

# Big steps forward

The year 2005 was a turning point for the concentrating solar power (CSP) industry in the U.S. A few surprising announcements in 2005 led to the construction of the first new CSP plant – Nevada Solar One – which has been online since June 2007.

In addition, nine other plants have been announced, proposed, or are being built since that time. Meanwhile, several start ups have pushed into the market.

**B**efore 2005, everyone was saying, forget solar, it's too expensive,« says Paul O'Hop, a partner with the international law firm Squire, Sanders and Dempsey, which specialises in renewable energy. For many years, only nine CSP the so called Solar Electric Generating System (SEGS) plants – located in California and built by Luz International – were up and running. The owners went bankrupt and in early 2005, FPL Energy of Florida, one of the leading clean energy providers in the U.S., purchased a stake in some of the plants, becoming the largest operator of CSP in the U.S., with 310 MW.

And then came the big surprise. In August 2005, the project developer Stirling Energy Systems, Inc. (SES), based in Arizona, announced that it had signed an agreement with the electric utility Southern California Edison (SCE) that would result in construction of a 4,500 acre (1,821 hectare) CSP station in southern California that would become the world's largest solar facility, with a capacity of 500 MW, expandable to 850 MW. »This was huge. It shook up the market to have a company like Stirling doing a big CSP project. Once you start doing big projects, there are economies of scale,« O'Hop says. About the same time, the California utility Pacific Gas & Electric (PG&E) announced that it had signed an agreement with Solel-MSP-1, a subsidiary of Israel-based Solel Solar Systems Ltd., to purchase 553 MW of solar power from the Mojave Solar Park. »The year 2005 we saw a big step up,« O'Hop adds.

Two years later, ten plants are online with a total output of 418 MW. They include the SEGS plants with a capacity of 354 MW, and Nevada Solar One with 64 MW. Developers and utilities have either announced, proposed or are now building nine additional plants with a total output of about 3,000 MW (see table on page 42). All of the activity is taking place in sun-kissed California and the Southwest. **A number of factors contributed to these big steps in the industry, says Michael Fritsch, president & chief operating officer of the California based Confoe Inc., which helps solar manufacturers build their manufacturing plants more efficiently.**

### Solar energy during peak hours

Many states by 2005 had renewable portfolio standards in place, chief among them California. California's aggressive Renewable Portfolio Standard (RPS), which took effect in January 2003, requires utilities to increase sales of renewable energy resources by at least 1 % of retail sales per year so that 20 % of retail sales are served by renewable energy by 2010. The governor has set a long-term goal of 33 % by 2020. Twenty-one states and Washington, D.C. now have RPS in place (see [www.dsireusa.org](http://www.dsireusa.org)). Arizona's RPS calls for 15 % renewable energy by 2025.

**Also driving the growth is the U.S. Department of Energy's (DOE) goal of installing 1,000 MW of CSP in the Southwest by the year 2010, with the hopes of driving prices down, Fritsch says.** »This level of deployment, combined with research and development to reduce technology component costs, could help reduce CSP electricity costs to 0.07 US\$ct/kWh,« defines the U.S. DOE's National Renewable Energy Laboratory (NREL). »At this

cost, CSP can compete effectively in the Southwest's energy markets.« NREL is partnering with the Western Governors' Association to promote CSP in Arizona, California, Colorado, New Mexico, Nevada, Texas and Utah, which have the best solar resources in the U.S., NREL says.

In these sunny states, a big plus of CSP is its ability to provide energy during peak hours. »One of the great things about solar: When it's strongest in California, it correlates with peak energy demands,« PG&E spokeswoman Jennifer Zerwer points out. »CSP is also great in terms of providing utility-scale solar.« That's important to helping meet the requirements of California's RPS. »We're working to meet California's RPS requirements for 2010. As part of our commitment, we are looking at a variety of technologies, and solar thermal holds a lot of promise,« Zerwer adds.

