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THE SOURCE OF POWER

The creation of large-scale photovoltaic power plant: the move to thin film modules

by David Owen
19.01.2009



Every day, mankind consumes as much energy as it took the earth 1,370 years to store. The International Energy Agency estimates that by the year 2030, worldwide electricity consumption will have increased annually by approximately 2.4 %. City Solar AG is seeking to increase renewable energy stocks through grid-connected solar power utilities. As one of the leading producers of large-scale photovoltaic plants, City Solar is uniquely placed to give us a better understanding of how these plants are put together. David Owen, Managing Director of pv-tech.org and Photovoltaics International, the only journal specifically designed for the PV supply chain, delineates in the solar report the drift to the use of thin film modules large-scale photovoltaic power plant and talked with Stephan Brust from the German systems integrator City Solar AG about the companies technology and future plans. At the end of the report three large-scale photovoltaic power plants will be featured, connected to the grid in Spain by City Solar.

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At Beneixama (Spain) City Solar built one of the world's largest PV plants.
Source: City Solar AG

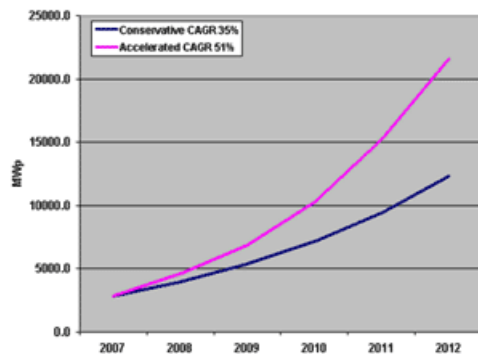
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Solar energy: the loophole out of the energy and climate crisis

Reserves of fossil fuels cannot cover our energy needs in the long term. Furthermore, price increases must be expected. It will be increasingly necessary to exploit deposits that are more difficult to mine, or that must be transported over longer distances. A worst-case scenario shows an increase in the number of political or even violent conflicts over control of remaining resources. A world that uses solar energy solves important, central questions for mankind: less air pollution, less climate-changing CO₂, fewer political and violent conflicts over fossil fuels and a multitude of new, permanent work places.



Conservative and accelerated PV industry forecast (2007-2012). Chart published with friendly permission by Paula Mints, Navigant Consulting Inc. PV Services Programm.

City Solar is making great strides in delivering cost-effective power to the masses through their ambitious and aggressive power-plant building projects. To date, City Solar has connected to the grid projects with capacity of more than 81MW, including a 20MW installation in Beneixama (Spain), one of the world's largest photovoltaic power plants.

Large-scale production of solar electricity. At Beneixama (Spain) annually approx. 30 million kWh are being produced on an area of approx. 500,000 square meters.



Source: City Solar AG

The resources and skills required to get a successful solar power plant up and running include securing the site, development and site management, excavation and foundation work, sourcing and testing solar modules, assembly of support frames and solar modules, installation of electrical equipment and ongoing technical operations management. Solar power plants with a peak capacity of approximately 3,200 MWp are worldwide connected to the grid¹, the majority of which are currently ground-mounted installations.

In order to install a power plant with a nominal power of 1MWp, an area of some 20,000 to 25,000 m² is needed, depending on the site. The solar modules are mounted on metal supports, the heights of which vary between 1.8 and 2.5 metres. To avoid shading, a distance must be maintained between the rows of supports. Depending on the geographical degree of latitude, the incline of the site and the height of the supports, this distance is between 5 and 10 metres.

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Solar power plant Götterborn approx. 15 km north of Saarbrücken Germany. With a peak capacity of 4,0 Megawatt peak (MWp) City Solar's system initially has been one of the world's largest. Meanwhile it was enlarged up to 8,4 MWp. Source: City Solar AG

City Solar develops and constructs solar power plants independent of any manufacturer. With a proven track record of 21 installations in Germany and Spain using modern, top quality technology from producers of renown, they are able to achieve optimum operational availability for their power plants. This is vital to create high and continuous electricity yields with low operating costs and attractive returns for owners.

Large-scale energy providers jumping head-first into the market

Without the financial support of government tariffs and the move by large utilities into the solar space, it is clear that the solar power plant market would not be growing at the triple digit growth it has enjoyed over the past five years. The recent Southern California Edison rooftops project is a great example of a large-scale energy provider jumping head-first into the solar energy market. In March 2008, Southern California Edison (SCE) announced an ambitious project designed to generate 250MWp upon completion in five years. Funded partially by national and state government grants, this project will introduce a new scale for power generation projects.

City Solar's track record and expertise is uniquely placed to greatly influence the solar power landscape now and in the future. I caught up with Stephan Brust of City Solar, and asked him a few questions regarding the company's technology and plans for the future.

Who supplies you with the volume of modules required for your projects?

"We use multiple suppliers like Q-Cells, aleo solar, SOLON, Canadian Solar, EPV, and Suntech. They were selected based on long-term experience in the market, high quality, reliability, large capacities, price-performance ratio and, of course, the strength of their warranties. Quality is paramount to everything we do and so we cannot afford any risks when putting together a 20MWp installation."

What are the key criteria for selecting different brands of modules?

"We focus on characteristics such as efficiency rates, durability, ease of installation and how the modules work with different inverters. The modules need a max voltage of 1,000V. We only work together with manufacturers who are able to ensure warranty. Furthermore, the modules must fit to our mounting system. The most important advantages of our patented system are its simple and quick assembly and its uncomplicated installation. This means a significant saving on material and time – savings of up to 50 percent. Particularly in the case of large-scale projects, these savings play an important role."

