



# Focus on SolarIndustry

The Magazine for the Solar Industry

2010

**SIEMENS**

## Geared for the Future

Efficient automation solutions and drive  
technologies for all stages of the value chain



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Glistening: the Layout Station by Schmid, Nidereschach

Cover



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**Dear Readers:**

**Bernhard Saftig**  
Head of Vertical  
Glass & Solar Industry

We believe that the title of this magazine is a very good reflection of how things stand today. Focus is now on the solar industry – and not just at Siemens. Solar energy is the pillar of hope for change in energy production and for climate protection. It is also a significant consideration in the politics of state funding, and above all it is a major economic factor. A future market with such growth potential is an absolute rarity in these times of saturated markets.

It is simply not possible to cover all of these topics in sufficient detail in a single magazine. However, we are pleased to be able to offer you a fascinating insight into current developments and projects with Focus on SolarIndustry. We would also like to showcase the automation solutions and drive technologies that we provide for all stages along the value chain. We are committed to being a partner that develops and grows together with its customers.



**Burkhard Müller**  
Director Business  
Development Solar

Since development is taking place at such a great pace, we are sure that this – the first issue of Focus on SolarIndustry – will not be the last. We hope this publication will allow us to keep you up to date at regular intervals, providing you with the latest information from the solar industry. As with everything, there is always room for improvement, so we would be pleased to receive your feedback for future issues of this magazine. The best way to get in touch is by sending an e-mail to [solar.industry.automation@siemens.com](mailto:solar.industry.automation@siemens.com).

We hope you find this first issue of Focus on SolarIndustry both interesting and informative.

*Bernhard Saftig Burkhard Müller*

■ Trends in the solar industry

# Fair to Cloudy

The climate in the solar industry: currently difficult, but with excellent outlooks.

Looming cuts in government funding, pressure on costs due to collapsing prices, capacity surpluses and even predictions that the industry is facing a market concentration process: the clear skies above the solar industry have recently clouded over. These developments have posed great challenges to many companies and have even caused others to fear for their survival.

Nonetheless, it is shortsighted to only consider the current situation. In the mid- to long term, the outlook in the industry is fair to sunny. Solar energy has

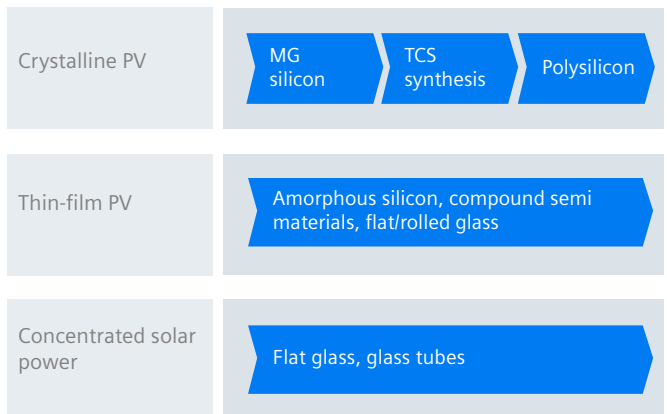
the potential to become the most important source of energy across the globe in the coming decades. The sun has always been our main source of energy: the sun radiates more than enough energy across the Earth's deserts alone in just six hours to provide the entire global population with energy for a year. With photovoltaics, this energy can be easily transformed at a local level into usable electricity. This is a major advantage for sparsely populated or less economically developed regions where there is not sufficient infrastructure to distribute electrical energy.

## Siemens offers automation solutions and drive technologies for the entire value chain in the solar industry

### E-learning

A concise online guide to the world of photovoltaics is now making its debut. Short, illustrated lessons at [www.siemens.com/solar-industry](http://www.siemens.com/solar-industry) help inquisitive minds learn about the workings of photovoltaics. The challenging e-learning system will go live with a chapter on universal solar tracking control. Further lessons will follow.

### Basic materials



## Annual growth rate of 30 percent

Researchers at Columbia University in New York have, for example, calculated that in the United States up to 70 percent of electricity could be obtained from the sun by 2050. The researchers in New York are also convinced that similar figures are possible for most of the world. Even in supposedly less sunny Germany, 20 percent to 30 percent of electricity in the long term could come from solar. Along with the ever-increasing number of photovoltaic installations, large-scale projects such as DESERTEC – in particular with its Concentrated Solar Power (CSP) technology – are beginning to show what might be possible in the future with solar energy.

For these reasons, industry experts expect annual growth rates of 30 percent. Once the major hurdle of grid parity has been cleared in less sunny regions (which according to the German Solar Industry Association will happen in four years in Germany), a major impetus will be felt in solar energy. Turnover in the solar industry, which in 2009 was around €35 billion worldwide, will then be set to increase rapidly. Those who are well prepared and are able to answer the expected demand affordably and efficiently may enjoy a very sunny outlook.

## From pioneering spirit to professionalism

The current situation is changing the face of the solar industry, and the founding days are behind us. Pi-

oneering spirit is still a driving force, though the delicate business of optimization down to the details is becoming more and more important. Some fear that this means the industry will lose some of its excitement, but on the other hand it is certainly becoming more and more professional. And professionalism is necessary as the pressure of international competition mounts. The leading German providers are having to assert themselves against aspiring providers from Asia and America – which has been and continues to be a decisive factor in the collapse of prices.

## Modular solutions meet customers' requirements

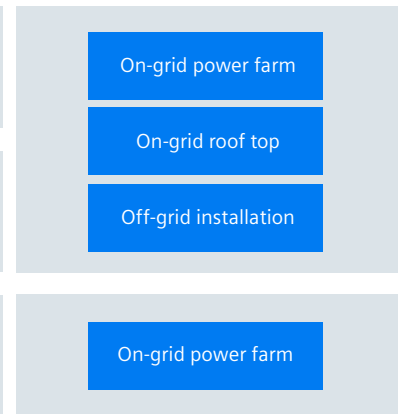
An integrated system that supports customers in controlling, monitoring and optimizing processes is essential to rigorously optimize all processes. With its Totally Integrated Automation concept, Siemens offers a modular solution that includes hardware and software components for automation and drive engineering for all links in the solar industry's value chain. Simatic, the world leader in automation engineering, forms the concept's core element. Simatic provides the connection between Enterprise Resource Planning systems and production control. Thanks to its modular design, the system is able to "grow" flexibly as demands in production change. All forecasts point to the solar industry experiencing rapid growth as clouds in the sector gradually break up to reveal a bright future. ■

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### Products for energy conversion



### Field installation



▪ Survey

# “What are your expectations of a partner in the solar industry?”

Choosing a partner can be a difficult decision. Siemens was therefore open to suggestions at the Photon Expo in Stuttgart at the end of April 2010. Innovative and flexible solutions from a reliable partner with a global market presence are top priority.



**Dagmar Metzger**  
Product Manager  
Robert Bürkle GmbH

“The ideal partner knows the global market, has a global presence, can provide around-the-clock service and consistently offers the most modern products that enjoy a good reputation internationally.”



**Dr. Hartmut Nussbaumer**  
Head of Development  
RENA GmbH

“To stay at the forefront of the global solar industry, we need very short innovation cycles. This can only be achieved with partners that offer the highest possible standards in technology and can react dynamically to our requirements.”



**Dr. Andreas Reischl**  
**Product Manager for Photovoltaics**  
**Schiller Automation GmbH & Co. KG**

“Reliability is absolutely essential for working together with a partner. By this we mean quickly developed, flexible and innovative solutions at prices that are in line with the market, so we can offer our customers top quality at all times.”



**Matthias Seidel**  
**Business Development Sales**  
**Roth & Rau AG**

“We need to offer our customers long-term perspectives with our products, which is why we work with partners that deliver us sustainable quality. Quality is paramount for us and it is worth paying for.”



**Andreas Schöni**  
**Sales Manager**  
**3S Swiss Solar Systems AG**

“For us it is important that our partners help us get closer to our goal of grid parity more quickly. Efficiency, the highest quality standards and, in particular, low costs of ownership are what matter to us.”



**Eckhard Knöchelmann**  
**Managing Director**  
**Torgauer Maschinenbau GmbH**

“We need a partner who we can rely on in any situation, anywhere in the world. Partnership for us means sharing work with a common understanding of the tasks, where each party contributes with its core competence.”

■ Interview

# “Performance,

Solar experts Bernhard Saftig and Burkhard Müller from Siemens on possibilities and challenges in the industry.



Bernhard Saftig is the head of Vertical Glass & Solar at Siemens Industry

five years. That is a massive figure. In the long term, solar energy has the best chance of becoming the leading source of energy in the world.

*Let's look at the challenges for the industry. What are the problem areas, Mr. Müller?*

**Burkhard Müller:** Grid parity remains an important issue, even though it is fairly certain that it will soon be reached. The first major consolidation phase is currently the main concern in the industry. Of course we knew that it would happen eventually, but it is a lot for a sector to absorb when prices for solar modules drop by 40 percent in a single year, for example. On the other hand, the immense pressure this has generated is accelerating the development of more efficient technologies and manufacturing processes. However difficult the situation in individual companies is at the moment, growing pressure in the three critical areas of performance, quality and economy means that a long-term strategy is essential for success and endurance in the solar industry. But even this has its advantages, as it helps the solar industry to establish itself quickly on a broader scale.

*What can Siemens do for a company in the solar industry?*

**Bernhard Saftig:** It is difficult to speak about “a company,” since – just as in any other industry sector – the structures in the solar industry are quite intricate. But we do in fact have something for all companies, because with our automation and drive technology we can support all stages of the value chain from raw-material production all the way to field installations. We are committed to being a partner that develops and grows together with its customers. In order to be an even better partner in the

*Mr. Saftig, can you give a picture of the solar industry in one sentence?*

**Bernhard Saftig:** I'll try... The solar industry is a comparatively young and very dynamic industry where there are both enormous potentials as well as enormous challenges.