Unlike photovoltaic systems – which produce electricity directly from sunlight – CSP technologies use the sun's heat to produce electricity in much the same way that conventional power stations create it. A series of mirrors or parabolic troughs focus the sun's rays on a central receiver containing a liquid. As this liquid heats up, it passes through a heat exchanger and generates steam, which is then used to drive a turbine. Solar thermal's ability to use a traditional turbine is a big plus for the technology, says John O'Brien, an associate in the energy group with financing provider KeyBanc Capital Markets. And that's not the only plus. »It's proven technology, you can use a traditional turbine, you can scale it up easier than PV,« he says. Southern California Edison (SCE) chooses CSP for similar reasons as PG&E. SCE likes CSP's ability to produce power when customers most need it, explains Vanessa McGrady, a SCE spokeswoman. In the utility's efforts to meet the requirements of the California RPS, SCE is technology-neutral and does not choose one versus another, she says. »With SCE's interest in renewable energy, it is more likely that SCE would contract with one technology in addition to another, rather than choosing one versus another.«

FPL Energy, which has said it will invest US\$ 1.5 billion in new solar plants in California and Florida, is interested in CSP in large part because it's becoming more cost-competitive, says Steve Stengell, spokesman for FPL Energy. FPL owns 147 MW of the 310 MW of the SEGS plants (SEGS 3-9) under its operation. »If you look at wind power, it's still the most economic renewable resource out there today,« explains Stengell. »But solar is becoming more cost competitive. The price is moving in the right direction.

### Challenges for new players

Given the potential for CSP to help utilities meet the requirements of state RPS, diversify their energy supply and meet growing electricity demand, a number of new players have entered the field in the U.S. They include Sky Fuel, Energy Innovations, Bright Source Energy, Ausra, Acciona (based in Spain), and a Colorado-based subsidiary of AbengoaSolar (see box on page 44).

However, these companies – and the utilities working with them – face three main challenges, points out Bill Felsher, vice president of project sales for Sky Fuel,

Israeli parabolic trough technology: The California utility Pacific Gas & Electric announced that it had signed an agreement with the manufacturer Solel to purchase 553 MW of solar power from the Mojave Solar Park.

