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David Ridsdale
Editor in Chief

Beware great expectations

An end of a year is the time most people tie up loose ends and prepare for a new journey into the next year. For the solar industry the end of 2012 does not seem an end of a journey but merely a crossroad between uncertainty as the expected market settling will be tested with a rash of industrial cases around the globe. The financial dynamics have changed as new regions kick start their own PV adventures as traditional ones begin to contract. The year ends with an industry overloaded with more product than even this rapidly expanded market could consume and a market divided over what caused the sudden change in fortunes.

One of the things that European strength in the PV industry gave companies was a number of market that were geographically close together. This allowed the early companies to expand faster than if they had been confined to their own areas. The subsidy inspired rapid growth in photovoltaics across Europe gave false inspiration for those seeking a quick return of fortunes and many companies were quick to rush into new regions assuming they were one of the few who had the experience to provide the services required. A quick review of the history of 'gold rushes' shows that whenever such an opportunity arises there is no shortage of willing participants and this was seen time and again as governments announced solar subsidies only to be inundate with more companies than their plans could bear. Each time the subsidies would be pared back due to the 'unprecedented demand' leaving businesses to complain that their expectations were not realised.

The new growth regions are not so geographically close and companies are having to respond to the new global reality of markets spread over vast distances. Solar has always been an industry that has manufactured as close to the end site to reduce cost and damage from transportation of fragile cells or modules. Some companies are struggling to maintain their international status as markets become truly global and growth remains erratic at each region. Careful planning and implementation is going to be required for those companies seeking a long term place in the solar market.

The region that saw the largest growth in new PV companies was China which saw extraordinary growth as manufacturer and consumer after the government made solar and renewable production a high priority in their last five year plan. This rapid growth and subsequent market expansion is the foundation of the issues that will dominate 2013. The basic accusation is that Chinese companies were given an unfair advantage via the China government that made it impossible for many companies to compete. China has responded with accusations of its own and the whole process has engulfed a number of regions around the world. The irony is that much of the declining PV price has come about due to the competition from China. The issue creates a level of uncertainty as no-one is sure how prices will be impacted at a time when consumer confidence in PV has taken a negative path in 2012.

Whatever does happen in 2013, the end of this year sees a slightly more sober and rational industry whose members are either seeking a careful long term path or as rewarding an exit as they can muster. Sadly it is not just technology that will drive the next year as court cases, subsidy choices and politics will provide much of the industry impetus. The best advice is choose your goals and stick with them. The industry will settle and only time will let us know who will be involved.

David Ridsdale
Editor in Chief

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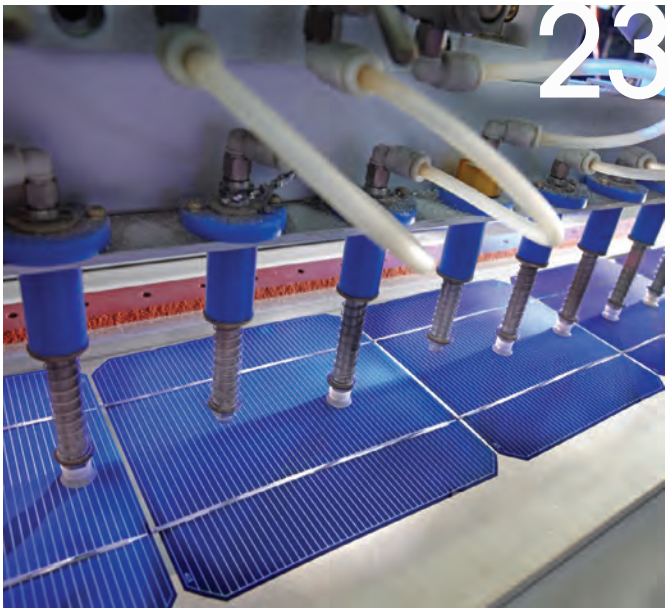

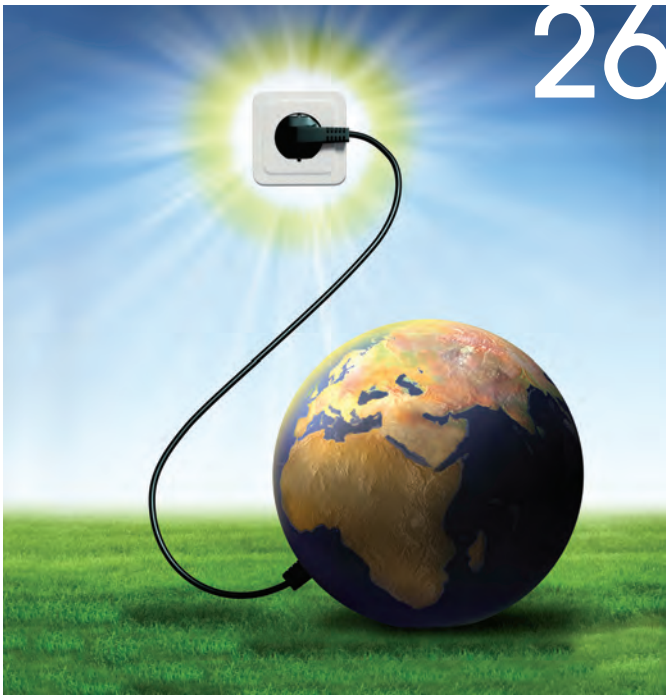

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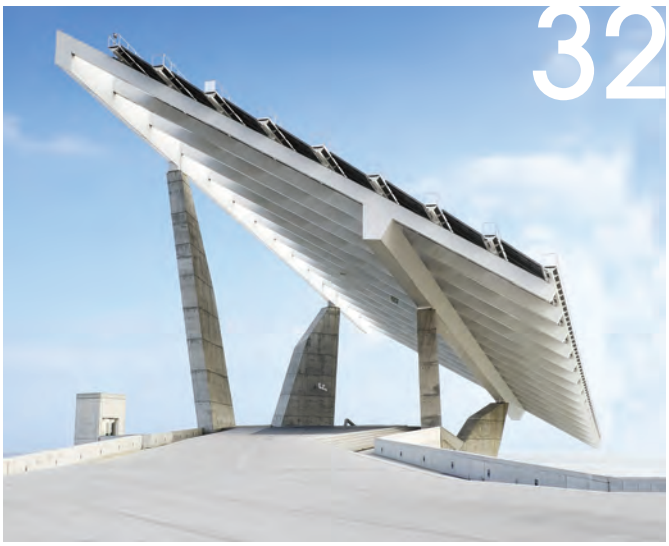

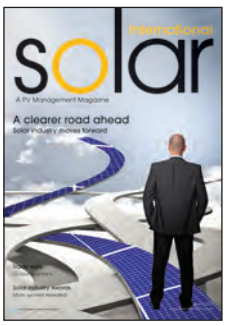

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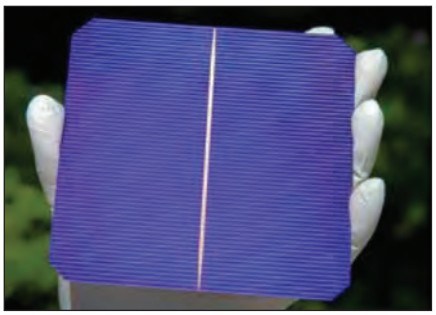
Solar Industry Award winner Silevo achieves 22 % hybrid cell efficiency

SILEVO, INC. has announced that its proprietary tunneling junction cell architecture has achieved 22.1 percent cell conversion efficiency, as measured by Sandia National Laboratories with Silevo's production materials and full-size substrates. This measurement validates that Silevo's Triex PV modules demonstrate one of the highest energy densities in the industry. Moreover, it validates Silevo's roadmap and plan to achieve 24 percent conversion efficiency in mass production over the next few years.

Silevo recently won a Solar Industry Award for innovation for the Triex modules.

In addition to demonstrating excellent conversion efficiencies, Triex hybrid technology is demonstrating real-world energy harvest benefits: California Energy Commission (CEC)'s test results rank Silevo's Triex modules first among modules that employ crystalline silicon (c-Si) layers. The CEC compiles a list of top modules, taking into consideration PV-USA Test Conditions (PTC), which classify module performance at a more realistic, real-world environmental



condition of elevated air temperature. Typically, modules are categorized by Standard Test Conditions (STC), which are measured at a much lower, controlled lab cell temperature. CEC's PTC/STC ratio (real-world performance divided by controlled lab environment performance) for Triex modules ranked first at 93.49 percent, thanks to the technology's inherent value of using materials and a device structure with very low cell temperature coefficients. As a result, its real-world performance is world class for technologies that employ c-Si layers, and its performance ratio exceeds that of all other advanced technologies that employ heterojunction, interdigitated back contact, as well as selective emitter techniques that are being commercialized by players today.

"We are very pleased to be executing according to our technology roadmap by continuing to drive higher power density in achieving 22 percent conversion efficiency. In addition, placing first in a performance ranking in a highly regarded, real-world environment PTC metric further validates the performance characteristics of our proprietary technology," said Zheng Xu, CEO at Silevo. "With our high volume manufacturing capacity ramping, Silevo is truly demonstrating that a new paradigm of high performance to cost ratio modules can further reduce system costs and levelized cost of electricity."

Silevo continues to focus on characterizing quality and reliability performance of its Triex module technology. Triex modules recently passed stringent Potential Induced Degradation (PID) and extended Damp Heat (DH) testing, during which modules are biased at high voltages and also exposed to elevated temperatures and humidity levels.

The PID and DH tests were conducted by RETC, a TÜV SÜD America's partner for PV testing.

Sharp triple junction solar cell conversion efficiency

SHARP CORPORATION has achieved the world's highest solar cell conversion efficiency of 37.7% using a triple-junction compound solar cell in which three photo-absorption layers are stacked together.

Sharp achieved this latest breakthrough as a result of a research and development initiative promoted by Japan's New Energy and Industrial Technology Development Organization (NEDO) on the theme of "R&D on Innovative Solar Cells." Measurement of the value of 37.7%, which sets a new record for the world's highest conversion efficiency, was confirmed at the National Institute of Advanced Industrial Science and Technology (AIST).

Compound solar cells utilize photo-absorption layers made from compounds consisting of two or more elements, such as indium and gallium. The basic structure of this latest triple-junction compound solar cell uses proprietary Sharp technology that enables efficient stacking of the three photo-absorption layers, with InGaAs (indium gallium arsenide) as the bottom layer.

To achieve this latest increase in conversion efficiency, Sharp capitalized on the ability of the new cell to efficiently absorb light from different wavelengths in sunlight and convert it into electricity. Sharp also increased the active area for converting light into electricity through optimal processing of the cell edges. These improvements led to higher maximum output levels for the solar cell and enabled Sharp to achieve a solar cell conversion efficiency of 37.7%—the highest in the world.

Sharp's aim for the future is to apply this latest development success to concentrator photovoltaic power systems that use lenses to collect and convert sunlight into electricity. The company also foresees numerous other practical applications for the cells, such as on space satellites and vehicles.

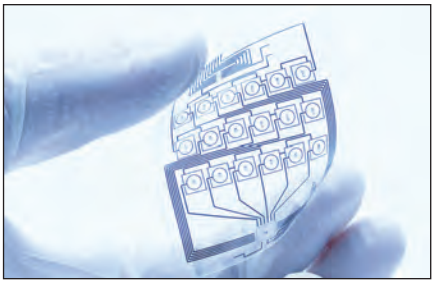
Flexible silicon solar breakthrough

PENN STATE UNIVERSITY is reporting that for the first time, a silicon-based optical fibre with solar-cell capabilities has been developed that has been shown to be scalable to many meters in length. The research opens the door to the possibility of weaving together solar-cell silicon wires to create flexible, curved, or twisted solar fabrics. The findings by an international team of chemists, physicists, and engineers, led by John Badding, a professor of chemistry at Penn State University, will be posted by the journal Advanced Materials.

The team's new findings build on earlier work addressing the challenge of merging optical fibres with electronic chips, silicon-based integrated circuits that serve as the building blocks for most semiconductor electronic devices such as solar cells, computers, and cell phones. Rather than merge a flat chip with a round optical fibre, the team found a way to build a new kind of optical fibre with its own integrated electronic component, thereby bypassing the need to integrate fibre-optics with chips. To do this, they used high-pressure chemistry techniques to deposit semiconducting materials directly, layer by layer, into tiny holes in optical fibres.

Now, in their new research, the team members have used the same high-pressure chemistry techniques to make a fibre out of crystalline silicon semiconductor materials that can function as a solar cell — a photovoltaic device that can generate electrical power by converting solar radiation into direct-current electricity.

"Our goal is to extend high-performance electronic and solar-cell function to longer lengths and to more flexible forms. We already have made meters-long fibres but, in principle, our team's new method could be used to create bendable silicon solar-cell fibres of over 10 meters in length," Badding said. "Long, fibre-based solar cells give us the potential to do something we couldn't really do before: We can take the silicon fibres and weave them together into a fabric with a wide range of applications such as power generation, battery charging, chemical sensing, and biomedical devices."