*Let's look at the potentials for now. As you see it, what possibilities does the future hold?*

**Bernhard Saftig:** The Boston Consulting Group released a study at the end of last year that predicts annual growth in the industry of 30 percent for the next



# Quality and Economy”

future, we have developed a new division: Vertical Market Management for Glass & Solar, located in Karlsruhe, Germany, which encompasses all of Siemens Industry Sector expertise in the area and provides a central contact point for the solar industry.

*So is Siemens new to the solar industry?*

**Bernhard Saftig:** No, even as early as the 1950's Siemens developed a method for manufacturing high-purity monocrystalline silicon via zone warming. Another innovation from the founding days is the Siemens Reactor – a thermal pyrolysis furnace that can be used to produce polycrystalline silicon. Of course, our portfolio of solutions for the sector is much larger and more comprehensive today. Furthermore, the solar industry is an extremely promising growth market for Siemens, all across the globe.

**Burkhard Müller:** It is actually remarkable how internationally oriented the solar sector is. Even smaller companies are globally active, which means they expect fast and professional service from their partners around the world. We therefore have something special to offer with our global presence and experience in international business. But a partner like Siemens, with decades of experience in diverse sectors, can also help companies make progress with processes.

*Can best-practice examples from other sectors be transferred to the solar industry?*

**Bernhard Saftig:** Yes and no. The solar sector has many unique issues that must be explored and taken into consideration. But there are still many parallels with other industry sectors, and looking at the bigger picture can give considerable and valuable mo-



**Burkhard Müller is the director of Solar Business Development at Siemens Industry**

mentum to the solar industry. A lot of individual experiences can be transferred to the solar industry, either tailored to certain requirements or even applied one to one. This is particularly true of areas such as standards, process optimization or modular design and scalability. These are all tasks that industrial companies are continually having to address in other sectors too. The solar industry does not have to try to reinvent each wheel, but it can use innovative work from other fields. There is still so much more new territory to be explored, and companies are better equipped to concentrate on further increasing the efficiency and the performance of their modules and systems. ■



■ PV Crystalox, Germany

# A Clear Advantage

Thanks to Simatic PCS 7, PV Crystalox has the complex processes in its new solar silicon production facility in Bitterfeld fully under control.



The PV Crystalox Solar Group is one of the world's leading manufacturers of solar silicon ingots and wafers for solar cells. PV Crystalox Solar focuses entirely on the manufacturing and processing of crystalline solar silicon. For this process stage, PV Crystalox opened in February 2009 a new production facility at the chemical complex in Bitterfeld, Germany. The establishment of this plant is an important milestone for PV Crystalox since it enables the company to produce solar silicon itself over the long term under favorable conditions, forming an important basis for further company growth. The plant will gradually reach its full capacity of 1,800 tons of solar silicon within the next two years. Production depends on a variant of the Siemens process through which high-purity silicon is produced by means of the thermal decomposition of chlorosilanes. The polycrystalline silicon is then melted and worked into multicrystalline ingots at another PV Crystalox site in the UK. PV Crystalox obtains the raw material for

the process in Bitterfeld from the neighboring company Evonik Degussa GmbH, which produces high-purity chlorosilanes.

## Process expertise and cutting-edge technology

For automation and electrical systems, PV Crystalox chose Siemens as a partner for the planning, engineering, delivery and commissioning of the process control system – Simatic PCS 7 – and the extensive bus-bar system. Siemens also delivered parts of the analytics, process instrumentation and medium-voltage supply equipment.

The engineering of the process control system is supported by high-performance tools. For example, the project team used the Safety Matrix engineering tool for the configuration and parameterization of the fail-safe signal circuits. The vendor-independent Simatic PDM (process device manager) software made it much easier to configure and commission



## Robust online analytics

Alongside the process control technology, additional technology from Siemens is used in another key function at PV Crystalox. Online analysis in a closed system in which the sampling, sample changeover and analysis are fully automatic minimizes the need for personnel to be in the vicinity of the dangerous process. However, significant expertise is needed to design and construct such solutions. Siemens is currently the only provider that offers expertise in the field of chlorosilane online analytics and also delivers a completely integrated solution from sampling and sample preparation to analysis devices.

### Maxum edition II keeps PV Crystalox satisfied

For PV Crystalox, Siemens supplied a Maxum edition II process gas chromatograph in an analysis cabinet, four primary sample preparations and a secondary sample preparation. Dr. Grit Pirwitz, head of process quality management and quality assurance at PV Crystalox, is particularly enthusiastic about the robustness of the apparatus: "In our process, there is always a certain amount of hydrochloric acid in the gas mixture. Other chromatographs often have problems when such aggressive substances go over the column. But the Maxum copes very well with the media." In everyday production, the Maxum has already withstood some critical situations as well. Dr. Grit Pirwitz continues: "If the apparatus is switched off by accident at night, the process gas chromatograph can simply be switched back on the next day and it works perfectly. With a normal laboratory chromatograph, in contrast, problems would immediately arise with the column."

the intelligent field devices, and it also supports diagnostics and servicing of the devices.

For preventive maintenance and diagnostics of the process control technology, Simatic PCS 7 additionally offers integrated asset management functions, which increase system availability and thus contribute to efficient and reliable production. Moreover, system information can also be easily used to determine key performance indicators (KPIs). The process data are transmitted from PCS 7 to the Simatic IT management execution system via an integrated interface. Simatic IT Historian calculates process progressions and KPIs from the data, saves the information, and makes it available for analyses.

## Clearly structured process control technology

In everyday production, PV Crystalox benefits from the clear structure of the process control technology, which facilitates system handling as well as servicing

and maintenance. The integrated safety technology simplifies the system architecture while ensuring reliable and trouble-free operation. Intelligent tools for system diagnostics and asset management also increase availability and contribute to cost-effective and easy maintenance. Information can be used and exchanged fluidly on all levels – from the process level up to the management level. New system parts or further automation components, including those of other manufacturers, can be integrated into the existing architecture at any time. All in all, the successful project enables PV Crystalox to concentrate on its core business: making even better use of the power of the sun with innovative solar silicon products. ■

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■ LDK Polysilicon Co., China

# A Well-Practiced Team

The process control system Simatic PCS 7 is making a meaningful contribution to quality improvement at the polysilicon production facility belonging to LDK, a Chinese wafer manufacturer in Xinyu, in the Jiangxi Province.

**A**t Siemens, mention the project in Xinyu with the Chinese customer and partner LDK Solar, and you're bound to get an elated response, even though the project is already two years old. In March 2008, a contract was signed with LDK Solar for the application of the Simatic PCS 7 process control system at the polysilicon production site in Xinyu. The factory there is a key element in LDK's expansion strategy, which, according to the company, in April of this year helped it reach a yearly capacity of 2.0 GW in solar wafers, making it the leading manufacturer in this product area.

"In order to increase efficiency as planned, LDK will not just concentrate on expanding its output. The optimization of plant availability reached with the Simatic system will also make a meaningful contribution to increasing quality," explains Rainer Mahler from Siemens. Simatic PCS 7 offers a large range of diagnostic functions for troubleshooting in complex automation systems and makes a significant contribution to attaining the highest-possible availability of modern industrial facilities. Siemens has also won a contract from LDK to supply 18 Maxum edition II gas chromatographs for the site in Xinyu. ■

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The production facility for polysilicon in Xinyu, Jiangxi province, is a key project of Chinese wafer manufacturer LDK



## News from the solar industry: China is booming

We are all aware of the great demand for energy in the most populous country in the world. In answer, China is turning increasingly to solar energy and is catching up with the Western market leaders in terms of technology. For years there have been speculations of great growth potential in the market for photovoltaic modules in China. In 2009 PV exports almost quadrupled to a total of 398 MW. Approximately 95 percent of the country's entire solar production is sent abroad. Polycrystalline silicon modules make up the largest portion of the exports at around 200 MW, followed by monocrystalline modules at around 126 MW and thin-film modules at 71 MW. Experts predict an average increase of the entire PV exports of around 80 percent by 2013. Thin-film modules are prescribed the greatest growth potential with an average of over 130 percent in the next three years.

### Moderate growth for facilities

More moderate behavior is expected in production facility exports; according to experts, the next three years will see an increase in the sector of 17 percent on average. Similar growth rates will be seen with facilities for processing ingots and producing wafers and cells. As for production facilities for cell-based modules and thin-film modules, growth will amount to 24 percent on average over the next three years.

### China's strong role in polysilicon

Between 2008 and 2009, polysilicon production in China increased by around 300 percent to a total of 18,000 tons. This is equal to half of the domestic demand. In 2010 growth of €470 million is predicted for the global polysilicon market, with China set to contribute 9 percent of this total.

### Support program comes into effect

Experts reckon that the support program instigated by the Chinese government in 2009 will bear results in the domestic market and that domestic demand will see positive development. Facilities with a total output of 642 MW will receive subsidies from the government; 35 solar power plants with a total output of over 300 MW are covered under the scheme. Electricity produced by solar thermal power plants is set to grow from a current output of just over 100 MW to as much as over 700 MW in the next three years.

### Foreign investment welcome

A Renewable Energy Act has been in force in China since 2006. The market is expected to enjoy an extra boost from planned compensation for solar energy that is fed into the grid – 85 euro cent/kWh is under discussion. In principle, the Chinese government supports foreign investment in the solar industry. According to market experts' predictions, 80 percent of current production technology is imported.

- Pilkington (NSG Group), Germany

# Crystal-Clear Performance

Simatic PCS 7 makes Pilkington's solar glass line in Weiherhammer, Germany, more efficient, cost effective and flexible.



## Energy from glass

Siemens glass engineers and the Pilkington research center in the UK have developed a special coating that is applied to the glass in a pyrolytic process. This type of coating was patented in 2007. The specially coated glass serves as the basis for a solar module with a conductive surface and low electrical resistance – entirely without silicon.



Solar glass has to withstand the effects of sun, rain, snow and hail. A tough call – which is why the glass must be specially hardened. For optimum energy conversion, the glass also needs to be highly translucent with a surface that scatters light rays in different directions to prevent the sunlight from simply being reflected back. The low-iron Optiwhite float glass measures up well on these requirements. Optiwhite is one of the types of glass manufactured by Pilkington (NSG Group) at its facility in Weiherhammer, Germany, where the company's production line II has been completely modernized and expanded.