Photo: Pacific Gas & Electric Company

Name of project	Location	Type of CSP	Capacity	Dates	Partners	References
<b>Plant in operation</b>						
Solar Energy Generating Systems (SEGS)	San Bernardino County and Mojave Desert, California	parabolic trough	9 plants totalling 354 MW	online; commissioned between 1984 and 1990	owned by Sunray Energy Inc (SEGS I & II) and FPL Energy (SEGS III-IX)	<a href="http://www.energy.ca.gov/siting/solar/index.html">www.energy.ca.gov/siting/solar/index.html</a> <a href="http://www.fplenergy.com/portfolio/contents/segsviii.shtml">www.fplenergy.com/portfolio/contents/segsviii.shtml</a>
Nevada Solar One	Boulder City, Nevada	parabolic trough	64 MW	online June 2007	U.S. Department of Energy; Acciona Energy & National Renewable Energy Laboratory; Solargenix Energy (now a subsidiary of Acciona)	<a href="http://www.ens-newswire.com/ens/jun2007/2007-06-05-09.asp#anchor2">www.ens-newswire.com/ens/jun2007/2007-06-05-09.asp#anchor2</a>
<b>Application for construction (AFC) filed</b>						
Carrizo Energy Solar Farm	San Luis Obispo County, California	compact linear fresnel reflector	177 MW	AFC filed October 2007	Carrizo Energy LLC; Pacific Gas & Electric; Ausra	<a href="http://www.news.com/8301-11128_3-9810199-54.html?part=rss&amp;subj=news&amp;tag=2547-1009_3-0-10">www.news.com/8301-11128_3-9810199-54.html?part=rss&amp;subj=news&amp;tag=2547-1009_3-0-10</a> <a href="http://www.energy.ca.gov/siting/solar/index.html">www.energy.ca.gov/siting/solar/index.html</a>
Unnamed	Imperial Valley, San Bernardino County, California	dish	300 MW with contract options expanding to 900 MW	20-year agreement signed October 2005; AFC filed August 2007; under review	Stirling Energy Systems; San Diego Gas & Electric (SDG&E)	<a href="http://pesn.com/2005/10/12/9600186_Stirling_300MW">pesn.com/2005/10/12/9600186_Stirling_300MW</a> <a href="http://www.energy.ca.gov/siting/solar/index.html">www.energy.ca.gov/siting/solar/index.html</a>
Victorville 2 Hybrid Power Project	Victorville, California	parabolic trough	50 MW	AFC filed February 2007; under review	City of Victorville	<a href="http://www.energy.ca.gov/siting/solar/index.html">www.energy.ca.gov/siting/solar/index.html</a>
Ivanpah Solar	Ivanpah, San Bernardino County, California	power tower	3 plants totalling 400 MW	AFC filed September 2007	Solar Partners / Bright Source	<a href="http://www.brightsourceenergy.com/BrightSource_Press_Release_AFC_09-07-2007.pdf">www.brightsourceenergy.com/BrightSource_Press_Release_AFC_09-07-2007.pdf</a> <a href="http://www.energy.ca.gov/siting/solar/index.html">www.energy.ca.gov/siting/solar/index.html</a>
<b>Projects announced</b>						
Mojave Solar Park	Mojave Desert, California	parabolic trough	553 MW	agreement signed July 2005; fully operational 2011	Solel with Pacific Gas and Electric Company	<a href="http://www.ynetnews.com/articles/0,7340,L-3430085,00.html">www.ynetnews.com/articles/0,7340,L-3430085,00.html</a>
Unnamed	Mojave Desert, California	dish	500 MW with option to expand to 850 MW	agreement signed August 2005; initial phase online 2009; projected completion 2012	Stirling Energy Systems & Southern California Edison	<a href="http://pesn.com/2005/08/11/9600147_Edison_Stirling_largest_solar">pesn.com/2005/08/11/9600147_Edison_Stirling_largest_solar</a> <a href="http://www.stirlingenergy.com/breaking_news.htm">www.stirlingenergy.com/breaking_news.htm</a>
Unnamed	to be determined, Nevada	dual axis tracking tower / thin-film lenses	100 MW	announced February 2006	International Automated Systems Inc. & Solar Renewable Energy-1 LLC	<a href="http://www.iaus.com/news02092006.aspx">www.iaus.com/news02092006.aspx</a>
Barstow Solar Thermal Electric Hybrid	Barstow, San Bernardino County, California	parabolic trough	59 MW	development commenced October 2007; permitting phase	Solar MW Energy Inc. & Ecosystem Solar Electric Corporation	<a href="http://www.stirlingenergy.com/breaking_news.htm">www.stirlingenergy.com/breaking_news.htm</a>
Unnamed	to be determined, Florida	compact linear fresnel reflector	initial capacity 10 MW expanding to a total of 300 MW within 4 years	announced September 2007; projected online in 2011	Florida Power & Light; Ausra	<a href="http://www.sptimes.com/2007/09/27/State/FPL_unveils_plans_for.shtml">www.sptimes.com/2007/09/27/State/FPL_unveils_plans_for.shtml</a>

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*Source: own research*

which is based in New Mexico. In November Sky Fuel was awarded a US\$ 435,000 grant to develop its advanced CSP system, called the linear power tower, for utility-scale power plants. The first challenge, says Felsher, is obtaining components in a timely fashion.

»The natural resource is not the limiting factor; it's how fast you can build these plants. The limiting factor is the supply chain for the critical components,« he explains. In fact, a September 2007 study by Black and Veatch Corporation for Arizona Public Service Company and Tucson Electric Power Corporation says that solar resources in Arizona are much larger than the potential near-term demand. The main factor limiting CSP development is equipment availability, the report found. For Sky Fuel, critical equipment includes mirrors and collection elements, specifies Felsher. Sky Fuel acquires its heat collection elements overseas. It will make its own mirrors in the U.S. using U.S. equipment. »The capacity of the industry to manufacture those two things is limiting,« he adds.