Badding explained that one of the major limitations of portable electronics such as smart phones and iPads is short battery life. Solar-boosted batteries could help solve this problem.

"A solar cell is usually made from a glass or plastic substrate," Badding explained. "Woven, fibre-based solar cells would be lightweight, flexible configurations that are portable, foldable, and even wearable."

This material could then be connected to electronic devices to power them and charge their batteries.

"The military especially is interested in designing wearable power sources for soldiers in the field," Badding added.

The team members believe that another advantage of flexibility in solar-cell materials is the possibility of collecting light energy at various angles. "A typical solar cell has only one flat surface," Badding said. "But a flexible, curved solar-cell fabric would not be as dependent upon where the light is coming from or where the sun is in the horizon and the time of day."

Pier J. A. Sazio of the University of Southampton in the United Kingdom and one of the team's leaders added, "Another intriguing property of these silicon-fibre devices is that as they are so compact, they can have a very fast response to visible laser light. In fact, we fabricated fibre-based photodetectors with a bandwidth of over 1.8 GHz."

In addition to Badding and Sazio, other researchers who contributed to this study include lead author Rongrui He, Todd D. Day, Mahesh Krishnamurthi, Justin R. Sparks, and Venkatraman Gopalan from Penn State.

Australia phases out solar credits

DUE to continued strong demand for household solar, the Australian Federal Government will phase out the Solar Credits mechanism six months ahead of schedule on 1 January 2013. This will lower the impact of the high uptake of solar PV on electricity costs for homes and businesses. Phasing out the multiplier early will strike the appropriate balance between easing upward pressure on electricity prices and supporting households and suppliers who install solar PV. The overall reduction in electricity bills is estimated to be in the order of $80 to $100 million in 2013.

Installation of small-scale systems and solar hot water heaters continues to be supported under the Renewable Energy Target scheme, with solar PV systems benefiting from generous arrangements that provide support for 15 years worth of generation upfront.

The Solar Credits mechanism has provided additional support for installations of small-scale solar PV by multiplying the number of certificates these systems would usually create under the RET scheme. As this benefit was never available to solar hot water heaters, the phase out puts solar PV and solar water heaters back onto a level playing field.

The multiplier was always designed to reduce over time. Bringing forward the phase-out to 1 January 2013 will help place the industry on a sustainable path and ease pressure on electricity prices. By 2014 the small-scale scheme is expected to cost electricity consumers around 70 per cent less than in 2012.

Consistent with a previous reduction in the multiplier announced in May 2011, legally binding contracts to install supported systems, already entered into will be preserved. The same applies to systems installed before 1 January 2013. Since the Labor Government came to power in, over 880,000 rooftop solar PV systems and over 560,000 solar and heat pump water heaters had support under the Renewable Energy Target (RET).

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World energy outlook cites North America leading energy shift

THE GLOBAL ENERGY MAP is changing in dramatic fashion, the International Energy Agency said as it launched the 2012 edition of the World Energy Outlook (WEO). The Agency's flagship publication, released in London, said these changes will recast expectations about the role of different countries, regions and fuels in the global energy system over the coming decades.

"North America is at the forefront of a sweeping transformation in oil and gas production that will affect all regions of the world, yet the potential also exists for a similarly transformative shift in global energy efficiency," said IEA Executive Director Maria van der Hoeven. "This year's World Energy Outlook shows that by 2035, we can achieve energy savings equivalent to nearly a fifth of global demand in 2010. In other words, energy efficiency is just as important as unconstrained energy supply, and increased action on efficiency can serve as a unifying energy policy that brings multiple benefits."

The WEO finds that the extraordinary growth in oil and natural gas output in the United States will mean a sea-change in global energy flows. In the New Policies Scenario, the WEO's central scenario, the United States becomes a net exporter of natural gas by 2020 and is almost self-sufficient in energy, in net terms, by 2035. North America emerges as a net oil exporter, accelerating the switch in direction of international oil trade, with almost 90% of Middle Eastern oil exports being drawn to Asia by 2035. Links between regional gas markets will strengthen as liquefied natural gas trade becomes more flexible and contract terms evolve. While regional dynamics change, global energy demand will push ever higher, growing by more than one-third to 2035. China, India and the Middle East account for 60% of the growth; demand barely rises in the OECD, but there is a pronounced shift towards gas and renewables.

Fossil fuels will remain dominant in the global energy mix, supported by subsidies that, in 2011, jumped by almost 30% to $523 billion, due mainly to increases in the Middle East and North Africa. Global oil demand grows by 7 mb/d to 2020 and exceeds 99 mb/d in 2035, by which time oil prices reach $125/barrel in real terms (over $215/barrel in nominal terms). A surge in unconventional and deepwater oil boosts non-OPEC supply over the current decade, but the world relies increasingly on OPEC after 2020. Iraq accounts for 45% of the growth in global oil production to 2035 and becomes the second-largest global oil exporter, overtaking Russia.

While the regional picture for natural gas varies, the global outlook over the coming decades looks to be bright, as demand increases by 50% to 5 trillion cubic metres in 2035. Nearly half of the increase in production to 2035 is from unconventional gas, with most of this coming from the United States, Australia and China. Whether demand for coal carries on rising strongly or changes course radically will depend on the strength of policy decisions around lower-emissions energy sources and changes in the price of coal relative to natural gas. In the New Policies Scenario, global coal demand increases by 21% and is heavily focused in China and India.

Renewables become the world's second-largest source of power generation by 2015 and close in on coal as the primary source by 2035. However, this rapid increase hinges critically on continued subsidies. In 2011, these subsidies (including for biofuels) amounted to $88 billion, but over the period to 2035 need to amount to $4.8 trillion; over half of this has already been committed to existing projects or is needed to meet 2020 targets. Ambitions for nuclear have been scaled back as countries have reviewed policies following the accident at Fukushima Daiichi, but capacity is still projected to rise, led by China, Korea, India and Russia.

Water is essential to the production of energy, and the energy sector already accounts for 15% of the world's total water use. Its needs are set to grow, making water an increasingly important criterion for assessing the viability of energy projects. In some regions, water constraints are already affecting the reliability of existing operations and they will introduce additional costs. Expanding power generation and biofuels output underpin an 85% increase in the amount consumed (the volume of water that is not returned to its source after use) through to 2035.

"Our analysis shows that in the absence of a concerted policy push, two-thirds of the economically viable potential to improve energy efficiency will remain unrealised through to 2035. Action to improve energy efficiency could delay the complete 'lock-in' of the allowable emissions of carbon dioxide under a 2oC trajectory – which is currently set to happen in 2017 – until 2022, buying time to secure a much-needed global climate agreement. It would also bring substantial energy security and economic benefits, including cutting fuel bills by 20% on average," said Fatih Birol, IEA Chief Economist and the WEO's lead author.

WEO-2012 presents the results of an Efficient World Scenario, which shows what energy efficiency improvements can be achieved simply by adopting measures that are justified in economic terms. Greater efforts on energy efficiency would cut the growth in global energy demand by half. Global oil demand would peak before 2020 and be almost 13 mb/d lower by 2035, a reduction equal to the current production of Russia and Norway combined. The accrued resources would facilitate a gradual reorientation of the global economy, boosting cumulative economic output to 2035 by $18 trillion, with the biggest gains in India, China, the United States and Europe.

Manufacturing a new class of BIPV

OXFORD researchers have developed a photovoltaic (PV) technology that has the potential to deliver low cost, efficient solar cells that can be readily incorporated into glass building facades. Results just released in the journal Science promise to provide the lowest cost-performance photovoltaic solution on the market.

The technology makes use of a simple manufacturing process with inexpensive and abundant raw materials. Prototypes of these new Meso-Superstructured Solar Cells (MSSC) demonstrated in the journal have already achieved an impressive 10.9% efficiency.

The technology has been exclusively licensed by Isis Innovation Ltd., the Technology Transfer company of the University of Oxford, to Oxford Photovoltaics Ltd (Oxford PV) who were spun out by Isis in December 2010. Oxford PV has since gained experience in developing solid state dye sensitized solar cells for the Building Integrated PVs (BIPV) industry. According to a 2010 Nanomarkets LC report, revenues for BIPVs are estimated to rise to US$6.4 billion by 2016.

CEO Kevin Arthur said: “Our experience with this hybrid technology gives us the perfect vantage point to quickly develop our exciting new MSSCs into commercial products. This new class of solar cells will deliver a massively scaleable product firstly for BIPV market and, as energy conversion performance improves further, for other high volume PV applications. Ultimately we envisage this technology competing directly with grid delivered electricity.”

The key to this new class of solar cell technology lies in combining specifically formulated ceramics with thin films. An MSSC can be printed directly onto glass and processed at below 150° C to produce a semi-transparent, robust layer. Dr Henry Snaith, Chief Scientific Officer of OPV who leads this research, said; “The MSSCs have proven to suffer from few losses to provide a photovoltage of 1.1 volts. The plan is to continuously optimise MSSCs towards the goal of over 20% efficiency. But even as they are today, they will outperform anything else on the market.”

Tom Hockaday, Managing Director of Isis Innovation Ltd., said, “These latest developments keep Oxford at the cutting edge of clean energy technology. We are delighted that Oxford PV has licensed the technology, their expertise will be invaluable in developing this new type of solar cell on a commercial scale

Technology progression

The original embodiment of the DSC was invented by Michael Grätzel and Brian O’Regan at the École Polytechnique Fédérale de Lausanne (EPFL) in 1991.

This class of solar cells is often referred to as Grätzel cells. This relatively new type of low-cost solar cell is based on a photo-sensitized anode immersed in a redox active electrolyte, known as a photoelectrochemical system.

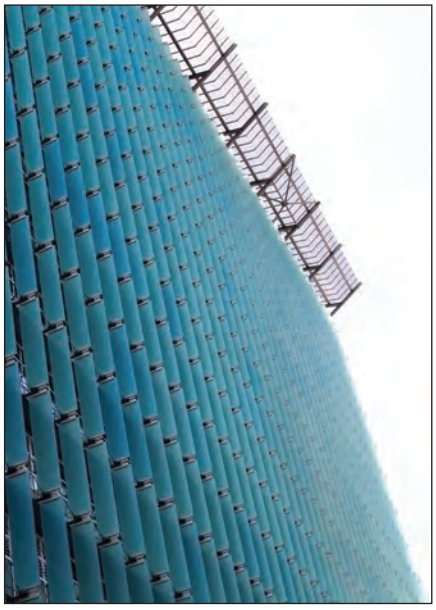
These existing dye-sensitized solar cells, incorporating an iodide/triiodide redox couple in a volatile solvent can convert over 12% of the solar energy to electrical energy. Despite this encouraging and commercially satisfactory efficiency, it is far from optimum.

There are three main areas of concern:

- The ability to effectively scale up the concept as the corrosive nature of the iodide/triiodide couple makes the use of metallic bus lines problematic.
- The liquid state of the electrolyte makes serial interconnection and long term sealing very challenging.
- The is a limitation on the maximum power this system could generate, due to a fundamental loss in energy during the charge generation process.

Oxford PV’s solid state DSC has been specifically developed to overcome these three problems through using a solid-state redox couple, the energy of which can be much more closely matched to the energy of the hole on the dye, minimizing the voltage loss in the dye regeneration process.

Solar energy power conversion efficiencies of over 10% have been demonstrated and devices incorporating this material can deliver open circuit voltages of up to 1.2 volts (c.a. ~0.9V for the original electrolyte cell). The variety of molecular hole-transporters available and



conceivable is also strongly in favour of this generic “solid-state” system delivering efficiencies closer to those of an ideal DSC.

Commercial potential

The team is commercialising technology developed by Oxford University’s Photovolatic and Optoelectronic Device Group, a research team within the sub-department of Condensed Matter Physics. .

Their research is primarily focused on developing the physics and technology for low cost photovoltaic concepts. The materials used include carbon-based organic semiconductors, solution processable ceramics and inorganic semiconductors.

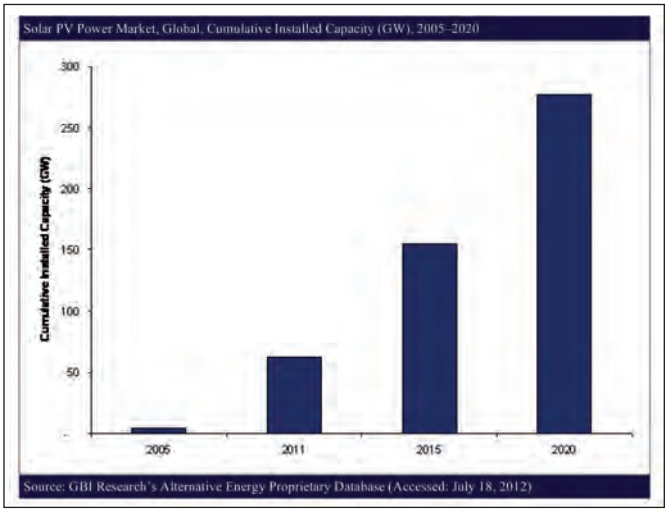
One advantage of these new material families is that they can be processed easily from solution, e.g. using spin-coating, doctor-blade coating and higher speed methods such a Gravure Printing. As a result, devices such as solar cells, light-emitting displays, and transistors will be manufacturable at very low cost.