The line's furnace, float bath and annealing lehr used to be equipped with the Teleperm M process control system. Even before the cold repair, a high-availability Simatic S7-414H automation system had been installed to manage the cooling circuit, and the advanced Simatic PCS 7 process control system was integrated into float line II. During the cold repair, the operator systems for the furnace, bath and annealing lehr were replaced by Simatic PCS 7 control systems. Since it monitors the entire float process and also verifies that every parameter is adhered to precisely, the distributed control system ensures that the flat glass has unfailingly high quality. In addition, smart control and auto-adjust features help save energy and minimize emissions.

## Greater melting performance

The three AS 235 automation systems (part of the Teleperm M process control system from Siemens) for individual line segments were retained when the operator systems were modernized, though some enhancements were made at I/O level. The longer bath and greater melting performance give the system higher tonnage output. Two additional burners were installed to make this possible. The configuration specialists extended the software to accommodate the new measuring points and control circuits. Fuel and combustion feed to the burners – now six in total – and the switching process are controlled by

the furnace automation system. With the larger float bath, additional thyristor actuators, thermocouples and pressure gauges were required. The additional measurements and control circuits necessitated adjustments to the software, and control circuits and overarching control functions had to be implemented for the annealing lehr's automation system. In total, in addition to the cooling circuit data, the control system now processes some 1,700 analog and 1,800 binary values. The OS (operator system) level is configured with redundant servers and three operating stations, via which the plant operators direct the float process. The engineering system is used primarily for central configuration.

## Excellent prospects

In the project to upgrade the control system, Pilkington worked closely with specialists from Siemens and the staff at Weiherhammer. Once the factory acceptance test had been completed in Karlsruhe on a shadow system, the next step was to carry out the site acceptance test and take the system into operation, after which it was tempered. Reliable technology from Siemens also plays a key role in Weiherhammer at the cold end, where cutting-line expert Grenzebach uses automation and drive technology from Siemens. A hardening system and new cutting system went into operation in summer 2008. The annealing oven is also controlled by Simatic S7 technology, and the oven's fans are powered by engines with Sinamics G150 converters. Thanks to the raised tonnage, the Weiherhammer facility has now stepped up its output from 550 tons to 810 tons of glass per day – equipping it excellently for the future. ■

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In December 2009, Masdar PV installed a solar plant with 260 kWp on the roof of its new manufacturing hall in Ichtershausen, near Erfurt, Germany

■ **Masdar PV, Germany**

# Shining Brightly

Masdar PV intends to establish itself as one of the world's leading providers of thin-film PV modules. In 2009 the company laid the foundation for future success with a high-tech production hall in Ichtershausen, near Erfurt, Germany.

Masdar PV has been providing customers with high-tech modules produced at its 15-hectare facility in Ichtershausen since October 2009. Following the ramp-up phase, the company expects an annual production of 40 MWp in 2010. The plant's special tandem technology allows the manufacture of amorphous silicon (a-Si/a-Si) modules that are at least 10 percent more efficient than single-layered amorphous silicon (a-Si) modules.

## Size pays off

These modules are well suited for use in solar plants on open spaces or in large-scale roof mounting where maximum energy yield (kWh/kWp) is to be achieved despite high atmospheric temperatures or diffuse light conditions. The company's headquarters in Ichtershausen produce solar modules of up to 5.7 m<sup>2</sup>, with other sizes including 2.8 m<sup>2</sup> and 1.4 m<sup>2</sup>. These factors are essential for providing PV modules with a very good cost-benefit ratio.

## Starting with the central control system

Right from the start, Siemens was on board as a subcontractor for the central control system in the new plant. Thomas Richter, technical operations manager at Masdar PV, recalls this phase: "The Siemens modular system soon proved itself as being very adaptable and flexible for all configurations. What's more, it is also very stable." This comes as no surprise considering that Siemens relied on the Simatic PCS 7 process control system, which has proven itself over a decade. Beyond these routine operations, it soon became apparent that the real challenges lay in the complex and sensitive facilities for treating wastewater and DI water. But Siemens was once again able to provide a solution. As a result, Masdar PV is also in talks with Siemens over possibilities for further cooperation to

automate process sections. "We intend to constantly develop our applied materials manufacturing plants and therefore see potential for automation," says Thomas Richter. The technical design stage is already in progress and Thomas Richter is expecting solutions tailored especially to Masdar PV from Siemens and other providers. "After all, you can't order automation solutions from a catalogue." ■

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## More on research

by Prof. Jürgen Mlynek,  
President of the Helmholtz  
Association, Germany



At the Helmholtz Association we are already working on future generations of solar cells and are testing new types of materials and cell architectures. With the synchrotron radiation facility BESSY II, the Helmholtz Center for Materials and Energy in Berlin has at its disposal a powerful instrument for research into new kinds of thin-film solar cells. At our research center in Jülich we develop materials, solar cells and solar modules for thin-film photovoltaics based on amorphous and microcrystalline silicon and its alloys. Along with research into silicon-based thin-film solar cells, we are also focusing on the large family of absorber materials that are based on compounds of copper, indium, gallium, sulfur and selenium (CIS/CIGSe).

■ Siemens Industrial Turbomachinery, Sweden

# Niche No Longer

CSP projects in Spain, the USA and North Africa are giving impetus to the global market, which is set to grow to around €10 billion by 2015.

Augustin Mouchot had a dream, and scarcely 150 years after the French mathematician produced steam using concentrated solar power did his dream appear to have been realized. The father of the solar thermal power plant has been proven right in recent years by developments in the field of concentrated solar power (CSP). The market for CSP is more dynamic than ever before. New projects on a gigawatt scale have been initiated in recent months across the world. Alone in the MENA (Middle East and North Africa) region, 11 power plants are in planning, with construction due to start in three to five years. In Spain, now the leading market in the CSP industry, capacities are to be increased by 2,339 MW by 2013. By the end of 2010, more than half of worldwide CSP production will be located on the Iberian peninsula.

Analysts predict that the greatest boost in the market in the coming years will be seen in the United States. By 2020, experts expect a total capacity there of 13,100 MW. Second and third places will be occupied by the MENA region with the addition of 8,650 MW and Spain with growth of 6,400 MW. The total capacity of solar thermal power plants is expected to reach 31 GW by the year 2020. Parabolic trough power plants are to remain the most common technology, which is used by more than 90 percent of power plants.

## The solar thermal power plant

In solar thermal power plants the captured sun rays are concentrated by mirrors on so-called receivers. The circulating heat carrier in the receivers (such as synthetic thermo-oils) is then heated. Next, the fluid is passed through a heat exchanger. This is where steam is generated for driving the turbines, which generate the electricity output. There are four different configurations of concentrating mirror systems: parabolic trough power plants, the linear Fresnel design, solar tower technology and dish/Stirling power stations. In each of these systems, the mirrors track the sun.



## The steam turbine – at the heart of the plant

Steam turbines form the heart of a solar thermal power plant. So it's great news that Siemens is the market leader in this area and is developing CSP projects across the globe. "Together with our Siemens colleagues from Industry Automation and Drive Technologies, we are able to put together a high-quality complete solution for our customers," says Eric Wiklund, manager of Standard Systems and Steam Turbines at Siemens Industrial Turbomachinery AB in Sweden. "Since 2006 we've been providing the Siemens process control system PCS 7 – first in Boulder City in the U.S., then in 2007 for Andasol in Spain and currently in five projects. A further 30 projects are already in the planning phase." Siemens' activity in the field shows that CSP is no longer merely a niche market and will become more and more prominent over the coming years – just as Augustin Mouchot envisaged. ■

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■ **Conergy AG, Germany**

# Fully Integrated into the Future of Solar

**Conergy manufactures wafers, cells and modules in one of the most modern facilities in the world in Frankfurt (Oder), Germany. Siemens provides automation technology for the entire production process.**

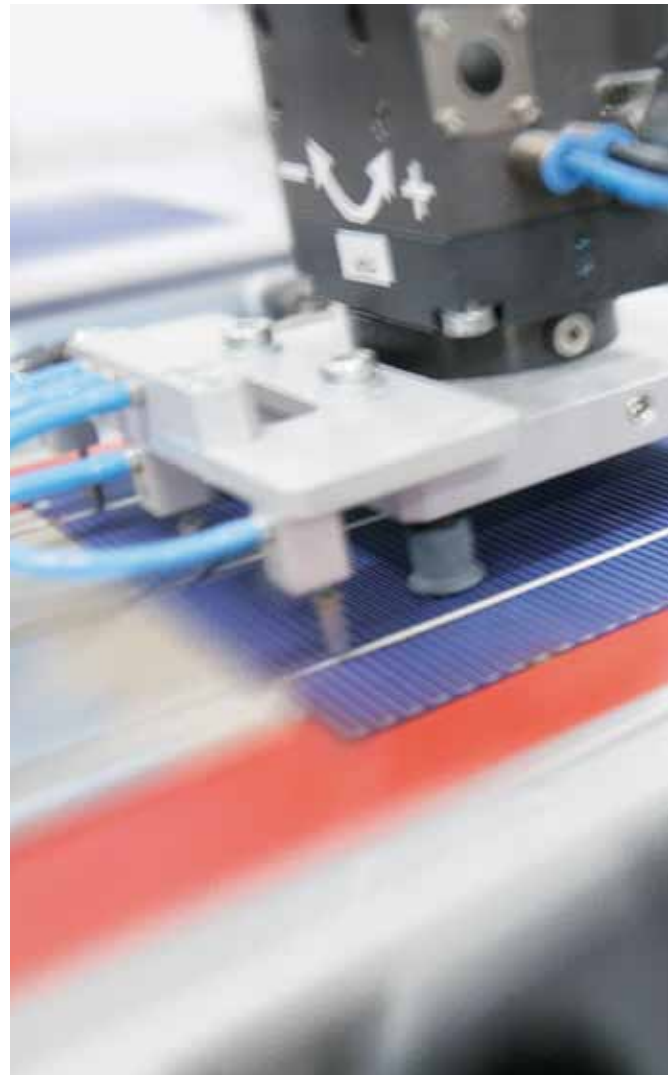
**B**ased in Hamburg, Conergy AG is one of the top five leading providers of solar systems in Europe and is a highly valued supplier for operators in the “green” energy sector. With its own development and production of modules under the same roof, the company aims to strengthen its own brand, improve margins and offer clients highly customized solar systems. Conergy intends to concentrate in the future on private consumer business in the solar market, where significant political influences are at play. The company is active in 16 countries across four continents. However, the German market is still by far the most important single market. The German federal government intends to step up subsidies for operators of solar plants who use the energy they produce themselves, rather than feed it into the grid. This may have the effect of discouraging business in domestic and commercial roof-top installations. For Conergy, however, it presents the opportunity to offer customized solutions for efficient energy management to the growing numbers of private consumers.