What's more, Sky Fuel expects that it will become more difficult in the future to find skilled workers. »It's not trivial to be able to capture the sun and focus it and collect heat,« Felsher says. »We need human resources with expertise in designing collectors and power plants. There are not many people who can do that.«

### »Transmission is a stumbling block«

In addition, the solar industry – like the renewable energy industry in general – faces transmission constraints. »Virtually all new renewable projects represent transmission challenges, as most projects are far away from where the energy is consumed,« states SCE's McGrady. »Also, the interconnection queue is congested, which is leading to delays in renewable project schedules.« In fact, she says, it's unclear when SCE's renewable energy projects will come online, given the transmission roadblocks.

To help relieve the problem, the California Public Utilities Commission in March approved SCE's application to build segments 2 and 3 of the Tehachapi Renewable Transmission Project. When completed, the project will include new and upgraded high-voltage transmission lines with the capacity to deliver 4,500 MW of electricity from wind farms and other generating companies that are proposed for northern Los Angeles and eastern Kern counties in southern California. To help move electricity from its Mojave Solar Park to customers PG&E will use some of the transmission infrastructure originally built for the now dormant coal-fired Mojave Generation Station, PG&E announces.

In addition, California has established a renewable energy transmission initiative aimed at developing a

## Plans of new players in the sector of concentrating solar power in the U.S.

The Spanish utility **Acciona** is the owner and operator of the Nevada Solar One project, online since June. »We look forward to additional projects in the future,« says Lena Stinsa, a spokeswoman for Acciona Energy North America Corporation.

[www.acciona.com](http://www.acciona.com)

**Abengoa Solar's** U.S. unit, based in Colorado, is actively pursuing projects, says Hank Price, vice president of technology development. The company with a Spanish mother is bidding on utility request for proposals, he adds. »We came here because the market is growing in the U.S.«

[www.solucar.es](http://www.solucar.es)

Project developer **Ausra**, based in California, has filed with the California Energy Commission an application to build a 177 MW plant in Carrizo, central California. Construction will begin in 2009, with the plant online in 2010. In November, Ausra signed a power purchase agreement with PG&E, according to Emily Chamberlin, a spokeswoman for Ausra. »We have additional plants in the planning process,« she says.

[www.ausra.com](http://www.ausra.com)

In September the Californian **Bright Source Energy Inc.**, filed with the California Energy Commission an application to develop a 400 MW solar power plant site. Bright Source plans to build three separate solar plants on a site in California known as Ivanpah, about five miles southwest of Primm, Nevada. The plant will use »Distributed Power Tower« solar field technology developed by Luz II in Israel, a wholly owned subsidiary of Bright Source Energy. The company is negotiating with California utilities for the purchase of the power. Charlie Ricker, senior vice president for marketing and business development, declined to discuss projects other than the Ivanpah plant.

Bright Source Energy was founded as Luz II in 2004 by Arnold Goldman and renamed to Bright Source in 2006. Goldman was the founder and CEO of Luz International Ltd., which built the nine SEGS plants in the 1980s in California.

In 2004, Goldman reassembled a number of members of the original Luz International executive and technical team and founded Luz II. In 2006, the

name of the company was changed from Luz II, Inc. to Bright Source Energy, Inc. The Luz II name was retained by Bright Source's wholly owned subsidiary in Israel, which is responsible for engineering and development, and the supply of solar fields for BrightSource plants.

[www.brightsourceenergy.com](http://www.brightsourceenergy.com)

The start up engineering group **Energy Innovations, Inc.**, based in California, is developing a concentrating PV system that is not yet in commercial operation, says Steven Chadima, executive vice president of external affairs.