The photovoltaic concepts the team focus on are Dye-Sensitized Solar Cells, semiconducting polymer / metal oxide photovoltaics and all polymer photovoltaic diodes. They strive to both enhance absolute performance whilst also improving their understanding of the fundamental processes.

Solar growth continues to impress

A new report from GBI Research expects the global solar photovoltaic power market to reach 277.1 GW by 2020. The authors claim that market leaders will achieve grid parity due to decreasing module prices as well as lower maintenance and ease of installation that has come from technological advances.

Solar Photovoltaic (PV) has been transformed into a commercially viable energy-generating technology in the past decade in over forty countries, and has shown robust growth even during economic slowdown, driven by continuous technological advancements, the availability of more effective and reliable equipment and machinery, and continuously improving project economics. The global solar PV market is expanding rapidly, with PV installations growing by 77% in 2011 over 2010. The global solar PV cumulative installed capacity increased at a Compound Annual Growth Rate (CAGR) of 56.4%, from 4.2 GW in 2005 to 62.2 GW in 2011, of which 27.1 GW was added in 2011. With the need to reduce dependence on fossil fuels, growing environmental concerns and increasing awareness, governments across the world are taking steps to exploit renewable energy, especially solar and wind. The global cumulative installed capacity for solar PV is expected to reach 277.1 GW by 2020, growing at a CAGR of 15.9% during 2012–2020.



Europe to lose top position

In 2011, Europe led the global solar PV market, accounting for a share of 76.2%. Countries such as Germany (which is the leading country in the market globally), Italy, Spain, France and Belgium have contributed significantly to the regional growth. However, Europe is expected to lose market share to the Asia-Pacific region. Emerging markets such as India and China, along with Australia, are expected to contribute enormously to the region's growth in terms of solar PV capacity installation. Factors such as increasing government support, growing electricity demand and governments' targets to reduce dependence on conventional resources for power generation are likely to drive the Asia-Pacific solar PV market.

Germany has witnessed stable growth for almost a decade and is the most developed solar PV market in the world, accounting for almost 40% of the total global solar PV market. However, Italy superseded Germany in 2011 in terms of annual capacity installed and connected to the grid

Germany has witnessed stable growth for almost a decade and is the most developed solar PV market in the world, accounting for almost 40% of the total global solar PV market. However, Italy superseded Germany in 2011 in terms of annual capacity installed and connected to the grid. In Germany, nearly 7.5 GW of capacity was installed and connected in 2011, while Italy had almost 9 GW of capacity connected to the grid.

Nearly 3.5 GW of capacity was added in 2010, which was connected to the grid by the end of 2011. This was because of the "Salva Alcoa" decree; according to this system owners would receive 2010 (Feed in tariffs) FiTs if a system installed in 2010 was connected by June 2011, which led to a flood of capacity installations in 2010. Significant capacity connections to the grid were witnessed only in the first quarter and until June, 2011. Thus, by the end of 2011, almost 9 GW of capacity was connected to the grid in Italy.

Grid Parity by 2020

According to the fourth annual solar energy survey conducted by Applied Materials Inc in June 2012, 98% of the world's population will achieve grid parity by 2020. Despite the speculations surrounding solar parity, several factors such as decreasing prices, modular flexibility, low maintenance and ease of installation make photovoltaic cells attractive long-term prospects for mass production and application in many parts of the world.

The global annual growth rate for the photovoltaic industry has been approximately 25% per year, taking into account the recession in 2009. These inspiring growth rates have also led to improvements in manufacturing efficiencies in the industry. European nations, mainly Italy, France, Germany, Spain and the UK; Asia-Pacific countries such as Australia, China and India; and North American countries – mainly the US – are the market leaders in terms of achieving solar grid parity.

Open market key to **global success**

The solar industry has been hit with a number of potentially divisive situations in the last couple of years. Many of these pressures are external from energy competition and changing government support. Potentially the most divisive is the current trade disputes developing around the world. Sadly the industry's biggest fights are now internal. Dr. Shawn Qu, Chairman and CEO of Canadian Solar provides his opinion on why he believes open markets are a key asset for future growth and employment in the European solar industry

Solar produces affordable and clean energy and thus creates the jobs and opportunities that will sustain the growth of the European green economy. The future path to success and competitiveness of solar energy, however, is currently at stake: Some European solar manufacturers try to gain individual advantages in the current industry crisis by calling for protectionist measures against Chinese competitors. This attempt to protect markets from competition does not do the European solar industry any service. Just the contrary – protectionist measures would set in motion a process that would be disastrous for all the parties involved.

Throughout the world subsidy cuts, excess capacity and pressure on prices are creating problems for the manufacturers of solar modules in particular. The challenges that European module producers are facing in this market situation, however, have not been caused by the foreign competition. Rather, many European solar producers have focused their business strategies too narrowly on a few European markets and their attractive public support – which helped mainly German manufacturers to grow their companies in the first instance and to reach leadership positions in the young solar industry. But in the longer run, these companies have been lacking a strategy beyond the mere reliance on the benefits from the system. Many of them simply have failed to adapt their business models fast enough to the changing market environment.

In the last ten years, the solar market has experienced a very substantial change. It originally was a dealer and distributor-focused business, based on selling to the installers who more or less served the rooftop market. This was where the strength of the German and European module manufacturers lay, and what they designed their production plants for. But the old business model has changed and moved towards an EPC-driven approach with a focus on large installations and ground-mounted systems. What used to be the main area of sales, today merely represents a fraction of what it used to be years ago. Most EU solar manufacturers have not been able to change in accordance with the trend. They have failed to invest in innovation and efficiency and did not increase their capacities when the market demanded it, as the costs for the raw material silicon fell. Later, when those enterprises tried to close the development gap between them and the Chinese producers, the necessary investments were not bearable for them. This development is also reflected in the undersized production capacities of many European producers. Today, the market is dominated by players who can produce 2 to 3 Gigawatts per year – and none of them are based in Europe.

A truly global value chain

Trade barriers might alleviate the current crisis symptoms of the industry in Europe in the short term by temporarily providing solar cell manufacturers with a competitive advantage. In the long term, however, this would not cure the actual malady of the sector, but would increase the price of PV systems, dampen demand and thus create even greater challenges to the European market. This is also due to the global and interconnected nature of the supply chain for photovoltaic products, in which components from different countries and

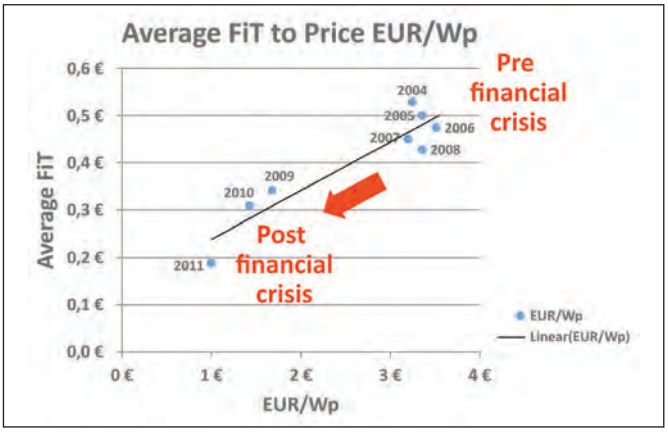


Figure 1: Prices per Watts peak have been continuously declining. (Source: The Alliance for Affordable Energy))

continents are assembled into one end product. To speak about the domination of companies from one specific country is misleading, as this only focuses on where the module is assembled and ignores the steps that happen before and after in the global solar value chain.

If one looks at each element that contributes to a PV system, a high degree of international collaboration is evident. For instance, the United States has one of the largest known deposits of quartz. Quartz crystals are used in reaction chambers and tools applied in the manufacturing process of silicon wafers, solar cells and finally the PV module. The largest producers of polysilicon come from Germany and Japan, and also the largest producers of manufacturing equipment and inverters are German. Finally, it's the local project developers, engineers and installers who are responsible for the set-up and maintenance of PV power plants that benefit from this global contribution.

The fact is that even if a solar panel is produced in China, about 70 percent of the total value creation is generated inside Europe. If protectionist measures impact on one part of this value chain, the consequences therefore spread far beyond this, finally

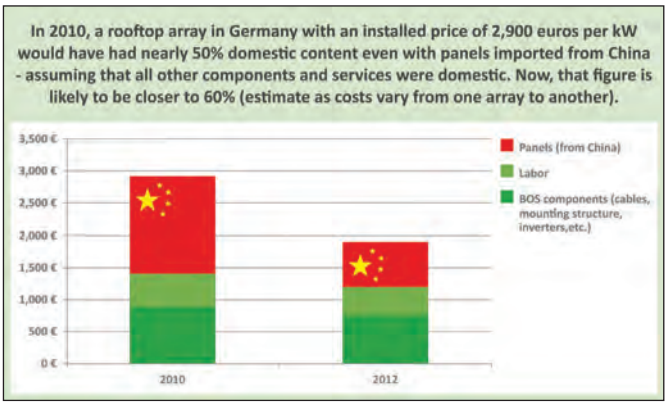


Figure 2: Domestic and foreign content of solar rooftop system in Germany, 2012 and 2012. Created by Petite Planète (Source: Heinrich-Böll-Stiftung)

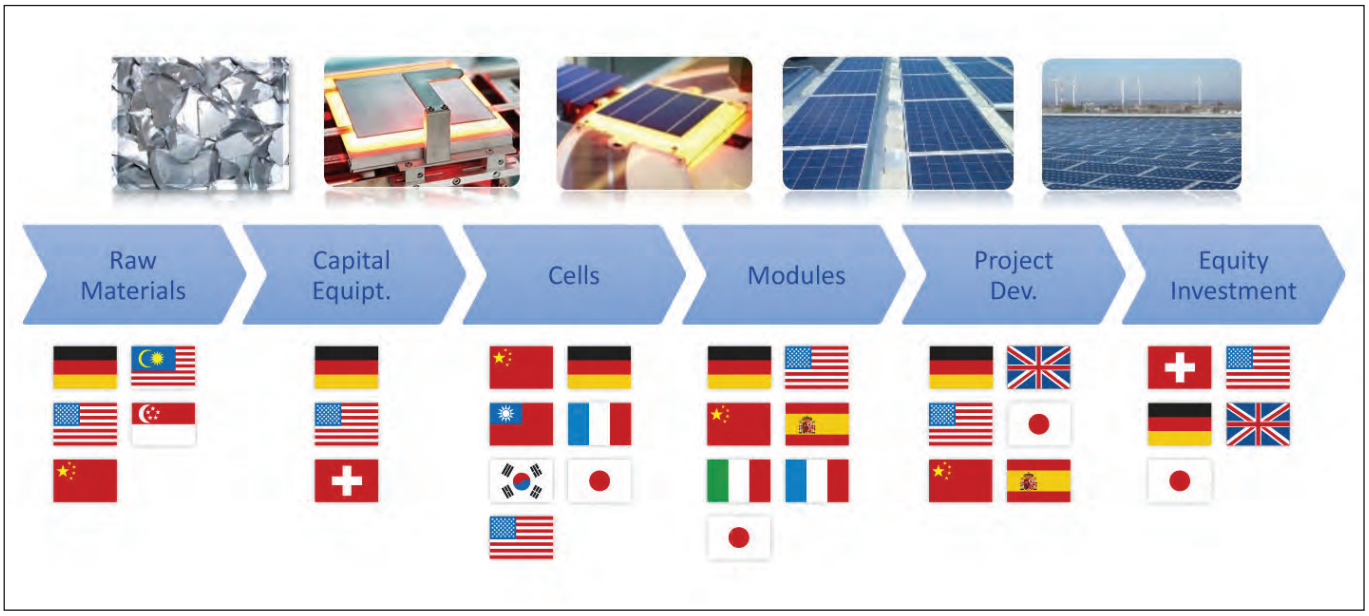


Figure 3: The value chain for photovoltaic products is internationally interconnected (Source: Canadian Solar)

damaging the very market they were intended to protect. And not only the value creation, also the majority of the jobs can be found in the country where the PV power plant is sold, installed and serviced. That is why punitive tariffs would have such a damaging effect on jobs along the whole value chain.

Jobs are not evenly distributed among the solar value chain. 80 percent of this solar workforce is employed upstream, for instance at equipment manufacturers or raw material suppliers, and downstream, in importing, distribution, engineering services, system integration and installation. In the German solar industry, for example, only 15 percent of jobs are directly connected to the production of solar modules, with corresponding numbers of only one quarter in France and less than one percent in Italy.

Affordable solar strategies

The photovoltaic business is one of Europe's fastest growing sectors, with annual growth rates of about 40 percent over the past decade, making it the world's largest PV market. Although the relatively new solar sector is currently going through a tough consolidation phase, there is good reason to believe that it will remain a growth and job engine for Europe – provided the framework conditions are right.