## Model factory in Frankfurt (Oder)

Conergy transformed a former chip facility in Frankfurt (Oder) into one of the most modern factories in the world for manufacturing solar systems. The new manufacturing facility reached full capacity in 2009. Equipping the new facility was a great challenge, both in terms of time and technology. Integrating several production systems under one roof was an extremely complex task. Everything from placing the order to completion was accomplished within just a few months. But the most difficult task, however, was connecting the various production sections with efficient and reliable interfaces. Nonetheless, the project team consisting of M+W Group, Siemens and Conergy responded to the challenge competently.

## Siemens entrusted with a key position

The M+W Group commissioned Schmid in Niederschach to provide the systems for the entire mod-



ule manufacturing process. The task for Siemens was to provide the automation technology for the entire manufacturing process. This included cooling systems, air-conditioning systems, hot-water systems, vacuum systems, water preparation, and chemical and power monitoring. Siemens was able to demonstrate its industrial expertise throughout the project. What is more, the integrated Simatic technology based on established industry standards offers the Conergy facility several considerable advantages. The Simatic S7 programmable control meets all the requirements of the various production sections in the new production facility. Simatic PCS 7 monitors the entire production automation, the alarm systems, and data analysis and archiving. The integrated communication concept with Profibus, based on Industrial Ethernet, enables a simple coupling of the controls for cooling systems, vacuum pumps and chemical cabinets. A particularly impressive solution was found for fast communication between the automation systems and the servers for the control unit. The switchgear systems for medium to low voltage were a further

### All under one roof

The solar facility in Frankfurt (Oder) comprises fully integrated wafer, cell and module production. Conergy invested around €250 million in the construction and startup phase of this fully integrated mass-production facility – the only one of its kind in the world. The company is pursuing ambitious goals and hopes to increase the efficiency of its mono- and polycrystalline solar cells, for example. Aligning internal production designs with the individual processes shortens the distances for transport, and the high degree of automation in the facility helps to minimize breakages when handling the delicate cells. The state-of-the-art machines even allow further improvements in silicon consumption.



Photos: Conergy



### Overview of services provided by Siemens

Simatic PCS 7 process control system for the entire manufacturing process for

- ▶ Cooling systems
- ▶ Air-conditioning systems
- ▶ Hot-water systems
- ▶ Vacuum systems
- ▶ Water preparation
- ▶ Chemical monitoring
- ▶ Power monitoring

part of the electric installation to be integrated into the main control system via Profibus. This allows Conergy to monitor the voltage from any operating station of the automation system.

A high level of system transparency and both local and central control are principles that have been implemented in the water preparation and the chemical cycle. This integrated and standardized system, which can also be used for visualizing engineering processes and operation, is a state-of-the-art innovation for the photovoltaic industry. Effective and efficient engineering is supported in this plant by user-friendly controls. A standardized software library operates on Version 7 of Simatic PCS 7 control system and allows integrated engineering. PCS 7 CAS (central archive server), which saves system messages and measurements for up to a year, was developed especially for the facility.

### Optimistic about the future

All involved in the conversion project are very satisfied with the results. This project has provided a great basis on which to continue successful cooperation for all partners. ■

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■ M+W Group and Q-Cells, Malaysia

# Global Cell Proliferation

The building that houses Q-Cells' solar cell factory in Malaysia is the result of a close international collaboration led by leading plant-engineering firm M+W Group.

## Q-Cells in Malaysia: Overview of services provided by Siemens

- ▶ Hardware/software automation components (Simatic PCS 7)
- ▶ Project and site management
- ▶ Software engineering
- ▶ HVAC systems integration (heating, ventilation, air conditioning), UPW (ultra-pure water), WWT (wastewater treatment), chemicals and gases
- ▶ Hardware and software commissioning
- ▶ Process instrumentation: delivery, installation and commissioning (sensors/actuators) of the technology in the building
- ▶ Frequency converter: delivery, installation, commissioning
- ▶ Switchboards: delivery, installation, commissioning
- ▶ Electrical installation

View of Malaysia's capital city, Kuala Lumpur

» As general contractors for the project, we were very satisfied with the services Siemens provided, and in particular with the integrated approach, global presence and competitive prices. «

Helmut Kurzboeck, CEO of M+W Asia

**D**eveloping a global presence as a photovoltaic company is essential for a strong hand in the sector. Gaining a share in the growing Asian markets, as Q-Cells is striving to do, can be a trump card. With the help of its new location in Malaysia, where employees have been producing crystalline solar cells on four production lines since 2009, Q-Cells is set to succeed. Several expansion stages will see production there grow to an annual capacity of over 600 MWp.

### Major contract for M+W Group

Intensive work on implementing the major project had been underway behind the scenes since 2008, and the plant-engineering firm M+W Group was entrusted with an important role. Q-Cells commissioned the group with a turnkey contract covering all links in the value creation chain – from the overall planning of the building to purchasing, construction management and finally connecting the industrial park with the factory's supply and disposal systems. The specialist M+W Group also took on the planning and coordination for the utility systems in the new Selangor Science Park near the Malaysian capital city of Kuala Lumpur.

In February 2008, the M+W Group's international engineering team began the planning stage. Only three months later construction had already begun on the new structure and in December of the same year the building work was completed. The plant engineers were then able to begin straight away with integrating and connecting the industrial park.

### Siemens as a partner

Siemens was the natural choice as an automation partner – for numerous reasons. Firstly because, as general contractors, the M+W Group Malaysia appreciated the extra advantage of the homogeneous automation concept for facility monitoring and control systems (FMCS) based on Simatic PCS 7. This allowed the standardized integration of all utilities and oper-

ating media (HVAC, UPW, WWT, chemical and gases). Secondly because of the overall FMCS solution, which comprises not only the automation system but also the instrumentation, electrical installation, switchboard engineering and plant commissioning. "Furthermore, within the very limited project time frame of just a few months we managed to provide international teams in Germany and Malaysia that would be able to work closely with M+W Group and Q-Cells," explains Mathias Ulbricht from Siemens. As a project developer working on a global scale, Mathias Ulbricht was also given the task of coordinating all parties involved and ensuring that Siemens' knowledge of the global industry as well as expertise relevant to its customer were transferred smoothly from Germany to Malaysia. Siemens accomplished this task through close cooperation between headquarters in Germany (Business Development Industry) and Siemens Malaysia.

### A homogeneous concept

The result was a comprehensive, transparent and standardized automation concept for the building. Distinctive features include the integrated hardware and software platform, a homogeneous engineering concept, high system-security levels, complete system flexibility, a standardized operator and training concept, and optimized spare-parts supply for all utilities. "As general contractors for the project, we were very satisfied with the services Siemens provided, and in particular with the integrated approach, global presence and competitive prices," says Helmut Kurzboeck, CEO of M+W Asia. With the project in Malaysia, the foundation for future global cooperation has been further strengthened for all partners. ■

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From left to right: Ralf Petzoldt, executive director for technology at DSAG; Andreas Villak, head of Technical Service at DSAG; Ulrich Goedicke, DS2000 project manager at DSAG; Wilfried Droege, Siemens Industry; Dr. Joachim Wicke, Siemens Division Lead I IA&DT East; and Dr. Jörg Sawatzky and Andreas Fuchs, both from Siemens Industry

■ Deutsche Solar AG, Germany

## A Strong Symbol

As a token of many years of strong partnership, representatives from Deutsche Solar AG (DSAG) and Siemens planted a tree at the new DSAG manufacturing location in Freiberg.

Many marriages don't even last as long as the 13 years of successful partnership that Siemens has enjoyed with Deutsche Solar AG, the silicon wafer manufacturer. The companies have been working together since 1997 – reason enough to celebrate the partnership with a symbolic gesture. And so, at the start of production at the new DSAG manufacturing plant at the Hilbersdorf industrial park in Freiberg, representatives from both companies marked the occasion by planting a tree.

The choice of tree was no accident: “The hornbeam can live as long as 150 years and reach a height of 25 meters. It therefore stands for the goals that both DSAG and Siemens set for themselves, namely continuity and sustainability in protecting the environment,” said Dr. Joachim Wicke from Siemens Division Lead I IA&DT East at the tree planting in November last year.

The representatives then visited the new manufacturing plant that produces solar silicon wafers in the production hall measuring approximately 120 meters by 320 meters. The visit also included an inspection of the control center where data collection and system control take place. There the entire data output is gathered and all relevant information can be displayed on 30 flat-screen monitors. The Simatic S7 300/400 product family provides a technological backbone for the control center. Siemens also provided further solutions to ensure smooth operation at the new plant in Freiberg: along with the components for process control, the company delivered and installed transformers, medium-voltage systems, low-voltage distribution boards and power rails. ■

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■ **Fluor Corporation and Renewable Energy Corporation (REC), Singapore**

# Key Technology in Singapore

For a photovoltaic project in Singapore Siemens has received an order from Fluor to supply process instrumentation and analytics.