[www.energyinnovations.com](http://www.energyinnovations.com)

**FPL Energy**, one of the leading suppliers of clean energy and owner of portions of the SEGS plants, plans to invest US\$ 1.5 billion in new CSP plants in Florida and California over the next seven years, according to Stengell. »We will start out with 10 MW projects and will work up to 300 MW projects,« he announces. »We're looking at a couple of locations in southern California and a couple in the southwest,« he says.

[www.fplenergy.com](http://www.fplenergy.com)

New Mexico-based start up **Sky Fuel** received the U.S. Department of Energy's (DOE) grant to develop a highly efficient and low-cost parabolic trough concentrator. The linear power tower called »Sky-Trough« utilises a lightweight space frame and a glass-free reflective surface that significantly reduce the cost of the solar thermal system, says a company press release. The DOE grant provides funding for the next generation CSP system.

[www.skyfuel.com](http://www.skyfuel.com)

**Stirling Energy Systems, Inc. (SES)**, a developer and owner of alternative energy solutions, is developing the 500 MW CSP plant in the Mojave Desert. Laura Hecker, a spokeswoman for Stirling, declined to provide details about the status of the project or about the company's future plans.

[www.stirlingenergy.com](http://www.stirlingenergy.com)

comprehensive plan for addressing the transmission requirements of renewable energy, says Adam Browning, executive director of California's The Vote Solar Initiative. »Solar will have a seat in this process,« he declares. New Mexico has a renewable energy transmission authority. »The idea here is to figure out ways to develop the industry most sensibly,« he says.

FPL Energy's Stengell agrees that transmission is a stumbling block. »This is especially true if you're looking at places like California that have transmission challenges to begin with. It's an issue for us whether we're developing a wind project or solar projects,« he differentiates. However, solar has one advantage over wind power when it comes to finding transmission, specifies KeyBanc Capital Markets' O'Brien. If developers build solar thermal plants along with natural gas-fired plants, they can maintain a flat level of output that makes it easier and less expensive to obtain transmission. »With wind, the wind could or could not be blowing. So when you're working with transmission, it's harder. You have to reserve space on a line, and you might not have the electricity. If you co-site solar with natural gas, you can have a good idea of how much energy you might have,« adds Pat Stanton, vice president of clean energy markets for the Massachusetts-based Conservation Services Group, »a power plant project that can be dispatchable – meeting the grid demand any time of day – is more attractive. I hear this from project developers as an argument for supporting large solar thermal projects.«

Along with transmission, the price of CSP is still a roadblock to large-scale implementation. However, many industry players remain confident that the price will drop to competitive levels in the near future. »We're optimistic that the costs are going to continue to move in the right direction and that we're going to see some new solar built,« states FPL's Stengell.

However, Fritsch says that CSP scores well against other technologies when utilities consider its leveled cost of energy. »This makes it an attractive RPS choice,« he points out. The DOE projects the leveled cost of large photovoltaic installations to be 0.22 US\$/kWh in 2007 and between 0.08 and 0.10 US\$/kWh in 2020, CSP, on the other hand, is expected to be less expensive – 0.20 US\$/kWh in 2007 and 0.05 US\$/kWh in 2020. »We've also seen estimates that the leveled cost of energy from a CSP plant in the first deployment phase is estimated to be 148 US\$/MWh, which is lower than a simple cycle natural gas plant at 168 US\$/MWh,« Fritsch adds.

In fact, CSP is seeing a »renaissance« especially in the sun-kissed Southwest, according to a recent study from Emerging Energy Research, a research and advisory firm analysing clean and renewable energy markets. CSP is the fastest growing utility-scale renewable energy alternative after wind power. Up to US\$ 20 billion will be invested in solar CSP over the next five years, the study says. ✨

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### Further information:

**Solel Solar Systems Ltd:** [www.solel.com](http://www.solel.com)

**Southern California Edison (SCE):** [www.sce.com](http://www.sce.com)

**The Vote Solar Initiative:** [www.votesolar.org](http://www.votesolar.org)

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