Open markets have contributed significantly to the fact that the solar industry is one of the most fastest-growing industries in Europe. Also in future, they will be essential for providing the foundation for new growth in this dynamic sector. Trade barriers on the other hand, would be a heavy burden especially for the small and medium-sized companies up and downstream on the value chain who could hardly cope with the associated price increases and the decline in demand. European manufacturers have identified a dumping margin between 60 and 90% for wafers, cells and modules. Especially at times when economies in the EU have already suffered through the Euro crisis and austerity challenges imposing trade barriers would not only damage the local solar energy business, but would slow down economic growth in general. It is common sense amongst economic stakeholders worldwide that trade and business growth in individual markets, as well as globally, cannot be achieved when trade barriers exist. A closed market environment has little potential for extensive growth and job creation. This is especially true for the primarily export-based European markets.

No one can foresee the future, but it can certainly be argued that the solar industry stands before a major crossroad. Not only is the consolidation phase and Euro crisis placing a lot of pressure on companies in the European solar industry, but the initiative to impose trade barriers is adding yet another layer of challenges.

EPCs and installers, whose business model is built around the set-up and maintenance of solar power plants, manufacturing equipment and component producers and certainly consumers and employees, as well as our environment, depend on affordable PV modules for making solar energy not only the alternative, but rather the most logical solution for power generation.

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Concentrated PV market set to soar?

As concentrated photovoltaic players Amonix and GreenVolts run into trouble, analysts predict a bright future for the solar technology. *Solar International* talks to IMS Research to find out why.

Only two months after market leader, Amonix, closed its manufacturing facility in Nevada, concentrated photovoltaic start-up, GreenVolts, called an end to most operations after key financial backer, ABB, pulled the plug on investment.

News report after news report predicted doom for the CPV market until late September, when UK-based IMS Research forecast sharp growth for the compound semiconductor-based technology. Predicting the CPV market to double in 2012, company analyst, Jemma Davies stated: "[Installations] will grow rapidly over the next five years to reach almost 1.2 GW by 2016."

At a time when key industry players are clearly struggling, why would an analyst firm paint such a rosy picture? According to Davies; "it's all based on perception".

Concentrated photovoltaic technology uses lenses or curved mirrors to concentrate the sun's energy by a factor of several hundred onto photovoltaic cells, fabricated from compound semiconductors, rather than silicon. Thanks to the massive magnification factor, plus a conversion efficiency of around 40 percent – compared to less than 20 percent for typical cells manufactured from crystalline silicon or thin film material – the price per Watt of the actual cell is by far the lowest compared to rival technologies. .

However, factor in technology complexities at the module level, and these cost advantages fade fast. Recent figures from the US Department of Energy's Energy Information Administration (EIA) state the average price of CPV module was $1.32/W in 2011, relative to $1.63/W for crystalline silicon and $1.28/W for thin-film systems.

But as Davies explains, CPV comes into its own when you look at the levelised cost of electricity. This figure represents the system cost or per-kWh cost of building and operating a module across its lifetime.

"Put this technology in one of its target markets and it will generate a much higher amount of electricity over its lifetime than rival [photovoltaic] technologies," she says. "This means the kilowatt hour cost comes down and the technology will become much more competitive over the next five years."
And as Davies is keen to point out, industry is beginning to realise this. US and central America are the largest markets for CPV technology; the majority of suppliers are based here and are already competing successfully against manufacturers of other photovoltaic technologies.

Crucially, these regions receive a lot of solar radiation. "In south-west US where the direct normal irradiance is higher, CPV becomes a viable option when you consider the levelised cost of electricity," says Davies.

And it's not just this region of the world. Davies expects strong growth to come from Mexico as US-based CPV system developer, SolFocus, readies to provide thousands of systems to a 450 MW project planned in Baja California. Meanwhile, Soitec and Schneider Electric are busy installing pilot projects in Morocco, totalling 10 MW, as the Moroccan Agency for Solar Energy lays out plans for 2 GW of solar power by 2020. And more than 100 MW of solar power is planned in the north of Chile to power remote mines. Davies reckons CPV will be favoured here as the technology will tolerate the region's dramatic temperature fluctuations more than convetional PV.

"Saudi Arabia has a 16 GW target, with projects at least 1 MW in size," she adds. "This is ideal for CPV, as the technology benefits from being deployed on a large scale, and the companies with the lowest levelised cost of electricity will win."

Clearly myriad projects are taking off, but can we ignore the fact that key industry players, Amonix and GreenVolts, are grounded? Davies highlights Amonix may have closed operations, but it hasn't disappeared completely. "The company was always planning to come back online with a new generation of systems and there have been no announcements to contradict this," she says. Meanwhile, she believes ABB withdrew GreenVolts' funds following uncertainty in the overall PV market, not a reluctance to invest specifically in CPV.

"Its perception is one of the major barriers for CPV suppliers, and these announcements overshadow success stories from suppliers such as Soitec, SolFocus and SunPower," she says. "Investors see this technology as an underdeveloped hot-bed of technology. These misplaced perceptions have a negative impact on the bankability of CPV suppliers."

Meanwhile, Soitec and Schneider Electric are busy installing pilot projects in Morocco, totalling 10 MW, as the Moroccan Agency for Solar Energy lays out plans for 2 GW of solar power by 2020. And more than 100 MW of solar power is planned in the north of Chile to power remote mines. Davies reckons CPV will be favoured here as the technology will tolerate the region's dramatic temperature fluctuations more than convetional PV

Long term solar vision

Georgia Power has announced it is initiating the largest solar programme in that states history that has met with regulators approval. The long term goal will see the state energy supplier lead the way in how utilities take on renewable options. With private money backing the initiative and the group plan to develop 210 MW of energy for the area as well as provide balance to the energy production methods.

Georgia Power has filed a new solar initiative – the Georgia Power Advanced Solar Initiative ("GPASI") – with the Georgia Public Service Commission (PSC). The PSC has now voted and in a 5-0 vote approved Georgia Power's new solar initiative The initiative will create the largest voluntarily developed solar portfolio from an investor-owned utility. Through GPASI, Georgia Power would acquire 210 megawatts of additional solar capacity through long term contracts over a three-year period.

"We are pleased the Commission has approved our Advanced Solar Initiative," said Georgia Power President and CEO Paul Bowers. "Developed in cooperation with the PSC, our solar plan will encourage new, cost competitive opportunities for solar development in our state while helping Georgia Power continue to build a diverse generation portfolio that provides our customers with the safest, most reliable and most cost effective electric system in the nation."

"We believe the Georgia Power Advanced Solar Initiative will encourage new opportunities for solar development in our state and catapult us to the forefront of this clean, safe energy technology," continued Bowers. "This initiative builds upon our record of maintaining not only one of the nation's safest and most reliable electric systems at rates below the national average, but one of the most innovative as well. We will continue to build a diverse generation portfolio that utilizes the most cost effective and advanced technologies to benefit our customers."

To meet the target of 210 megawatts, Georgia Power's Utility Scale program will purchase 60 megawatts annually for three years through a competitive request for proposal (RFP) program with projects ranging in size from 1-20 megawatts. By as early as 2013, a Distributed Scale program would provide opportunities for up to 10 megawatts per year of smaller solar projects with specific reservations for Small Scale (less than 100 kW) and Medium Scale (100-1,000 kW) projects.

RFPs for the Utility Scale program will be conducted in 2013, 2014, and 2015, and require commercial operation dates in 2015, 2016 and 2017. Georgia Power could begin signing solar contracts under the Distributed Scale program as early as first quarter of 2013.

Customer contribution

Developed in cooperation with the PSC, the GPASI will complement the company's existing solar resources, which include leading-edge research and demonstration projects and a 50-megawatt Large Scale Solar program already in place.

Since the creation of the company's Green Energy Program in 2003, which enables customers to support and foster the growth of renewable energy resources, Georgia Power has consistently pursued opportunities to grow solar in the state.

Through various initiatives, including the Large Scale Solar Program approved in 2011, Georgia Power has worked closely with the PSC to add solar economically to its portfolio. There are currently 61.5 megawatts under contract – enough green energy to power approximately 7,600 homes.

Georgia Power is the largest subsidiary of Southern Company, one of the nation's largest generators of electricity. The company is an investor-owned, tax-paying utility with rates below the national average. Georgia Power serves 2.4 million customers in all but four of Georgia's 159 counties.

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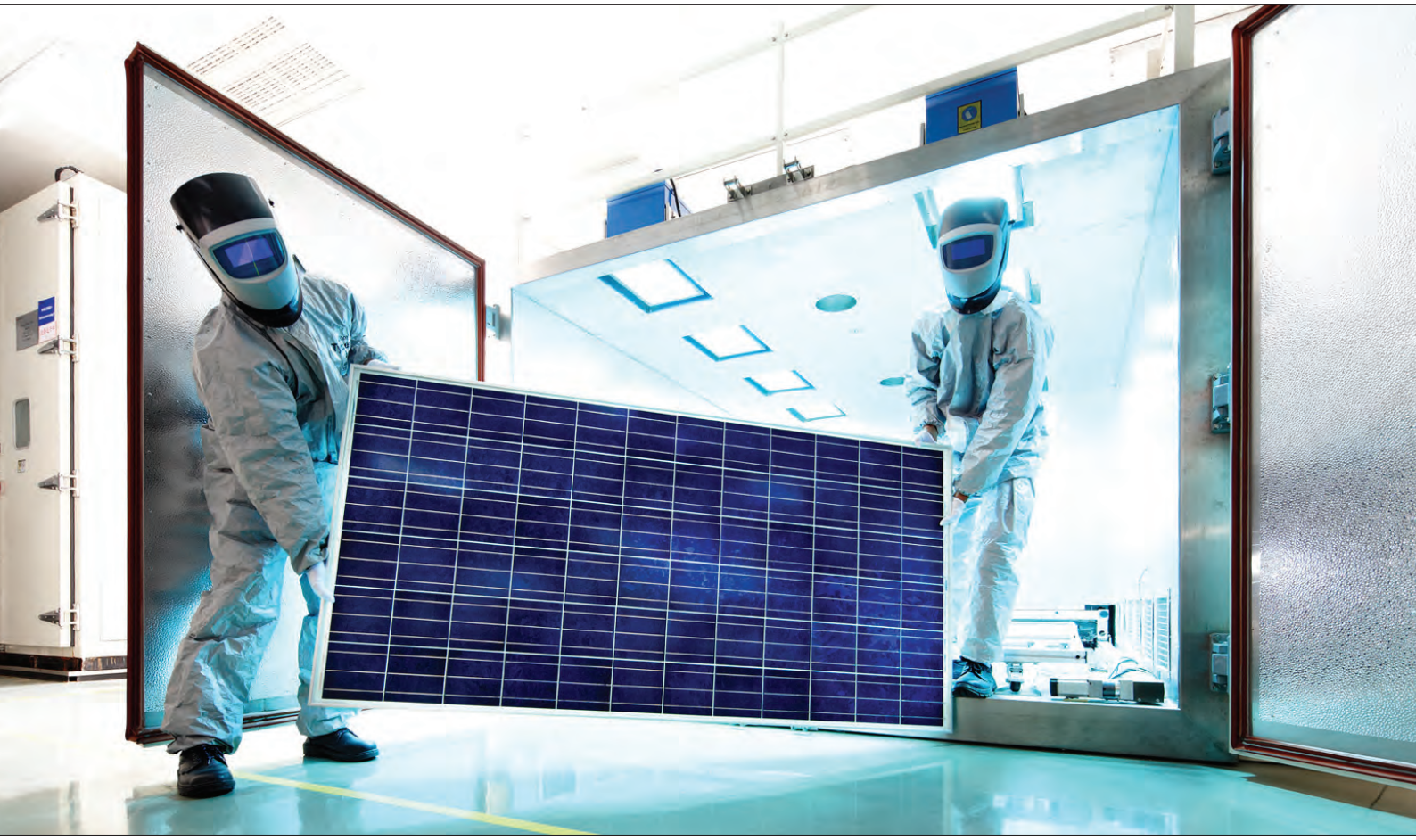
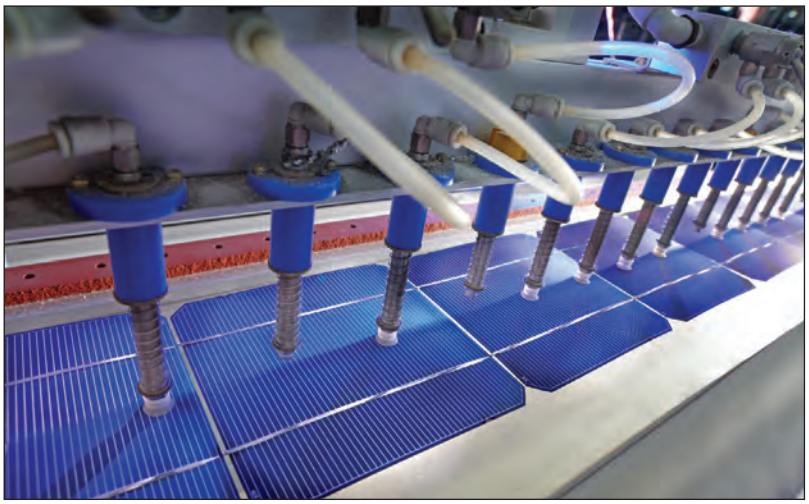


Efficient PID challenge

Potential induced degradation (PID) poses a serious challenge to solar companies attempting to expand PV as an energy alternative. Stefan Jarnason, Technical Director at Suntech Power Australia discusses the efforts the company has made in identifying key areas of concerns and the development of solutions to combat this potentially challenging aspect of PV manufacturing.