**F**luor Corporation provides services on a global basis in the fields of engineering, procurement, construction, operations, maintenance and project management. Among other Siemens products, the scope of supply includes flow meters, level meters, point level switches and a Sitrans CV gas chromatograph for the determination of calorific values.

## REC strengthens its worldwide position

Fluor Corporation has won a contract with Renewable Energy Corporation (REC) Group for the engineering, procurement, construction management (EPCM) and commissioning for a new solar panel manufacturing complex in Singapore. REC – globally the largest producer of polysilicon and multicrystalline wafers for the solar cell industry – is building a new solar panel manufacturing facility in Singapore with

a production capacity of 740 MW wafers, 550 MW solar cells and 590 MW solar modules.

## Siemens as one of Fluor's preferred suppliers

The long-term cooperation agreement between Siemens and Fluor was especially helpful in receiving this order. According to this agreement, Siemens has become one of Fluor's preferred suppliers for global projects. Both companies have agreed in this strategic alliance to coordinate operating processes in order to improve the fulfillment of project requirements. Risk reduction, planning acceleration and implementation of large-scale projects are the focal points. ■

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REC is globally the largest producer of polysilicon and multicrystalline wafers for the solar cell industry





■ SolarWorld, USA

# Start to Finish in Four Months

When SolarWorld took over a silicon wafer production facility in Hillsboro, Oregon, in 2007, extensive modifications were necessary. A big challenge was posed by the complex overhaul of the facility so that ultra-pure water could be made available for the new production.

SolarWorld group is one of the world's largest solar energy businesses. SolarWorld's family of companies covers all stages of the photovoltaic value chain, from the raw material silicon to turnkey solar power plants. In 2007 SolarWorld acquired the Komatsu silicon wafer production facility in Hillsboro, near Portland, Oregon. The company has invested about \$100 million to renovate the 45,000 m<sup>2</sup> facility into a world-class manufacturing plant. The Hillsboro facility went on line in 2008 with a capacity of up to 500 MW per year of photovoltaic wafers and cells. A module assembly factory in a second building will begin production in the second half of 2010.

### A job for Siemens Water Technologies

Siemens Water Technologies played a major role with the renovation, providing engineering, equipment,



» SolarWorld chose Siemens as a partner because we were best able to understand their needs. «

Alan G. Knapp, director Semiconductor & Solar, Siemens Water Technologies

site construction and operational services. “We offered an out-of-the-box approach to the ultra-pure water, wastewater and reclaim water systems in the facility,” says Alan G. Knapp from Siemens Water Technologies. The challenge was big and included fundamental modifications, refurbishment and commissioning of a facility that had been stored for ten years, since the original plant had never been tooled. And all of this within four months. Engineers encountered, for example, frost damage to outdoor transmitters and piping on the storage tanks, damaged motors, and instrumentation that no longer functioned or was no longer supported by the original manufacturer.

### Work in every nook and cranny

The water quality and waste treatment needs of SolarWorld differed from what was originally designed, requiring extensive piping modifications as well as new equipment including an oxygen removal membrane system. In addition, pumps had to be brought online, many of which didn’t work because they were not maintained. A team from Siemens Water Technologies developed a proposal to meet the specific project goals of speed, cost, quality, efficient and green operations, reliability, and safety. Sanitizing the system was a real challenge because no one really knew where all the points of use went to on the manufacturing floor. As a result, many hours were spent exploring the facility and entering confined spaces to verify piping integrity and locations. Thanks



Photos: SolarWorld

Reverse osmosis membrane units

to a strong Siemens Water Technologies team effort from multiple business segments, Siemens was able to provide SolarWorld the specified pure water needed to meet the production schedule for the company’s first North American manufacturing facility.

### A sunny future

“SolarWorld chose Siemens as a partner because we were best able to understand their needs and execute efficiently from the local field service branch,” says Alan G. Knapp. “At every step we were able to count on support from all respective Siemens Water Technologies business segments.” To this day, Siemens in Oregon continues to provide site support and solutions for SolarWorld during expansions of the production facilities. ■

### An overview of the challenges facing Siemens

- ▶ From extensive renovation to commissioning in just four months
- ▶ The facility had been stored for ten years and had never been tooled
- ▶ Variations from the original design for water quality and treatment
- ▶ Pumps and bearings had not been maintained

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- Schmid Technology Systems GmbH, Germany

## Another String to the Bow

Gaspare Hilgner from Schmid (right) and Stefan Kreudler from Siemens (left) headed up the Layup Station project as a team. Siemens provided the automation and drive technology – from developing the hardware and software all the way to commissioning.

*Mr. Hilgner, with the inauguration of the Layup Station at the start of the year, Schmid has successfully integrated a further major development in modular processes of its own into the portfolio. What is special about the system in your opinion?*

**Gaspare Hilgner:** More important than my opinion is that of our customers', and from what they say it seems they are very satisfied with the module cycle time and the extremely compact system design. The print surface size, for example, is without parallel in the market. With our Layup Station we can apply approximately 50 MW and have also been able to prove that it arranges with very high precision. Everyone is very satisfied with the annual output we guarantee. Customers also appreciate the fact that our unit can be integrated modularly into existing lines, even in those from other manufacturers.

*Mr. Kreudler, you and your colleagues at Siemens had very little time between November and January to answer the exacting requirements for the module's automation concept. What was important for Schmid?*

**Stefan Kreudler:** Compared to our competitors for the contract, our comprehensive concept encompassing development, hardware, software, service and budget was what sealed the deal. Thanks to the cooperation with Mr. Hilgner, it was possible to implement the project on time and without problems.

**Gaspare Hilgner:** In particular, it was important to us that Siemens help us with choosing the hardware components, advise us on the control cabinet planning and provide technical assistance for calculating the theoretic braking distance of the linear motors in armature short-circuit braking – to name but three examples.

*What makes Siemens the right partner for this in your eyes?*

**Gaspare Hilgner:** The advantage with Siemens is that the group can provide all elements of automation, including all functionalities. Also, with their global presence they are always close to their customers. With 15 international locations, we too have a global presence and must therefore be able to deliver spare parts quickly when servicing is required. It is simply not an option to have a system down for two or three days.

*Are there things that Siemens is able to offer you that other providers cannot?*

**Gaspare Hilgner:** The issue of security is becoming more and more important. Siemens is in the position to integrate safety technology – an area where we have already had very positive experiences in other projects. The Siemens solution means no additional hardware components are needed to evaluate safety

sensors. The function Safety Limited Speed (SLS) was implemented with a single absolute encoder.

**Stefan Kreudler:** We're doing everything we can to make sure that the system can be used easily even when, for example, small corrections need to be carried out or a product changeover is due. With Safety Integrated, we have met Schmid's requirements for a safe reduced drive speed with motors from other parties. The solution is very easily serviceable and Schmid does not require service technicians from Siemens in the event of a disruption.



The project team, from left to right: Stefan Kreudler, Thomas Pflugfelder, both from Siemens; Uwe Keck, Gaspare Hilgner and Martin Tomaszewski, all from Schmid. Not shown is Reinhard Jacob, from Siemens

**Gaspare Hilgner:** That's right. Also the amount of wiring required in the control cabinet is significantly reduced with the safety function via Profisafe. For our customers this translates into reduced times for disassembly and reassembly of the Layup Station.

*What challenges did you face during commissioning?*

**Gaspare Hilgner:** Since it was the first time for us at Schmid to install a Siemens Motion Control System (Simotion D445), we were glad that Siemens representatives assisted with commissioning the system on site for our customers. We are focusing on acquiring the relevant know-how and want to be able to carry out programming and commissioning without extra assistance as soon as possible.

**Stefan Kreudler:** This is precisely what we mean by our motto "learning by doing." We provide support where necessary and then take a step back – in the positive sense.

*Siemens will surely be called upon for advice on customer-specific engineering modifications for the next Layup Station contracts Schmid receives?*

**Stefan Kreudler:** Not necessarily. We have already taken applications for both Schmid machine types into account in the development phase. A solution for both system types was developed for both single- ▶▶



A Schmid employee operates the Multi Panel 377 touch



Simotion/Sinamics drive units

► and double-sided string transferal. No additional engineering is required, nor any software adaptations. The system can therefore be started up quickly.

**Gaspare Hilgner:** This was a priority for us right from the start, since we hope to implement the application on a large scale for our customers. Only the teach points and formulation have to be adjusted for new situations.

*We can tell from this interview that you're a well-practiced team. How would you describe your work together?*

**Gaspare Hilgner:** At all times I had the feeling that we were all working with a common goal. A good relationship on a personal level is a great advantage in working together and it benefits the outcome. This good relationship was important as we continually had to make adjustments during the project, which required a great deal of flexibility from Siemens. Those who imagine that a large group is impossible to work with are wrong. In reality, we enjoy a successful cooperation everyday with Siemens employees

and not with some faceless corporate body. This human interaction works perfectly. The Layup Station is in fact only one of many areas in which we work together with Siemens.

**Stefan Kreudler:** That's absolutely right. For our part we also really appreciate that Schmid is considering us with regard to new innovations, which is a great show of confidence. This is really exciting for us, as Schmid is a leading company in terms of technology, and one that continually develops its systems rigorously in line with the process. Schmid sells technology and overall processes, which is what makes the company so strong. Furthermore, there are already clear signs that the process stages will become even further consolidated in the future, and we look forward to presenting our own ideas in this innovative environment. ■

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Layup Station with the Tabber Stringer

### The Layup Station from Schmid

The Layup Station's portal-axis system allows exact arrangement of cell strings in a uniform matrix on the glass with EVA foil. The strings are transferred automatically by the Tabber Stringer's stringer unit to the Layup Station, where they are taken on by a gripper system. Camera systems check the strings for breakages, orientation and performance, and defect strings are separated. Two combined cutting-bending units shorten the bus bars to the required length and bend them to exactly the desired angle before they are positioned on the glass plate with EVA foil.

