homes. eSolar now has a number of planned projects in the U.S., India, and China. When this column went to press, the total electricity output of these projects was expected to be about 3,000 megawatts. You can watch videos shot at the Sierra plant at www.esolar.com/our_projects/videos.html.

Photo 3—Computers control mirror tilt.

Recalling the Facts

1. Describe how a concentrating solar power plant generates electricity.
2. How does a CSP power plant differ from a CST power plant?