Usually, photovoltaic (PV) modules have a warranty period of 20 to 25 years and experience has shown that solar systems can work for even more than 30 years without significant degradation. On the other hand, solar systems often operate in difficult environmental conditions with the potential to stress the photovoltaic modules and accelerate module degradation. During the last few years, potential-induced degradation (PID) has been identified as one of the main negative influences on the energy yield of solar panels. Since 2010, industry and science have conducted intense research about the phenomenon.

This kind of performance reduction occurs especially at large PV plants, when the modules are subjected to a high negative voltage between the cells and the ground. The system voltage depends on the number of panels serially interconnected and the irradiation as well as the panel temperature. On the panel level, leakage currents which are caused by electrons that do not move in a power circuit but flow through the module on non-targeted paths, lead to the reduction of the efficiency. The observed output reduction can amount up to 80 percent. But PID is different to identify for PV plant operators as decreases in the power output can have multiple reasons.



In the case of installed modules, PID first affects modules with the highest electrical potential and those located in humid environments. Also high temperatures are conducive to the phenomenon. It has been observed that it occurs more frequently in warmer regions and in coastal areas. This effect can be counteracted taking precautions in the design of the solar plant. The string length, the inverter and the grounding of the PV array play a role. With the help of a transformer inverter and through the earthing of the negative pole of the generator, the effect can be avoided that a potential difference between the module and the cell arises. However, transformer inverters have been abandoned mostly in recent years because of their lower efficiency and higher costs.

Material selection

Through careful and diligent material selection, manufacturing processes, and quality control procedures, the performance risks can be reduced already by the PV module manufacturer. Within module production, the front glass and encapsulation material can be modified in order to counteract PID. As the effect is mostly caused by sodium ions, sodium-free front glass could be a solution, but again this would imply higher costs. The standard encapsulation material EVA shows high PID and there are other materials with a better performance, but the introduction of new components can pose new problems. Impact factors on the cell level include the base resistivity of the wafer material as well as the emitter sheet resistivity. Laboratory tests have shown that the PV cells of one module are not necessarily affected in the same degree. Furthermore, experiments revealed that the process is reversible - in some cases, modules can recover from potential-induced degradation. High temperatures and dry weather foster the regeneration.

The stringent PID test sequence, which is based on the protocol established by TUV Rhineland, identifies the problem via three main indicators: losses in yields, power and voltage losses as well as infrared imaging

Testing the potential

Recently, the German Association for Electrical, Electronic and Information Technologies (VDE), one of the world's leading testing and certification institutes, has performed potential-induced degradation tests which confirmed that Suntech photovoltaic modules of the Wd poly and Ve poly series are highly resistant to PID.

According to the VDE test report, the tested Suntech modules "show no significant degradation at the end of the test sequence..." with all of the modules exhibiting negligible change in output power within the test lab measurement accuracy, and no changes in visual appearance. The stringent PID test sequence, which is based on the protocol established by TUV Rhineland, identifies the problem via three main indicators: losses in yields, power and voltage losses as well as infrared imaging. The test begins with flash-testing the modules to determine their electrical performance characteristics, as well as an inspection using electroluminescence (EL) imaging. Then, the modules are subjected to high humidity and negative voltages of 1000 volts for one week. Finally, the modules are again tested for electrical performance and for any visual defects using EL imaging.

TUV Rhineland and VDE are both highly renowned institutions for standard development and quality assurance in Germany. Together with two other independent institutes, the Fraunhofer Institute for Solar Energy Systems (ISE) and the Photovoltaic Institute Berlin, as well as leading solar companies, they have developed the testing conditions regarding the PID responsiveness of solar modules. If a module losses less than five percent of its power output, it is considered as resistant to PID. Standardized module qualification tests such as IEC 61215 and IEC 61646 for c-Si and thin-film modules in contrast have shown shortcomings in their ability to detect PID. For now PID tests are carried out by solar panel producers on a voluntary basis.

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Punitive tariffs harm the entire solar industry

Trade disagreements with China have continued to spread around the globe dividing the industry on the pros and cons of such actions. Till Richter, CEO of Richter Solar and member of the Alliance for Affordable Solar Energy (AFASE) discusses the reasons why the European consortium is fighting against punitive reaction to concerns about Chinese manufacturers selling practices.

A group of solar manufacturers collected around German company SolarWorld have called on the European Commission to impose punitive tariffs on Chinese solar products. At the beginning of September the European Commission opened an investigation into these dumping allegations. The result of the investigation could be punitive tariffs at a considerable level.

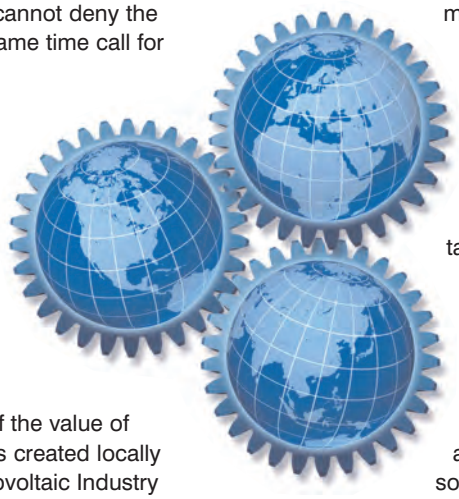
I believe punitive tariffs are not in the interest of the European Union, because punitive tariffs would increase the prices of solar products significantly. The alliance EU ProSun argues that anti-dumping measures would have no consequences on the prices for solar products and prices would decrease despite duties.

The very opposite is true

The complainants themselves call for a price increase of up to 70 percent for modules, 90 percent for wafers and 80 percent for cells from China in order to be able to operate profitably. Given a module price of $0.77/W on the spot market, this would lead to a module price of up to $1.31/W. One cannot deny the impact of duties on prices and at the same time call for duties at a significant level. EU ProSun contradicts itself there.

Value chain impact

What would be the consequences of strongly increasing prices for solar products? Companies along the entire value chain in the solar industry would be affected, since the value chain is a global one. Above all, in Europe thousands of companies situated before and after the module production would suffer. Nearly 70 % of the value of the PV supply chain in the EU market is created locally according to EPIA, the European Photovoltaic Industry Association.



Many of these small and middle sized companies are already very export-oriented. EU member states, which have opted for the expansion of PV, benefit from the experiences German solar companies like Richter Solar have gathered regarding trade with Chinese solar modules. Punitive tariffs would drive these small and middle sized companies out of business.

The same is true for equipment manufacturers and raw material suppliers, who mainly sell their products in Asia. Many of these European companies strongly benefitted from the growth of Chinese solar manufacturers and became market leaders in their segments. All in all thousands of jobs in the EU would be at stake if punitive tariffs were introduced. This cannot be in the interest of the EU.

The price increase of China-made solar products would not only cost thousands of jobs, it would also prevent the solar industry from becoming competitive with traditional energy sources. The European Union aims at producing 20 percent of its energy demand from renewable energy sources until 2020.
To reach this goal the still infant solar sector needs to become independent from subsidies. Competitive prices and a free solar market guaranteeing the former are a precondition for reaching this goal.

The European solar industry finds itself in a consolidation phase, which is of course painful but rather natural for such a young industry. It remains to be seen which of these companies and products will be able to persist on the market in the long run. Some European companies rested on the soft pillow of subsidies and did not invest enough in R&D. In such a situation it is all too human to look for a scapegoat for its own mistakes. But this will not help to find a solution for homemade problems.

Forging solutions

At the moment solar manufacturers worldwide suffer from overcapacities which were caused by decreasing module prices. There are three fundamental reasons for this: First, production processes became much more efficient. Second, polysilicon has become much cheaper. And third, the political framework conditions have changed.

Since the beginning of the financial crisis feed-in-tariffs decreased continually, because many regions simply did not have the money anymore to support the solar energy to the same extent as before the crisis. The reduction of feed-in-tariffs by 10ct/kW let to a price decrease of 1 Euro/Wp in the last years. This shows that price building is strongly influenced by subsidies and not – as some argue – steered by Chinese solar manufacturers.

For Richter Solar free trade and a well-functioning global solar value chain is essential. Therefore, we got together with 170 other like-minded mainly European solar companies and founded the Alliance for Affordable Solar Energy (AFASE). AFASE speaks out for free trade and informs about the risks of protectionism in the solar industry. Its supporters stem from all parts of the value chain and represent over 27.000 jobs.

Punitive tariffs will only create loser. For this reason AFASE speaks out for a negotiated solution in this conflict, as German Chancellor Angela Merkel explicitly called for during her recent trip to China. We will do everything to enter into dialogue with all parties involved and look for a possible solution. The common goals, to sustain a competitive European solar industry, to create jobs and to develop innovative products, are too important to sacrifice them on the altar of individual interests.

Seeking a level field

Chinese solar manufacturing has been accused of unfairly grabbing global market share and the issue has divided the industry. A group of companies in the European value chain has formed an alliance called EU ProSun and believe Chinese dumping is destroying the European and worldwide solar market. Milan Nitzschke, President of EU ProSun argues that China is poisoning the solar market by their actions and selling at below cost in order to seize control of the market, and ultimately increase prices.

Solar energy in Europe is the most developed in the world. 75% of the global photovoltaic expansion in 2011 was installed in Europe, which is also where 75% of the globally installed PV capacity is located. McKinsey forecast that global annual installations of solar energy could increase 50-fold by 2020 compared with 2005, which happened to be the same year that China started its expansion into the EU market.

Since then, Chinese companies have captured over 80% of the EU market for solar products from virtually zero. EU manufacturers have the world's best solar technologies but are beaten in their home market due to illegal subsidies and destructive dumping of Chinese solar products below their cost of production. China set in its Five

Year Plan a goal to become the world leader in PV production, and aggressive expansion which has led to over 30 major European solar manufacturers going out of business already in 2012 alone. If China destroys the EU solar industry where labour accounts for less than 10% of production costs, then virtually all European manufacturing sectors and jobs should fear for their future.

A fair deal

This summer EU ProSun requested that the European Commission investigate illegal subsidies and destructive dumping by Chinese solar manufacturers. If the EU acts quickly, there is a chance to maintain a sustainable solar manufacturing base in Europe for the benefit of jobs, growth, innovation and the planet.
Only fair international competition can prevent creation of a Chinese monopoly with subsequent pricing. Only competition ensures that a wide variety of products and prices is offered to both installers and end customers.

China however is currently working on creating a monopoly for machinery and materials which is currently destroying PV manufacturers worldwide but now threatens the entire upstream industry in Europe.

The anti-dumping and anti-subsidy duties EU ProSun is calling for will not prevent fair competition by Chinese manufacturers, but only reduce the unfair trade practices that the Chinese government orchestrates. Once Chinese manufacturers have to sell their products at a fair price, European manufacturers will be happy to compete with Chinese products just as they compete with producers from other countries such as Korea and Japan.

Destructive Dumping

China has no natural cost advantage over the EU given that labour accounts for only around 10% of production costs, and it must import raw materials and equipment to produce their solar cells and modules. However, Chinese companies are selling solar products in Europe far below their cost of production, with a dumping margin of 60 % to 80%. This means that Chinese solar companies are making enormous losses, but are not bankrupt because they are bankrolled by the state.

European industry does not want to increase prices but rather stop the ruinous race to the bottom. Overcapacity in China has led to solar products being sold at unsustainable prices, as the Chinese manufacturers try to empty their stocks at any cost before EU trade defence measures are implemented. EU ProSun supporters have continuously improved technology and production methods and hence driven prices steadily down.

The average price of a PV module in Europe (disregarding Chinese dumping) in 2012 was about 60% lower than 5 years ago and it is an ongoing process. According to a study by AT Kearney, solar system prices could decline even further by up to 50% across the EU by 2020. This long term downward trend in module prices in Europe will continue, however, only if fair international competition is maintained. If China manages to gain a worldwide monopoly for solar products, it will be able to raise prices, as there will be no more competition – the only motor of affordability and innovation. If a level playing field is re-established and the price of solar installation continues to decline sustainably, demand and local installation jobs will increase accordingly.