## Drive technology from Siemens

### Development

- ▶ Support and consultancy for choosing hardware components used in the system
- ▶ Use of an absolute encoder with SinCos signal tracks on the drive shaft of the double gantry systems
  - ▶ no reference run required
  - ▶ only one encoder system per motor
  - ▶ reliable actual value detection for safely reduced speed
- ▶ Safely reduced drive speed for where motors from other parties are used
- ▶ System operation inside the system via a Mobile Panel 277
- ▶ Controlled stopping of the drives in the event of power failure
- ▶ Buffering of the control voltage by integration of a UPS
- ▶ Calculation/dimensioning of the armature short-circuit function for stopping the axles, even in the event of drive disruption (independent stopping for the gantry system)
- ▶ Control-cabinet planning
- ▶ Considerable space was saved in the control cabinet by using an FCPU, and amount of wiring required for the safety technology was minimized
- ▶ Installation of only one control system for automation and safety technology



A Schmid employee at the Mobile Panel for teaching positions during active SLS inside the machine

### Drive hardware

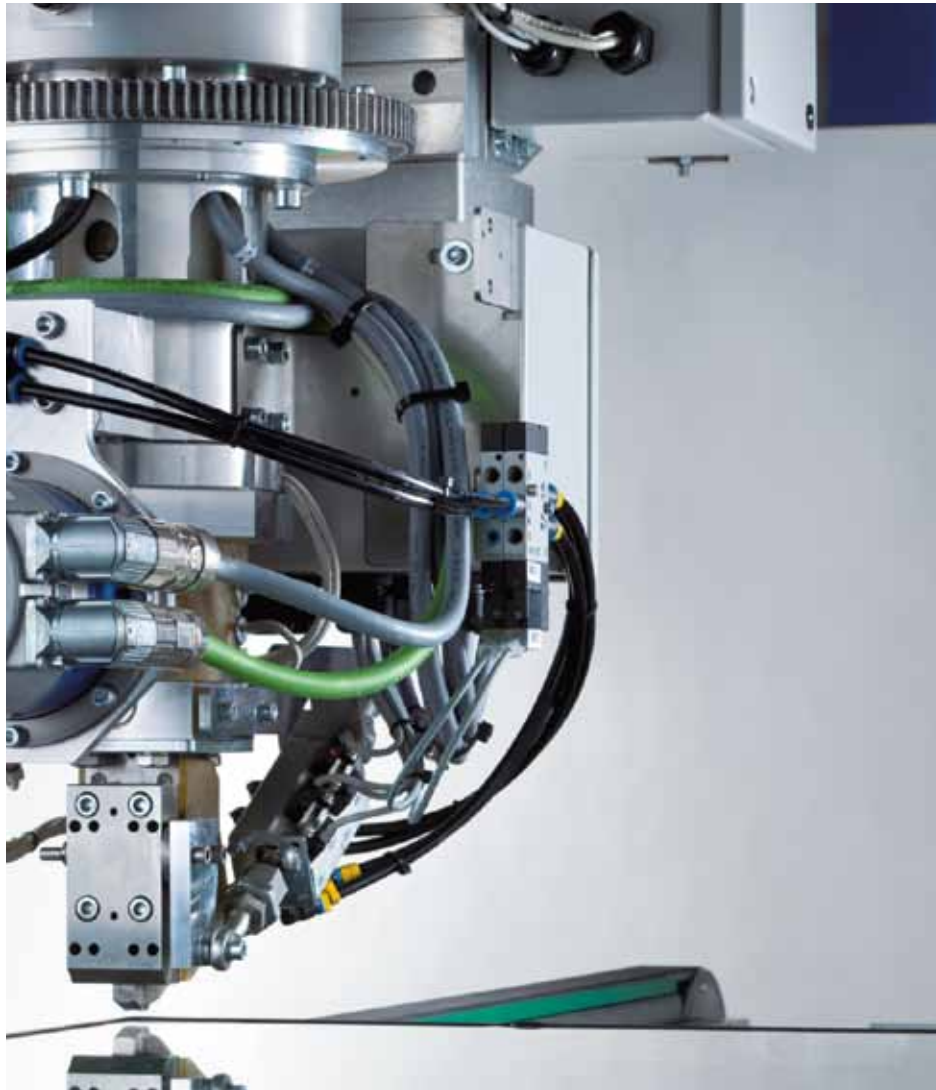
- ▶ Short cycle times thanks to the use of multi-axle path interpolation in the Simotion control
- ▶ Safety functions integrated into the drive
- ▶ Control of the safety functions via PROFIsafe
- ▶ Use of an Active Line Module to compensate for fluctuations in mains voltage
- ▶ Controlled stopping of the drives in the event of power failure without extra drive components



Simatic ET200eco for connecting the distributed peripherals, rotary grippers for the strings

### Drive software

- ▶ All positions/stations in the machine are recorded via various teach routines and archived in Simotion
- ▶ Jog mode, positioning of individual axles and teaching with a Mobile Panel MP277 in setup mode with safely reduced speed. Special feature: System operator inside the machine
- ▶ Material protected by rotation via automatically generated cam profile interpolation
- ▶ Programming according to Siemens Application Styleguide
- ▶ Use of standard components from the Simotion Easy Basics library (e.g., OMAC operating mode manager, FBCreateCam for generating cam profiles)
- ▶ Use of Simotion Handlings Toolbox for carrying out multi-axle path interpolation
- ▶ Extensive monitoring of the gantry system integrated into the Simotion
  - ▶ incline-angle monitoring of the parallel axles
  - ▶ fully automated collision monitoring of the gantry system for double-sided string application via definition of areas (kinematic zone, working area, product zone, restricted area)
- ▶ Coordinated error handling (mirroring of error response by one parallel axle of the other)
- ▶ Error monitoring of the parallel axles (identical drive behavior to avoid mechanical damage)
- ▶ Software development appropriate to Layup Stations with single- or double-sided string application
- ▶ Teaching and alignment routines/alignment calculations for alignment/orientation at right angles to the depositing surface/glass, developed individually for the Layup Station



■ **Bystronic Lenhardt GmbH, Germany**

## Sealing with Drive

**Drive-based motion control enables extremely dynamic and precise application of butyl on semiconductor thin-film substrates.**

**T**he first system in the world to allow fully automated continual application of thermoplastic butyl sealants on semiconductor thin-film substrates is in production in Germany's Black Forest region. The manufacturer is Bystronic Lenhardt GmbH based in Neuhausen-Hamberg, a subsidiary of the Bystronic glass group. The group has already explored the basic principles of horizontal photovoltaic

TPAs (Thermo Plastic Applicators) with its tried-and-tested solutions for sealing insulated glass windows. "With Siemens' support, we have further developed the systems in essential areas and adapted the automation concept that was previously based on PLC and CNC to the Simotion D Motion Control System," says Dr. Christian Daniel, technical manager at Bystronic Lenhardt. Integrating this system means

interfaces can be eliminated and cycles times can therefore be reduced. The high-performance motion control and communications functions also ensure faster processes and precise, repeatable results.

### Motion control and PLC in one

A Simotion D445 forms the heart of the new automation solution and combines motion control, PLC and technology functions in a single device. The motion-control unit of the system is housed in the modular Sinamics S120 drive system in a compact book-size format. This provides complex motion control of the applicator's ten servo axes, operated continuously by Siemens High Dynamic 1FK7 motors. The Simotion system also controls all other processes of the applicators, simplifying coordination significantly and making it possible to eliminate previously unavoidable downtimes.

### Motion control in top form

The Top Loading standard library, specially designed for handling applications with Simotion, enables optimum motion control for the applicator head. This is done by interpolating smooth and at the same time highly dynamic path motions from the few polynomial descriptions generated in the CAD system – particularly relevant when changing directions in corners, making sure motion is not abrupt but that it follows a smooth radius. For changes of direction, the rotation of the applicator head is coupled to the transverse motion by means of an electronic cam. This makes it possible to adjust the motion speed and therefore apply more sealant in the corners, and allows optimum sealing all over the module.

Another new feature is the connection of the operating panel via Industrial Ethernet using the latest OPC XML mechanisms. This means the machine can transfer up to 3,000 variables in less than 100 ms, as is required, for example, to quickly archive process data.

### Reaching goals more quickly

Thanks to this integrated solution, it is no longer necessary to align PLC and CNC parts during engineering stages, and using the Top Loading standard library significantly reduces the amount of programming required. Simotion also allows programming in the user-friendly standard language Structured Text (ST), and makes it possible to easily insert stops in the program to simplify troubleshooting. The high-performance Trace functionality from Simotion also assists troubleshooting by rapidly providing an overview of the technology and processes. "All this together results in a significant reduction of development and commissioning time, allowing us to reach our goals more quickly," says Jürgen Schnorr, head of Engineering. Bystronic Lenhardt makes use of the

many possibilities of scripting with Simotion, such as for automated parametering of projects and of identical axes. Version management is another potential area of application. When a project is opened, a script automatically checks if there is a newer version of the relevant library or software module. The operator then has the choice to update or not. Another script assists in preparing the integration of safety functions such as SS1 (Safe Stop 1) and STO (Safe Torque Off) into the Sinamics S120 drive system, and therefore also helps save valuable time.



The tried-and-tested horizontal photovoltaic TPA (Thermo Plastic Applicator) for sealing insulated glass was further developed for sealing solar modules with butyl

### Simulation supports evolution

Commissioning times can also be greatly reduced by simulating the entire application on an office PC in advance. This means a machine can be mostly pre-programmed, tested and optimized before commissioning so that all work on the actual machine won't have to be carried out all at once during the often short and problematic commissioning phase in which the various components of a line are aligned with each other. ■

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■ Mecasolar and Rios Renovables, Spain

# Racing with the Sun

Simatic S7-1200 tracks photovoltaic systems precisely to the sun.

Photovoltaic systems are at their most efficient when the sun shines as vertically as possible onto the collector surfaces and no shadow falls onto the solar cells. However, the sun's radiation is subject to daily and seasonal as well as to weather-related fluctuations. For stationary installed photovoltaic systems, a reduction in the electricity yield over the day and over the year is par for the course. But not for photovoltaic systems in which the panels and modules are mounted on a moving support system. Using robust tracking systems, these movable panels come very close to achieving the goal of maximum exploitation of solar energy and thus the highest-possible electricity yield.