What are the characteristics of industrial strength inverters for solar power installations and how important are they to the running of a plant?

"They are very important for the running of a solar power plant. We work together with Siemens - in 2003, when our first power plant was built up at the Saarbrücken airport, Siemens was permanently involved in the construction. Siemens supplies inverters, transformers, substations, and takes care of the engineering as well as the electrical fittings. The example of our transformers demonstrates our strategy: we use dry-type transformers (Geafol), as, even though they are more expensive to buy than oil transformers, they do not need servicing, operate more efficiently and are environmentally friendly."



A Siemens engineer installing modules at a City Solar facility.

Is there anything particularly unique about the way you put together a plant?

"Yes. City Solar has an inbuilt facility for research and development that works on cost reduction or efficiency improvement strategies throughout the supply chain. An example is our new tracker system that is 40% cheaper to make and has a 22% higher yield than other ground-mounted systems. Two projects in Spain's Albacete are using these systems; one 15MWp system in Mahora goes live in July 2008."



15 MW solar power plant in Mahora. Source: City Solar AG

Are thin-film modules an obvious choice over Si modules?

"Absolutely. Recently, we entered into a long-term solar module supply agreement with EPV Solar, Inc., a leading thin-film solar module manufacturer and photovoltaic systems provider headquartered in New Jersey, USA. The framework agreement allows us to purchase 250MW of amorphous silicon modules over a period of five years. We use EPV modules to further execute our profitable growth strategy in Europe. A

first 2MW project with EPV modules will be realized in Germany by the end of 2008."

What is next for City Solar?

"At the moment we are in the final phase of the big 15MWp Tracker project in Mahora (Spain), which will be finished in July. Moreover, we realized another two big ground-level power plants in Spain (7.5MWp in Yecla and 10MWp in Alconchel). So currently, City Solar has connected to the grid projects with capacity of more than 81MWp. Further markets are Italy and Greece: in Italy, we will build two projects by the end of this year; Greece will start in 2009."

With City Solar moving into thin-film modules and large players like juwi already using CdTe thin-film modules from First Solar, it seems clear that the future of the power generation segment of the solar industry will become increasingly about scale.

Competing Technologies

. Crystalline silicon technology

Crystalline silicon cells are made from thin slices cut from a single crystal of silicon (monocrystalline) or from a block of silicon crystals (polycrystalline); their efficiency ranges between 12% and 17%. This is the most common technology representing about 90% of the market today.

Cost of running power plants with crystalline technology: 73% modules, 27% BOS (DC-Cables, engineering, substructure, installation, inverters).

. Thin-film technology

Thin-film modules are constructed by depositing extremely thin layers of photosensitive materials onto a low-cost backing such as glass, stainless steel or plastic. Thin-film manufacturing processes result in lower production costs compared to the more material-intensive crystalline technology, a price advantage that is currently counterbalanced by substantially lower efficiency rates (from 5% to 13%). Major developers such as juwi international and Phoenix Solar use the cadmium telluride (CdTe) technology of First Solar (efficiency rate about 10%).

Cost of running power plants with thin-film technology: 52% modules, 48% BOS (DC-Cables, engineering, substructure, installation, inverters).

Photovoltaic power plants by City Solar

1. Location: Beneixama (Province Alicante, Spain)

Nominal power:	200 x 100 kWp (20 MWp)
Global radiation:	1,934 kWh/m ² per annum at module level
Ground area:	Approx. 500,000 m ² (approx. 71 football pitches).
Solar modules:	Approx. 100,000 pieces, Manufacturer: City Solar (PQ 200)
Module surface:	Approx. 160,000 m ² .
Electricity production:	Approx. 30,000,000 kWh per annum (requirement of more than 12,000 average households)

CO2-avoidance:	Approx. 30,000 tons per annum (over 25 years: approx. 750,000 tons)
Completion date: August 2007	

2. Location: Alconchel (Province Badajoz, Spain)

Nominal power:	10 MWp
Global radiation:	1,937 kWh/m ² per annum at module level
Ground area:	Approx. 250,000 m ² (approx. 35 football pitches)
Solar modules:	Approx. 59,530 pieces. Manufacturer: Conergy AG
Electricity production:	Approx. 15,500,000 kWh pro Jahr per annum (requirement of more than 6,200 average households)
CO2-avoidance:	Approx. 12,400 tons per annum (over 25 years: approx. 310,000 tons)
Completion date: June 2008	



10 MWp solar power plant Alconchel. Source: City Solar AG

3. Location: Mahora (Province Albacete, Spain)

Nominal power:	15 MWp (Tracker)
Global radiation:	2,311 kWh/m ² per annum at module level
Tracker:	Approx. 7,000 Type: City Solar system
Ground area:	Approx. 1,000,000 m ² (approx. 142 football pitches)
Solar modules:	Approx. 70,000 pieces. Manufacturer: Canadian Solar, Inc.
Electricity production:	Approx. 28,000,000 kWh pro Jahr per annum (requirement of more than 11,200 average households)
CO2-avoidance:	Approx. 22,400 tons per annum (over 25 years: approx. 560,000 tons)
Completion date: July 2008	

Acknowledgement

The contributions of Denis Lenardic of PV Resources, Stephan Brust of City Solar AG, and Paula Mints, Navigant Consulting Inc. PV Services Program are greatly appreciated. Photos courtesy of City Solar AG.

Further information:

- [2008 Photovoltaic trends: Innovative thin film technology and large-scale power plants; Gigawatt perspectives in the USA](#)
- [Large photovoltaic power plants: average growth by almost 100 % since 2005.](#)

Footnotes

¹Source: pvresources.com

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