With technological advances, the cost of producing solar panels has come down substantially, but prices in the last three years have come down much faster due to the dumping of subsidised Chinese production. Costs and prices should continue to decline steadily as this technology continues to develop. Hence, demand for solar systems and local installation jobs will not

decrease if anti-dumping measures are imposed on unfairly traded imports from China. Trade measures would only restore fair competition with China, and prevent a monopoly over solar manufacturing that would be destructive for European consumers, jobs, installers and industry.

Illegal Subsidies

China declared photovoltaics as a key industry and emerging market and dedicated this high-technology a separate chapter in the 12th Five Year Plan of the People's Republic of China, mandating banks, local governments and other financing sources to heavily subsidise the solar industry. Whereas European support schemes such as FITs are available to everybody, Chinese government subsidies are only available to Chinese companies.

Massive subsidies and state intervention have stimulated overcapacity more than 20 times total Chinese consumption and close to double total global demand. Hence, more than 90% of Chinese production has had to be exported. Irrational overproduction on this scale cannot generate profits.

Chinese producers are highly indebted; and make significant losses, but are still ramping up production. Many of the biggest Chinese companies are insolvent according to Western standards, however subsidies save them from bankruptcy. State-owned Chinese banks continue lending money to unprofitable companies in order to support the PV industry at any cost. European companies do not benefit from this kind of support, therefore are driven out of the market one by one due to Chinese dumped prices.

Counting the costs

EU ProSun has identified many forms of significant government subsidies to Chinese solar manufacturers. For instance, Chinese banks implement government policy by giving preferential terms to solar manufacturers, and, if a borrower cannot pay back its loans, they may be written-off, extended indefinitely or paid off by other government-controlled entities. This makes it easier, cheaper, and a lot less risky for Chinese solar companies to obtain financing.

In accordance with China's Five Year Plan until 2015, credit lines have been granted by the state banks at very favourable lending conditions and subsidised at all levels of government. One bank alone - China Development Bank Corp. - has extended € 33 billion in credit lines to 12 Chinese solar companies since 2010, according to Bloomberg. Additional regional and local subsidies have been granted, such as the repayment of interest, electricity costs, and transaction costs for land, as well as credit guarantees. State-owned banks provide additional credit facilities for the purpose of increasing sales in Europe. For example, JinkoSolar reported this week that it signed a US$ 1 billion strategic cooperation agreement between its Swiss subsidiary and the China Development Bank to "expand the Company's presence overseas". The existence of massive Chinese subsidies was also recently confirmed in a similar investigation into PV cells by the US government.

In the last 5 years, around 300,000 jobs were created in the renewable energy sector, many more will be created in the future – most of them in the photovoltaic sector. Unless the EU takes urgent action, many jobs will be at risk, as there will no longer be any manufacturing or R&D solar jobs left in Europe, in the face of such aggression from China.

EU ProSun, the Sustainable Solar Energy Initiative for Europe, represents the majority of solar manufacturing in Europe. In reply to the unfair Chinese market practices EU ProSun supporters filed an anti-dumping and anti-subsidy complaint with the European Commission with a request to reestablish a level playing field in the sector and come back to international fair free trade.

Massive subsidies and state intervention have stimulated overcapacity more than 20 times total Chinese consumption and close to double total global demand. Hence, more than 90% of Chinese production has had to be exported

Listening for long term success

With a changing industry and market solar PV manufacturers are requiring evidence of their claims of longer lasting or better quality products. Differentiators are minimal in the PV industry and manufacturers need to achieve these objectives at a continuously lower price. Tom Adams is a consultant for acoustic specialist company Sonoscan and discusses how solar longevity can be achieved by acoustic micro imaging whilst helping with cost.

High quality and low price are two key demands of buyers of solar-powered systems. Quality will dictate the reliability of a system over the long term, and various solar technologies and manufacturers will accumulate their own reputations in this area.

The long-term reliability of a particular system will depend in part on the structural integrity of the individual solar cells and panels. Are there cracks in the silicon? Are there breaks in the traces? Are there voids between the silicon and its substrate?

The challenge for solar system manufacturers is to select materials and to design processes that will avoid these and other anomalies both during manufacture and over the service life of the system.

The anomalies include gap-type defects such as cracks, voids and delaminations, as well as variations in flatness, insufficient material (as may happen, for example, with the solder in concentrator solar cells) and other structural changes. In a thin film solar cell, defects are often contaminants or material variations that may occur within or between the several thin layers that are deposited onto the glass substrate and covered by a glass face sheet.

Despite their diverse natures, these defects all have one thing in common: they reflect very high frequency or ultra high frequency ultrasound in a manner that permits them to be imaged and analyzed nondestructively, without dismantling the cell or panel. Acoustic micro imaging is performed with an acoustic microscope such as a Sonoscan C-SAM system and lets manufacturers make changes to processes or materials to upgrade their products' long-term reliability.

Echo effect

The acoustic image in Figure 1 was scanned by the C-SAM's transducer. Echoes were collected from the top of the silicon in order to inspect for defects. The feature marked by red arrows is a long crack oriented vertically within the silicon. Vertically oriented cracks do not reflect ultrasound strongly and do not appear white because they present a knife edge that scatters ultrasound but reflects very little of it. Much of this crack appears as a black line - black meaning "no echo signal." The crack becomes fainter (perhaps because it becomes thinner or more vertical, or both) to the right side of the image, but actually extends beyond the field of view. The occurrence of the crack at this location may be related to the damage to the traces also seen here. The cluster of debris at centre probably consists of fragments of traces.

This crack is so thin that, like many cracks seen acoustically in silicon and similar materials, it would be very difficult to image or view optically. Ultimately, this area of the solar cell crumbled into pieces. When dealing with thin vertical cracks the acoustic microscope operator may make use of a method developed by Sonoscan's application laboratories that images such a crack as a bold black feature.

The ultrasound is pulsed into the surface of the cell or panel by the rapidly scanning transducer. Depending on the type of solar cell and the location of the defect, an ultrasonic frequency from as low as 10 MHz (lower resolution) to 230 MHz

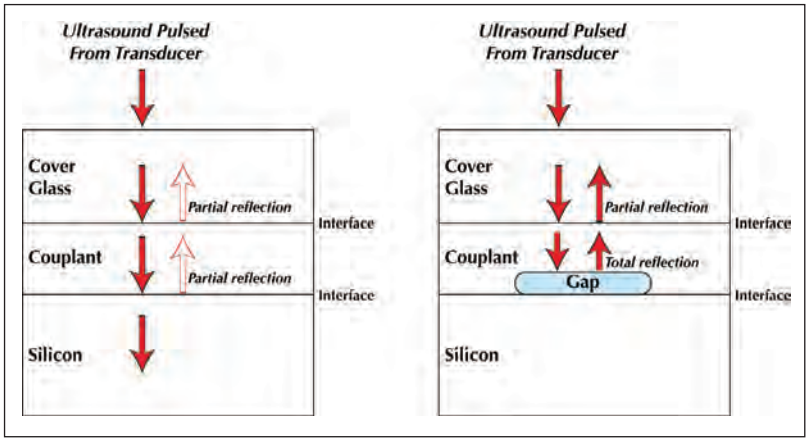


Figure 1: Acoustic image of broken traces and cracks in the silicon of a solar cell

(very high resolution) may be used. In a silicon cell, the ultrasonic pulse travels at high speed through the cover glass, and a portion of the ultrasound is reflected back to the transducer at the interface between the cover glass and the adhesive layer that bonds the cover glass to the silicon, as shown in the left diagram (not to scale) in Figure 2. The transducer will receive this echo signal a few millionths of a second later. The amplitude of the signal, along with its polarity and transit time, are recorded. Solid-to-solid interfaces reflect a percentage of the ultrasound that can be calculated precisely from their physical properties.

When the portion of the pulse that has travelled across the cover glass to adhesive layer interface arrives at the next solid-to-solid interface (adhesive layer to silicon), a different percentage of the ultrasound will be reflected. Reflections from solid-to-solid interfaces are typically mid-range - perhaps 20%, 40%, 60% or a bit higher.

But if the pulse encounters a gap [Figure 2], the percentage of ultrasound reflected is invariably >99.99%. The degree of reflection at a given interface is determined by the density and acoustic velocity of the two materials at the interface. When one material is a solid and the other is air, which has a vastly lower density and which hardly transmits ultrasound at all, reflection is essentially total. This also means that any feature lying directly below the gap will not be imaged because no ultrasound reaches it.

A gap in expectations

A gap can be a crack, a delamination, a void, a non-bond - any space that contains air or another gas, even if its vertical extent is as small as 0.01 micron. In the acoustic image assembled from the thousands or millions of coordinates from which

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the scanning transducer has collected echo signals, solid-to-solid interfaces are represented by various shades of grey, but solid-to-gap interfaces are bright white. Both can also be represented by various arbitrary colours.

If not regulated in some fashion, echoes will be recorded from all of the material interfaces from which ultrasound is reflected. To avoid packing too many depths in the same acoustic image, the echoes are typically gated on a specific depth of interest. Echoes from only that depth are used in making the image; echoes that arrive before or after the gate are ignored. The echoes might be gated, for example, on the two interfaces between the cover glass and the silicon (cover glass to adhesive layer, and adhesive layer to silicon). The adhesive layer is typically so thin that the two interfaces can be considered as a single interface.

Acoustic micro imaging is most often used during the designing or prototyping of a product, and during early production. At these development stages it speeds and simplifies the understanding of anomalies that occur during processing. Some imaging is also carried out during volume production to spot and correct unexpected anomalies. Although the usual method is to image one solar cell at a time, Sonoscan has found that some of its larger scale acoustic microscopes can handle and image solar panels that are considerably larger.

What lies between

The white features in Figure 3 are gaps - in this case, delaminations between the cover glass and the silicon. More precisely, the delaminations probably lie between the adhesive layer and top of the silicon, rather than at the top of the adhesive layer. It appears that they have grown from smaller initial delaminations, but that they have not been able to cross the traces (dark horizontal lines) on the silicon.

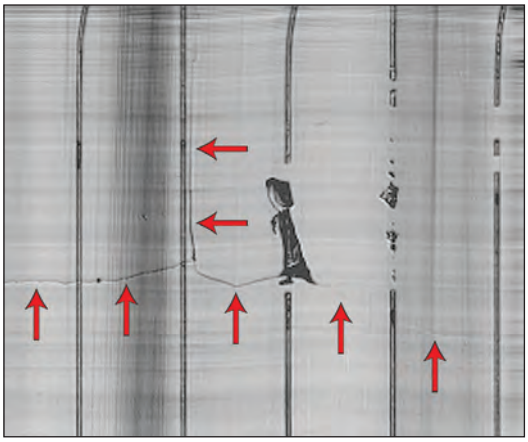


Figure 2: Partial reflection of ultrasound at a solid-to-solid interface (left), and near-total reflection at a solid-to-air interface (right)

Figure 3: Delaminations (white) seen acoustically at a adhesive layer-to-silicon interface

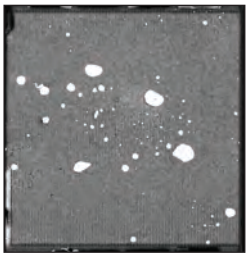
It is common for gap-type defects to expand their area, especially when they are exposed to thermal variation and the two materials at an interface expand and contract at different rates. Solar cells by their nature experience frequent thermal changes, and gap-type anomalies such as delaminations and voids are very likely to grow in area.

Delaminations and voids are also very efficient blockers of heat, an important consideration in concentrator cells, which need to dissipate heat efficiently to avoid failure from overheating. Gap-type defects can prevent adequate thermal dissipation. A single delamination or void, for example, may cause local overheating of the silicon to the point that local expansion will stress surrounding silicon and crack the cell.

In Figure 4 ultrasound was pulsed into the top surface of the solar cell, and the return echoes were gated on the interface between the bottom of the silicon and the substrate below the silicon.

These two materials are joined by an adhesive, and the purpose of imaging was to inspect the integrity of the bond between the silicon and the substrate. This cell is part of a concentrator-type solar assembly in which a lens concentrates light onto the cell, where temperatures are very high. The need for thermal dissipation is therefore even more critical than it would be in a cell of a different type.

Figure 4: Acoustic image of voids (air bubbles) in the adhesive between silicon and its substrate in a concentrator solar cell



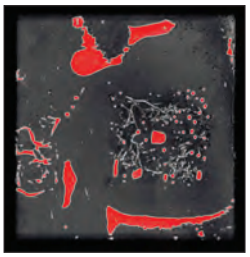


Figure 5: Red features are voids in the solder joining the metal heat sink to the underside of a concentrator cell

The numerous large and small features are voids in the adhesive. Like delaminations, they block heat flow and cause overheating.

In a concentrator cell, overheating is even more dangerous than in other cell types; the cell shown here is likely incapable of providing reliable long-term service.

Imaging all sides and features

Figure 5 is also a concentrator solar cell, but it has been imaged from the bottom side - that is, the transducer scanned the external surface of the metal heat sink beneath the cell.

The heat sink is attached by a layer of solder, and the purpose of imaging was to look for voids in the solder, since voids are very efficient blockers of heat and can easily cause the cell to overheat and fail. The echoes were gated just above and just below the solder layer.