## Rotating and tilting to coordinates

The course of the sun changes constantly during the day and over the year, and its course is different everywhere in the world. For tracking based on astronomical information, data from the sun's path is converted into individually parameterizable control programs for any location on the globe. The Simatic S7-1200 controllers on every tracker enable the trackers to not only simulate the astronomical movement of the sun but also to adapt to climatic conditions. An added feature of the S7-1200 is that the trackers can be controlled remotely.

The controllers determine the optimum radiation coordinates on a daily basis so that the photovoltaic modules can follow the course of the sun from east to west, and the sun's rays always hit the surface of the modules at an angle that allows maximum conversion of the radiation. The photovoltaic modules are moved and tilted azimuthally, i.e., vertically in relation to the radiation, and zenithally, i.e., horizontally. The azimuthal movement is performed by a gear rim that turns the complete carrier plate from east to west once a day. The second, zenithal movement is made by a threaded rod or rack that tilts the carrier plate towards the sun. The solar panels can withstand wind speeds of up to 130 km/h, and a vertical position can be programmed for wind speeds up



to 70 km/h. The PLC programming also enables the tracking units to respond to snow, thunderstorms, fog, darkness and wind. Both carrier axes are moved by three-phase current motors. Every tracking system has its own PLC controller and an independent electrical switching system.

### Automatic tracking with Simatic S7-1200

A Simatic library that runs an astronomical algorithm is stored in every CPU. The library is the heart of this application: the position of the sun (sun vector) is determined exactly by an astronomical algorithm. The library provides nominal values for controlling the motors that move every single carrier plate. Data for various astronomical and geographical parameters can be saved in the control program for a broad time span with minimum uncertainties ( $\pm 0.0003$  angular degree). Parameters such as longitude, latitude and exact time are required to compute the necessary angle of inclination of the sun vector in short cycle times and to control the movements of the trackers.

All the tracker movements of a solar park are visualized and monitored centrally with an OPC Server in a central station. The Simatic library offers efficient engineering support for the Simatic Net OPC Server visualization system.

The Fustinana Solar Park in Navarra, Spain, operates with equipment from Mecasolar and Rios Renovables

### Robust and simply efficient

If the incident angle is very flat and the shadow cast is accordingly long, for example in the mornings and evenings, the controller automatically moves the modules into (tilted) position so that the modules do not cast shadows on each other and the efficiency stays as high as possible. At night, the panels adopt an almost horizontal position. The panels are immediately moved to a safe position in storms. This is all taken care of by the control program. For this, Simatic S7-1200 relies on dependable automation hardware that has already proven effective in industrial applications even under harsh ambient conditions. The reliability and longevity of the standard products are highly valued for these applications. The fast availability over many years minimizes downtimes so that Mecasolar and Rios Renovables can safely offer a ten-year warranty. ■

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### Robust tracking systems in worldwide service

Mecasolar and Rios Renovables develop, build and sell tracking systems through a company called Proinso. The tracking systems are able to increase the yield of photovoltaic solar energy by more than 35 percent. The Spanish company Mecasolar belongs to the OPDE Group (as do Rios Renovables and Proinso) and has one of the greatest production capacities for sun trackers worldwide. Approximately 14,000 trackers are produced at five production sites in Spain, Greece and the United States and assembled and connected at solar parks worldwide – in Spain alone at more than 20 solar parks. Up to 90 m<sup>2</sup> and 13 KWp of PV modules made by different manufacturers can be installed flexibly in pre-fabricated frames. Some 500 of these solar trackers align the solar panels exactly to the sun at the Fustinana Solar Park in Navarra, Spain, which, with an output of 5 MW, is one of the world's biggest energy parks.

■ Semprius, Inc., USA

# Concentrating on Efficiency

The potential of concentrated photovoltaic (CPV) is undisputed. Semprius and Siemens have taken the first steps toward making the technology more efficient and economical.

At the 2009 Intersolar in San Francisco, Peter Krause, Business Segment manager at Siemens in the United States, got into a conversation with the person next to him in the hotel elevator who noticed the Siemens logo on his shirt. They introduced themselves and Peter Krause learned he had just met Joe Carr, President and CEO of Semprius.

## Having the same focus

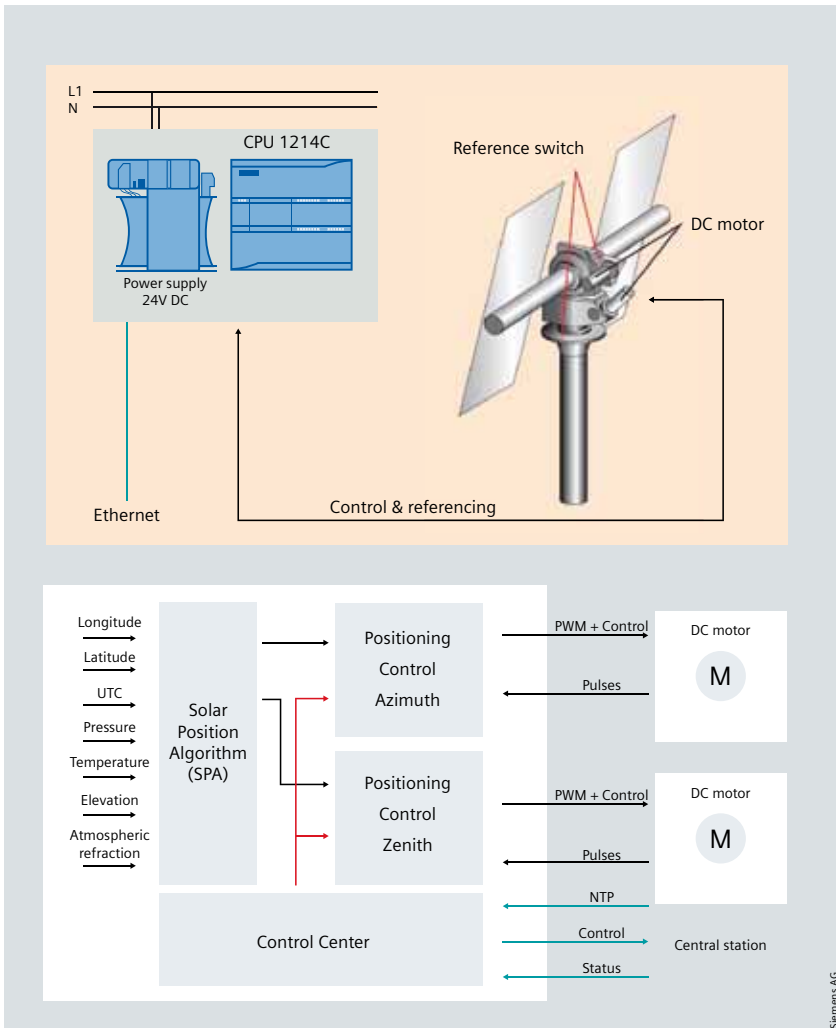
This elevator meeting set the ball rolling on further discussions that would lead into joint activities in January 2010. The two companies signed an agreement in regard to the joint development of a demo system based on a CPV module array by Semprius with a Solar Tracking Control system by Siemens. “It was soon apparent that we all had the same focus, and so we joined forces to establish an ambitious development partnership in which each company would contribute its own technology,” recalls Peter Krause the early days of the partnership with Joe Carr’s young company.

## Patented production method

Located in Durham, North Carolina, Semprius has been active in the market since 2008 and is known for its innovative high-performance CPV modules. The key to this success is a patented production method that includes a unique process for transferring the solar cells onto the substrate. “Our PV module arrays will make the generation of solar power economically viable in clear, sunny climates found in many parts of the world,” explains Joe Carr. “We are excited about teaming with Siemens to demonstrate the value of this technology.”

## Drive and control systems by Siemens

For the demo system, Siemens provided the Simatic S7-1200 automation system and special software for the double-axis tracking of the photovoltaic array. The azimuth and zenith axes are adjusted by DC motors, which are mounted on a TD 20 drive from Siemens. Siemens is leveraging a state-of-the-art solar position algorithm (SPA) that was converted into a Step 7 Basic executable code. The Simatic library with the SPA is used. Semprius and Siemens are focusing on optimizing positioning accuracy in order to offer potential customers a high-quality and at the same time economical solution.



Siemens AG



Fraunhofer

### More on research

by Dr. Andreas W. Bett,  
Deputy Director of the Fraunhofer Institute  
for Solar Energy Systems ISA

Concentrating sunlight using an inexpensive lens is relatively old as a way of reducing the costs in producing photovoltaic energy. In recent years, developments in the field of high-efficiency compound solar cells and modules have made the technology more market-ready. Cell efficiency levels are now at over 40 percent and the current efficiency level of AC systems is 25 percent. This means that in sunny locations it is now possible to achieve a cost efficiency of 15–20 euro cent/kWh. This progress will allow concentrating photovoltaics as well as standard photovoltaics to access new markets, in particular in the power station sector. I expect the efficiency levels of cells and modules to increase even further in the future, so costs will soon be even lower.

### On the way to grid parity

In the spring the demo system was configured with Step 7 Basic. Next, the prototype was completed, installed and finally commissioned at Semprius in Durham, North Carolina. The surface of the array measures approximately 12 m<sup>2</sup> with 1.5 kWp. Semprius is currently gathering experience with the demo unit and is working with Siemens to improve it step by step to finally exhibit it around the world. “Competitive project-deployment cost for CPV will be the key for the success of this technology. Combining Siemens’ automation and control equipment with Semprius module arrays has the potential to deliver electricity at grid-level prices to both industrial and utility scale customers,” concludes Peter Krause. ■

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### The solar market in the United States bucks the trend

Despite the economic crisis, the solar industry in the United States recorded growth in 2009. PV systems and solar power plants produce 2,100 MW of energy in the U.S. – enough to provide 350,000 households with electricity. Although this amounts to less than 1 percent of the country’s total energy requirements, experts believe that in future years solar energy shows the best potential for growth in the renewable energy sector. In 2009 some 481 MW were installed, nearly half of which were in California. In terms of new installations, the U.S. ranked fourth globally, behind Germany, Italy and Japan. Going by total amount of solar energy produced, the U.S. also ranked fourth, at approximately 2,100 MW. Around half of this figure again is from California. Turnover in the U.S. solar industry also saw significant growth of 36 percent in 2009. Over 45,000 jobs depend either directly or indirectly on the sun.

The PV solar market in the U.S. amounts to 800 MW (\$1.8 billion) and is set to grow by over 50 percent annually until 2013 to 3,500 MW. Where turnover is concerned, this will mean an average growth of 25 percent. The largest portion of this growth will come from thin-film modules, with an increase over the next three years of 240 MW to 1,500 MW. This will be followed by growth in monocrystalline modules (285 MW to 1,025 MW) and polycrystalline modules (295 MW to 1,030 MW). As for polysilicon production, the U.S. is far ahead of Germany with a predicted growth of 44 percent in 2010. Wafer production is also set to grow by around 6 percent in 2010. China is far ahead here with a predicted growth of 90 percent.

Manufacturing plants, however, are experiencing less dramatic growth in turnover. By 2013 analysts expect an average growth of 17 percent from currently \$360 million to \$705 million. This is less than in Canada (26 percent) and in the other countries in North and South America (40 percent). Growth of 7 percent is predicted in ingot processing and similarly modest results are expected in wafer plants, at 3 percent. Turnover in cell manufacturing plants should see 6 percent growth on average, and experts believe the handling equipment sector will experience 8 percent growth over the next three years.



### The Siemens inverter family

- ▶ Conversion efficiency >98 percent
- ▶ Best performance ratio
- ▶ Simple to install
- ▶ Low service and maintenance costs
- ▶ Extremely robust, long service life

- Gehrlicher Solar AG and Kemper Solar GmbH, Germany

# Simply Transformational

Inverters are a vital part of site installations. Siemens provides the right concept for every need.

Photovoltaic systems transform direct current into alternating current, which is then fed into the grid. Choosing the right inverter is an important decision, since it is key to achieving the highest possible return on investment and maximizing conversion efficiency. Kemper Solar GmbH and Gehrlicher Solar AG are two of many companies that have chosen Siemens Sinvert PV inverters. The three-phase grid-feed system – complete with other services such as system planning and monitoring as well as provision of medium-voltage components – genuinely excels in medium-sized installations of 10 kW and up, and in large plants and solar power stations from 500 kW to the megawatt range. For the commercial segment, Siemens offers 10 kW to 20 kW Sinvert PV inverters; for the power plant segment there are high-efficiency Sinvert PV inverters with ratings from 350 kW to 2 MW.

## Kemper chooses Sinvert PVM10

Kemper Solar GmbH has invested in a solar park with 20 free-standing, elevated PV systems with their own tracking systems. The park, located in Vreden, Germany, connected to the grid in June 2010. The demonstration and test facility in Vreden, where the company is headquartered, is expected to achieve up to 250 kWp. Five Siemens Sinvert PVM10 inverters form part of the system and are contributing to its success. Alexander Lenfers, project manager at Kemper Solar GmbH, explains why the company chose Siemens: “Thanks to their protective housing,

these components are ideal for outdoor use on the tracker mast, and they integrate communications and also deliver great performance. We have been looking for inverters with these characteristics for a long time.”

## Sinvert TL series wins over Gehrlicher

In late December 2009, Gehrlicher Solar AG completed an open-space photovoltaic plant at Rothenburg/Oberlausitz airport. With a total peak output of 21 MW, the new 68-hectare solar park is one of the largest in the German state of Saxony and the company’s most powerful to date. For this project too, Siemens made the running with its expertise in inverters, providing a total of 11 container units for the solar power plant. “This is the debut deployment of our transformerless Sinvert TL, which is particularly suitable for large PV systems,” says Siemens PV expert Reza Foroutan about the challenge. System integrator Gehrlicher is using the WinCC system for visualization and monitoring as well as numerous generator junction boxes and other components for PV plant monitoring. All medium-voltage equipment such as transformers and switchgear systems is also from Siemens. ■

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■ **Siemens Forchheim, Germany**

## A Place in the Sun

The PV system on the roof of the Siemens Healthcare facility in Forchheim, Germany, is a showcase project for performance and teamwork. The conversion efficiency of the modules exceeds 18 percent, and all three Siemens Sectors – Industry, Energy and Healthcare – worked hand in hand.

It's a good sign when we can follow words directly with deeds. Since late 2008, the roof of the Siemens Healthcare X-ray manufacturing facility in Forchheim has sported a PV system that is emblematic of the Siemens commitment to green technologies. With approximately 3,600 solar modules delivering a conversion efficiency of over 18 percent, the solar power plant is highly efficient and profitable. The monocrystalline modules from Sunpower Solar each deliver an excellent 225 watts of power per panel. Each year the plant produces more than 750 MW/hr of climate-friendly electricity – a third more than conventional installations of this size.

### Hand in hand

The team from Siemens Energy planned and set up the PV system and put it into operation. The Industry Division not only contributed inverters, switch-gear technology and transformers, but also connected the finished system to the local power grid. Thanks to the advanced technology, the plant has been providing maximum power delivery for almost two years. ■

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■ Eolia Renovables, Spain

# A Quarter-Century of Trust

Siemens is providing the entire electro-technical equipment for one of the world's largest solar parks in Alicante and for three further PV systems in the region. The group is also responsible for maintenance and service as well as for technical operations until 2024.

Three kilometers from Beneixama in Spain's Alicante province is one of the largest photovoltaic parks in the world. More than 100,000 solar modules making up 200 individual systems, each with an output of 100 kW, are able to provide electricity for 12,000 households. This 500,000 m<sup>2</sup> site is operated by Madrid-based Eolia Renovables, one of the leading European operators of wind and solar power plants. The group operates three further photovoltaic systems in Mahora, Bonete and Alconchel. Siemens provided the entire electro-technical equipment for the four solar parks – which have a total output of over 45.8 MW – from the cabling, the Sinvert PV inverter system and transformers all the way to the WinCC visualization system.

## A full-service contract

At the end of September 2009, Eolia Renovables also entrusted Siemens with the maintenance and technical operations for the four photovoltaic systems, in-

cluding the Sinvert 100 inverter. This also entails providing all electrical equipment and constant monitoring of the systems. The focus of the contract is service for the technical equipment and reaching high availability. Siemens will additionally procure and supply spare parts throughout the entire period of the contract. Access control is another responsibility the group will take on. The duration of the full-service contract is 23 years for the Beneixama, Mahora and Bonete locations, and 24 years for Alconchel. The services provided by Siemens at Eolia Renovables are part of the Simain service portfolio for integrated system maintenance.

## In good hands

“We chose Siemens as a partner, having been convinced by their impressive products, solutions and services for photovoltaic facilities. Another major decisive factor was having a reliable partner for the entire term,” says Fermín Matesanz from Eolia Renovables. ■

### Overview of services provided by Siemens

#### Products

- ▶ The entire electro-technical equipment for the four solar parks – from the cabling, the Sinvert PV inverter systems and transformers all the way to the WinCC visualization system

#### Services

- ▶ Service and maintenance as well as technical operations for the four photovoltaic systems

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■ Service from Siemens

# The No-Worries Package

| Optimal machine service worldwide with the Siemens repair contract

Its official Siemens name is just “repair service contract.” But a more apt title might be the “no-worries-package” or “insurance.” For a very reasonable flat-rate fee, machine manufacturers who use Siemens components can transfer the risk of having to repair defects on operational machines. Specifically, if there is a problem with a system, the Siemens service team takes care of the repair – immediately, anywhere in the world. This enables OEMs to plan costs with greater reliability.

The repair service contract, with a duration of 12 or 24 months, includes a range of services such as trained staff, on-site troubleshooting and fault correction, plus documentary evidence that the customer’s problem has been resolved. Cover under the Siemens contract begins when the machine is installed on the customer’s site and has gone into permanent operation. In the event of a problem, the ser-

vice engineer can use the certificate number to immediately retrieve all the salient machine data. And, with no order preparation work to slow things down, the machine is soon ready to go back into productive operation.

The process of entering into a service contract is equally transparent. During the online registration, contract and equipment details are recorded. In the event a repair service call is required, the details can be retrieved quickly via secure authorization procedures – ensuring all the information is on hand when and where it is needed. ■

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## Mechatronic support: saving time and money with virtual prototypes

Mechatronic support is a range of services from Siemens for optimizing and evolving machines that are already in operation, and up-fitting them for more challenging requirements. Enabling equipment to be reviewed and reworked virtually, the service not only saves customers time but also delivers significant cost savings.

Experience shows that, over an extended service life, machines tend to gradually grow out of sync with modern requirements. Frameworks and environments can also change, necessitating further development. A detailed analysis of the machine is conducted to stake out what changes are needed to bring the machine into line with requirements, and what potential the system concept offers. Through simulation and virtual prototyping, the machine’s

properties can be represented with precision on a PC. It is also possible to simulate different levels of development. The advantage for customers is that they can identify and cost each of a variety of possibilities, and make a decision – even at this early concept phase – on which solution makes the best commercial sense. Working with the results of this analysis, the engineers then build virtual prototypes. The outcome is a simulated machine model. With development still at a very early phase, design changes can be made to this model very easily. The virtual prototype already has all the relevant features of the real machine. Accordingly, Siemens can present customers with a coordinated system concept after a relatively short development time, which reduces costs and accelerates time to market.

# When will this be the standard on earth?



**With the right manufacturing technology and innovative processes, maximized efficiency will become reality.**

The solar industry's market potential will increase exponentially. To put the sun to use economically, the efficiency of all individual components has to increase as well. With efficient processes, products and solutions to continually increase product quality, we are providing a solid base for manufacturing highly efficient solar energy components. With many years of experience in this industry, we are offering you an inspiring partnership for the future.

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