The red pseudocolor features of various sizes are all voids - air bubbles introduced when the solder was fluid. They occupy 11.86% of the area, a dangerously large heat-blocking area for such a thermally sensitive system. The red voids also tell something about their own formation. When, in making a second image, the gating was changed to collect echoes only from the deeper part of the solder, no new voids appeared.

Also, the voids that are red in Figure 5 appeared as dark acoustic shadows, because they were blocking the ultrasound returning from the bottom of the solder layer. All of the voids were therefore at the interface between the solder and the heat sink. Use of a new mode developed by Sonoscan can, simultaneously with imaging, map the thickness of the internal solder layer.

Acoustic microscopes have numerous techniques and modes that succeed in imaging and analyzing internal anomalies in solar cell assemblies.

The data from acoustic micro imaging is a powerful tool for achieving long-term reliability.

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In Germany, there are financial incentives to primarily use one's own solar production which has led to the creation of a new market called « self-consumption ». Other countries are heading in the same direction by, for instance, introducing net metering schemes. In many developing countries solar energy is more economical to use as it is cheaper than power from the grid, making a mix of grid power and solar energy an ideal system. Indeed, solar energy does not need an initial bulk investment as the grid can complement it, and the solar part can be upgraded as per the financial capacities of the owner. In addition, the battery inverter system provides backup of the installation in case of power outage.

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Agenda Day 1

Chaired by

Dr Andrew Nelson, IQE
President and Chief Executive Officer

Keynote speaker

Dr Wilman Tsai, Intel Corporation
Program Manager of Technology Manufacturing Group, Intel III-V CMOS for High Performance and Low Power Logic Devices

Asif Anwar, Strategy Analytics
Director Strategic Technologies Practice
What's the Future of GaAs Microelectronic Manufacturing

Dr Thomas Uhrmann, EV Group
Business Development Manager
Wafer-Level Packaging of Compound Semiconductor Devices

Michelle Bourke, Oxford Instruments
Senior Product Manager
Review of The Various Deposition Techniques and Their Uses in Compound Semiconductor Devices

Gunnar Stolze, Oclaro Inc
Vice President, Global Sales
Industrial and Consumer High Power Lasers

Malcolm Harrower, Indium
Sales Manager Europe
Overview of CS Critical Elements – Indium, Gallium and Germanium

Allan Jaunzens, Evatec
Marketing Manager
Presentation TBC

Dr Elisabeth Steimetz, LayTec AG
Director Marketing and Sales
In-Situ Monitoring - The Key to MOCVD Production Process Control and Yield Enhancement

Dr Michael Lebby, Translucent Inc
General Manager & Chief Technology Officer
Challenges & Opportunities of Using Epitaxial GaN, GeSn, & Rare Earth Oxides on Large Format Silicon Wafers for Power Electronics, Solar, & Lighting

Noriyuki Matsubara, Panasonic Europe
Dry Etching and Photolithography Engineer
Dry Etching Technology for III-V Devices

Gregg Wallace, Temescal
Managing Director
Fundamental E-Beam Coating Collection Efficiency & Paths to Improvement

Pars Mukish, Yole Développement
Market & Technology Analyst
New Trends in LED Industry: A focus on China and GaN-on-Si LEDs

Dr Schang-jing Hon, Epistar Corporation
Associate Vice President
High-Voltage LED for General Lighting Application

Professor Tao Wang, Seren Photonics
Scientific Advisor
Improving LED Performance

Marianne Germain, EpiGaN
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GaN Epiwafers for Power and RF Electronics: From Development to Production

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Dr YiFeng Wu, Transphorm
Vice President, Product Development
Status of High-Voltage GaN Power Electronics

Daniel Cline, Lux Research Inc
Senior Analyst
WBG Devices Electricity Grid Opportunities

Dr Philippe Roussel, Yole Développement
Business Unit Manager
GaN vs SiC in Power Electronics - Status and Roadmap to 2020

Dr Frank Schulte, Aixtron
Vice President
MOCVD - Enabler for mobility and energy efficiency

Ms. Ann Hughes, SAFC
Business Manager
Innovation to Maximise Production Uptime

Bryan Bothwell, TriQuint Semiconductor
Strategy and Business Development Manager
Maximizing Gallium Nitride Product Solutions and Foundry Services for Advanced RF Design Success

Dr Markus Behet, Dow Corning Corporation
Global Market Segment Manager Power Electronics
Large Diameter SiC and GaN/Si Substrates as Cost-Effective Solutions for Power Electronic Applications

AJ Nadler, RF Micro Devices (RFMD)
General Manager, R&D and Engineering Gallium Nitride for High Voltage Power Electronics

Dr Vijit Sabnis, Solar Junction
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Dr Rainer Krause, Soitec
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Dr Simon Fafard, Cyrium Technologies Inc
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Erwin Ysewijn, Azzurro
VP Sales & Marketing
GaN on Si. Large Size High Voltage Wafers showing Superior Electrical Performance and Volume Production Track Record

Dr Tudor Williams, Mesuro Ltd
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Module Manufacturing Innovation Award

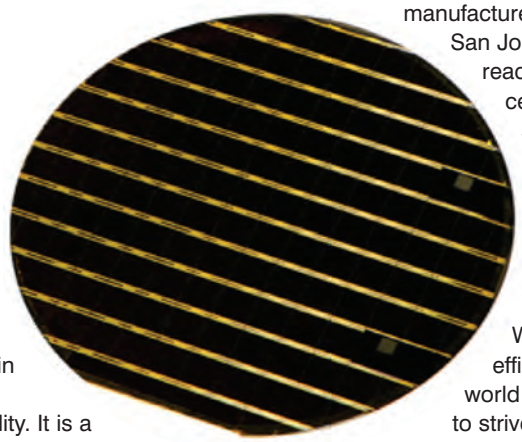
SJ3 Cell

Solar Junction

MANY multi-junction solar cell technologies are lattice mismatched and therefore have defects within the cell. Additional material is used to try and buffer the defects which results in stunted efficiency gains and reliability issues. Solar Junction's technology is lattice matched resulting in higher performance yield reliability and lower cost.

Solar Junction has successfully produced III-V multi-junction solar cells using dilute nitrides reaching high-efficiencies. The material substrates used by the company allows for a tunable and lattice-matched structure that has not been obtained by others.

Solar Junction's cells incorporate the company's proprietary adjustable spectrum lattice-matched A-SLAM™ technology which enables the company to more optimally partition the solar spectrum. This enables bandgap tunability over the solar spectrum to maximize the absorbed sunlight within the CPV modules while enabling lattice-matched pathway to solar cell efficiencies beyond 50% within the decade. This technology leads to maximum efficiency and greater reliability. It is a sustainable technology that leads to a roadmap of continual efficiency gains and innovation without changing the fundamental structure of the cell which is not true for other multi-junction solar cell providers.



Solar Junction breaks with multi-junction innovations by continuing on a lattice-matched path leading to higher efficiencies and higher reliability. The cell structure maintains pure while other companies are using innovations that use different processes that do not maintain a lattice-matched structure. Solar Junction standard cell achieved 40.9% efficiency in January 2011 which was tested and verified by the National Energy Laboratory (NREL.)

The cells submitted where standard design production cells and manufactured entirely in-house on its production line in San Jose. CA. February 2011 Solar Junction reached a 41.4% efficiency on a production cell again validated by NREL. The cell submitted for testing was also a standard commercial-ready production cell. It is significant because it was not a champion cell gain but a product that could be introduced straight into a customer's line.

In April 2011 Solar Junction broke the World Record in cell efficiency. At 43.5% efficiency Solar Junction has retained the world record for the past year and continues to strive to make additional technology improvements to reach higher efficiency percentages. The cell tested by NREL was once again a standard 5.5mm x 5.5mm production cell.

Jim Weldon, CEO at Solar Junction accepts the award from David Ridsdale, Editor in Chief at Solar International

winner

Project Development Award

Rural Electrification with Plan Ethiopia

Phaesun

Plan International works in the field of Rural Electrification in Ethiopia and has a holistic approach including the development of local infrastructure, the set-up of educational institutions such as schools and training centres and health stations, as well as capacity building. As part of their activities they provide solar off-grid power supply to public institutions. Phaesun, in cooperation with the local partner Lydetco PLC provided the equipment and installed the systems.

Photovoltaic technology was selected as the only viable energy source for several reasons. The national electricity grid does not reach many rural areas. The use of diesel generators is not encouraged owing to the scarcity of fuel, noise factor, environmental problems and high price of transport of the fuel to far flung remote sites. Additionally the operation and maintenance cost of generator sets is problematic.

Special challenges

The challenge to successfully implement these systems was mainly due to the remoteness of the sites. Transportation of the equipment and installation crews was a challenge but was safely and efficiently carried out by local partner Lydetco PLC.

LOCATION-7 sites in Shebedino District, Ethiopia
Funding and local Project coordination: PLAN Ethiopia

LOCAL FACILITATION AND INSTALLATION: Lydetco PLC

END USER: End users are the beneficiary communities (schools, health centres, village population) in Shebedino District

INSTALLATION: 12/2010 - 08/2011

SIZE: 1 x 2,6 kWp 3 x 1,6 kWp/ 3 x 1 kWp

System components

94 x Istar Solar Module Istar 100W
82 x Hoppecke power.bloc Battery 12V/100 Ah (C10)
5 x Solar Charge Controller Outback FLEXmax FM 60
6 x Solar Charge Controller Steca Tarom 245
12 x Inverter Steca Solarix PI1100
293 x Energy Saving Lamp 13 W with Sundaya Lamp Shade
64 x Energy Saving Lamp 9 W with Sundaya Lamp Shade
cabling, mounting structure and accessories

Geraldine Quelle, Head of Marketing and Michael Mansard, Managing Director of Phaesun collect their award

winner

Rural Electrification Development Award

Steca PF 166 and Steca PF 240: Solar refrigerator/freezer

Steca Elektronik GmbH

THE STECA PF 166 and Steca PF 240 are efficient DC energy-saving refrigerators which can also be used as a freezer.
The Steca PF 166 and Steca PF 240 are fully programmable and the inside temperature and each of the other configuration values can be set by the user. They are perfectly suited for all DC applications including even the refrigeration of medicines in hospitals. Thanks to the latest A+++ energy efficiency class, together with optimal electronic control and an RPM control of the compressor, it is possible to ensure that the energy is used extremely efficiently. This leads to significant cost reductions. This product stands out for its user-friendliness, thanks to a large digital display with setting options, the highest standards of quality and reliability and a long service life. The refrigerator or freezer is easy to clean as it has a sealing plug on the bottom for draining water. This maintenance-free appliance can work with an input voltage of either 12 V or 24 V.

Product features

- A+++ energy efficiency class
- Fast cooling due to compressor speed control
- Freezer runs on a 70 W photovoltaic module in most climates
- Automatic detection of voltage
- Temperature fully programmable
- Adjustable refrigerator or freezer function
- Suitable for all DC applications
- Low maintenance and easy to clean
- Lock with two keys
- Suitable for mobile use
- Auto-dimming for reduction of own consumption

Martina Wucher, Marketing at Steca Elektronik accepts the award from David Ridsdale, Editor in Chief at Solar International

winner

Solar Award For Excellence (Company)

Life Shines Brighter
(End User communication campaign on benefits of PV)

SMA SOLAR, global leader in photovoltaic inverters launched a defining end-user marketing campaign in the UK. The PV market has changed dramatically in the UK over the past five years and with the ever changing 'feed-in tariffs' so has end-user perceptions. SMA have developed a series of cross-media initiatives with the overall aim to raise public awareness of the importance of photovoltaic technology and the role of the inverter plus dispel the myths surrounding renewable solar energy and the feed-in tariff. SMA identified that when it comes to solar energy most householders focus their attention on choosing the panels however it is the quality and efficiency of the inverter that determines how much energy is produced. So whether householders are looking to mitigate the impact of climate change or reduce the cost of their energy bills choosing the right inverter is crucial if they want a high performing system. That is why SMA Solar UK created Life Shines Brighter – a simple concept built on the premise that with more electricity to use and sell householders can enjoy the things in life that really matter.

What, exactly, is novel about the campaign?

Firstly a unique integrated campaign that educates the householder into the benefits of PV as a lifestyle choice and sound investment in todays sceptical and uncertain market. When we researched the available communications to end users there was no component manufacturer communication directly to end users purely just to distributors and wholesalers.

Therefore the main messages were cost points and technical jargon which completely switched off the end user homeowner. We recognised a need to educate the benefits of a PV lifestyle and worked with a specialist agency to develop a campaign targeted to educating and providing tools that allowed homeowners to discuss a PV system with an installer and help make the best educated choice.

The tone of voice is removed from technical language allowing the end user to discover the benefits and what to look for in choosing the best performing system regardless of cost or price. We believe this is unique in the inverter category and in the UK as a manufacturer of system components. SMA UK has also made the unique step of entering B2C marketing and advertising rather than the traditional B2B standard approach that exists in the UK market today. We have backed this up by providing sales tools to the smaller installer so they can use the communications and tools to aid their selling approach to end users.

Wolfgang K. Weber, VP of Marketing, medium power solutions SMA Solar Technology accepts the award from David Ridsdale, Solar International

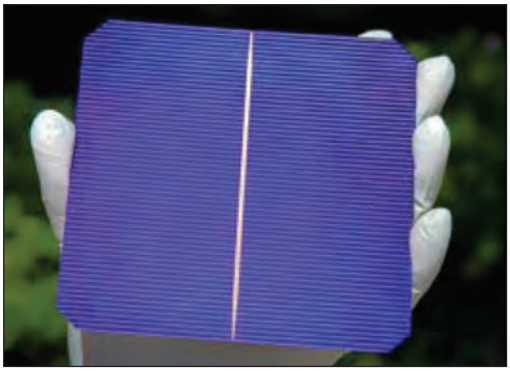
winner

Solar Award For Excellence (Innovation)

Silevo, Inc.

Triex Solar Technology

SILEVO, INC., a solar cell innovator and photovoltaic solar module manufacturer, was founded by leading executives and engineers from the semiconductor industry.



The Silevo proprietary Triex technology evolves silicon-based PV as the first hybrid solar solution to combine high-performance crystalline silicon N-type substrates, thin-film passivation layers, and a unique tunnelling oxide layer – all in a single solar module. Powered by breakthrough "tunnelling junction" architecture, these three materials together enable the Triex module to deliver high efficiency, competitive module costs, and optimal energy harvest.

The Triex "silver free" technology also eliminates the use of costly silver pastes that traditional c-Si device manufacturers rely on for electrodes – typically the second highest priced material in a module after silicon itself. By utilizing a low resistivity copper-based metallization scheme instead, Silevo is immune to silver's increasing cost issue in the marketplace, while capturing the performance advantages of copper.

Silevo is currently producing modules in pilot production, manufacturing Triex cells that demonstrate between 20 – 21 percent conversion efficiency on full-size substrates with proven production materials.

The Triex technology roadmap shows headroom for up to 24 percent conversion efficiency in commercial products.

As well, Triex yields cell temperature coefficients of -0.22%/C, which will enable thin film module like energy harvest in real world service environments.

Chris Beitel – VP Business Development & Marketing, Dr. Jianming Fu – Co Founder, Chief Technical Officer, Dr. Benjamin Heng – Sr. Director, Device and Process Integration and Vincent Beaurain – Head of European Sales from Triex Solar Technology with their award.

winner

Solar Award for Excellence (Product)

Mobile PV Testcenter

MBJ services

The “Mobile PV-Testcenter” combines MBJ’s EL testing with IV-curve measuring and thermal imaging of PV-modules for the use at the installation site.

Today, most PV modules are being shipped around the world before installation. It is already known that rough handling and improper transportation can significantly influence the quality and performance of solar modules. Performing a quality inspection before leaving the production site may not be sufficient to guarantee best the performance of the generators.

In addition, there are concerns with the quality assurance (QA) of low cost module manufacturers which may result in not “bankable” products.

In order to verify the performance and the quality at the latest point in the delivery chain, solar module testing right before the installation is the best solution. MBJ Services has developed a combined mobile test center, covering the most popular inspection methods. The mobile inspection system will provide Electroluminescence inspection, IV-curve measuring using an innovative LED flasher, and Infrared Imaging.

With the Mobile PV Testcenter it is possible to verify the actual performance and to get an idea of hidden defects like hot spots or micro cracks which will decrease the life time of solar modules.

The Mobile PV Testcenter is designed for use in the field at installation sites for an in-depth quality analysis of solar modules. In addition, pre-sorting of modules for best matching strings is much easier with the provided test results. Servicing existing generators is accelerated with having the test lab on site.

Dr. Michael Fuss, CEO at MBJ Services accepts the award from David Ridsdale, Editor in Chief at Solar International

winner

Solar Award For Excellence (Individual)

Jifan Gao, CEO of Trina Solar

JIFAN GAO, Chairman and Chief Executive officer of Trina Solar Limited was born on January 15, 1965, Changzhou, Jiangsu Province, Mr Jifan Gao graduated from Jilin University with a MS degree in physical chemistry in 1988. He earned his BS in chemistry from Nanjing University in 1985.

Mr. Gao established Trina Solar in December 1997. Under his leadership Trina Solar has developed to a world leading solar company over the past 15 years.

In 2006, Jifan Gao led Trina Solar to a successful IPO at the New York Stock Exchange. In 2011, Trina Solar's revenue reached 2.05 billion US Dollars and the company ranked #187 among the top 500 Chinese private enterprises. Trina Solar ranked first worldwide according to the latest 2011 global PV industry sustainable growth index released by PRTM. In the global Solar Scorecard 2012 ranking, published by the Silicon Valley Toxics Coalition, Trina Solar was ranked No.1 among all global PV manufacturers.

With Trina Solar's leading global position, Jifan Gao has been contributing to the world renewable energy industry through international industry forums and associations. He was elected Global Director of SEMI (Semiconductor Equipment and Materials International) and President of the Asian Photovoltaic Industry Association.

From 2010, Trina Solar was selected as Global Solar Industry Shaper by the World Economic Forum, and in 2012 Jifan Gao was invited to be one of the mentors of the WEF annual meeting. In 2012, Mr. Gao participated in the Rio+20, together with 26 leading companies and NGOs which formed the "Friends of Rio+20" and provided suggestions to nation leaders,

presented at the UN Conference on Sustainable Development. On behalf of the PV industry, Mr. Gao put forward his suggestions to Premier Wen Jiabao and other state leaders on developing a healthy and sustainable Chinese photovoltaic industry. His suggestions have received broad attention from Chinese and global leaders and his speeches have been quoted and reported by Xinhua Newswire, CCTV, Reuters, Bloomberg, Dow Jones and Financial Times, etc.

Jifan Gao and Trina Solar attach great importance to corporate social responsibility. Trina Solar has donated and constructed numerous solar power plants in Tibet, China and developing regions of the world. Mr Gao and Trina Solar also took part in the society welfare programs initiated by former US president Bill Clinton, donating solar modules to Haiti, Africa and other areas without electricity.

winner

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Bringing light to all

20% of the world's population has no access to electricity or to clean, reliable, affordable light that's 1.6 billion people.

LITTLESUN GMBH is a company founded in Germany by artist Olafur Eliasson and engineer Frederik Ottesen with the goal of addressing the huge number of people who still do not have access to reliable light.

Little Sun is a global project to get clean and affordable light to the 20% of the world's population who have no access to the electrical grid.

Little Sun is a long-term global project that uses a business approach to spread lamps to the largest number of people. The unique business model pushes profit to local enterprises that bring light to local users. A network of individuals and commercial, cultural, and social organisations actively support and promote

The project assists in the creation of small businesses in off-grid areas, supplying them with Little Sun lamps at a reduced rate and providing retailers with the support they need to profit. Little Sun aims to spread light, safe energy, and profits everywhere.

Little Sun has two prices: one for users living in areas within the electrical grid (€20), and one for those living in off-grid communities (approximately half price). This means that when

Olafur Eliasson (left) & Frederik Ottesen (right)

you buy a Little Sun at the regular price, you make it possible for Little Suns to be sold in off-grid areas at locally affordable prices.

The Little Sun Solar-Powered Lamp has 5 hours of charging time to provide 3 hours of solar-powered light. The light comes in the shape of a hand-sized sun. Its adaptability means users can wear it as a pendant, carry it as a handheld lantern, fix it as a table lamp, hang it on a wall, or attach it to a bike.

The project is driven by four components:

1. An extraordinarily attractive and functional light in the shape of a hand-sized sun.

2. An object of desire that not only works wonderfully, but makes people smile.

3. We believe a business approach is the best way to spread the lamps to the largest number of people. The business model pushes profit to local enterprises that bring light to local users.

4. A network of commercial, cultural, and social organisations and individuals actively support and promote the project, getting light to where it matters.

Malawi health boost with Trina panel donation

Trina Solar donates solar panels with the goal of improving medical treatment for 85,000 people in Malawi

TRINA SOLAR has announced the donation of solar modules to three health care centres in Malawi servicing over 85,000 people. Together with partner Innovation: Africa, Trina Solar will make clean energy available to two remote medical centres and a community-based organisation offering HIV/AIDS support, vocational training, adult education, orphan care and more. In combination with a storage system, these solar modules will allow all three facilities to offer care and services to their communities at night and other conditions of low visibility.

Today, over 1.3 billion people live without electricity. Nearly 600 million of those people live in Africa.

Trina Solar, Innovation: Africa and shipper Schenker International have joined forces to bring electricity into these communities in Malawi. The Innovation: Africa partnership began in May 2011, when Trina Solar provided the solar modules for the installation of solar energy systems at Visezi Medical Clinic in the Bagamoyo District of Tanzania. The Visezi Medical Clinic serves a community of 2,770 people, but until last year they had no way to offer proper medical care at night. Women gave birth in rooms heavy with kerosene fumes, and doctors could often barely see the patients they were treating.

With a solar energy system, Visezi Medical Clinic can now offer 24-hour care in sanitary, well-lit conditions.

“We are pleased to support local communities in need with our technology” said Ben Hill, Head of Trina Solar Europe. “Looking forward, our aim is to continue to bring solar power to improve the quality of life of people who live without access to electricity.”

Sivan Ya’ari, Founder and President of Innovation: Africa explained, “Trina Solar has been an ideal partner in our work to uplift African communities. With their solar panel donations, we are able to spend our resources where they are needed most: identifying communities without energy and working with them to build sustainable solar projects. We have ambitious goals, and with Trina’s support we hope to double our impact in the next year.”

solar international
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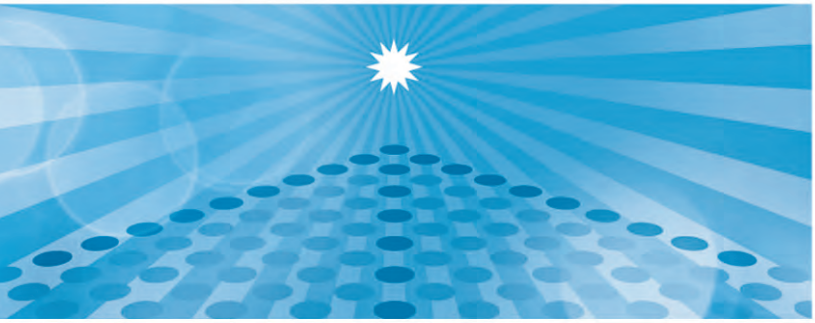

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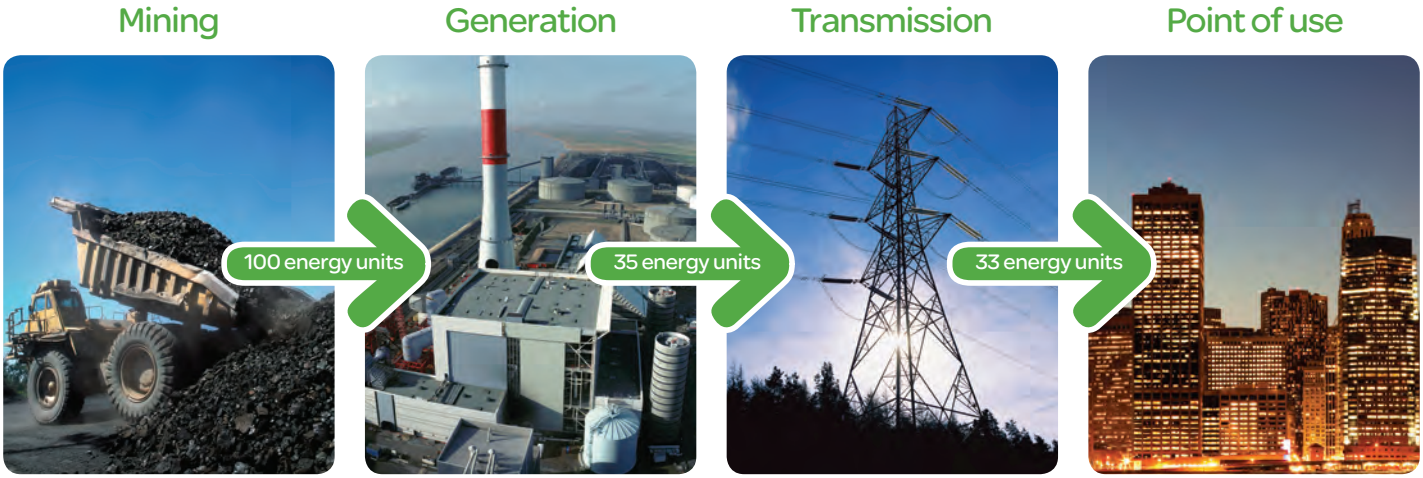

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*International Energy Agency, *World Energy Outlook 2009*, (Paris: International Energy Agency, 2009)