

Solar international

A PV Management Magazine

Testing future quality

Pasan on award winning development

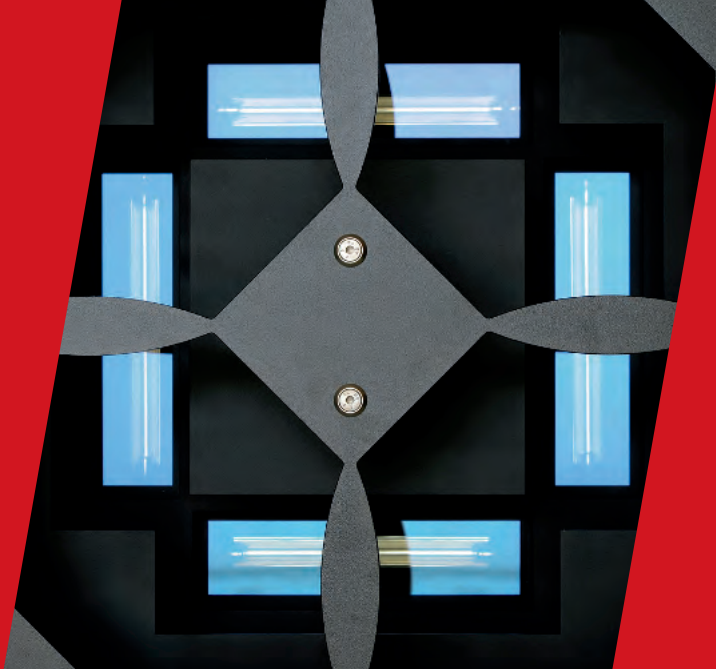
Fear and innovation
US conference reveals concerns

Global concerns
Creating a worldwide enterprise



Issue VI 2012

www.solar-international.net



PASAN
MEASUREMENT SYSTEMS

Tested, Certified, Best in class – Pasan

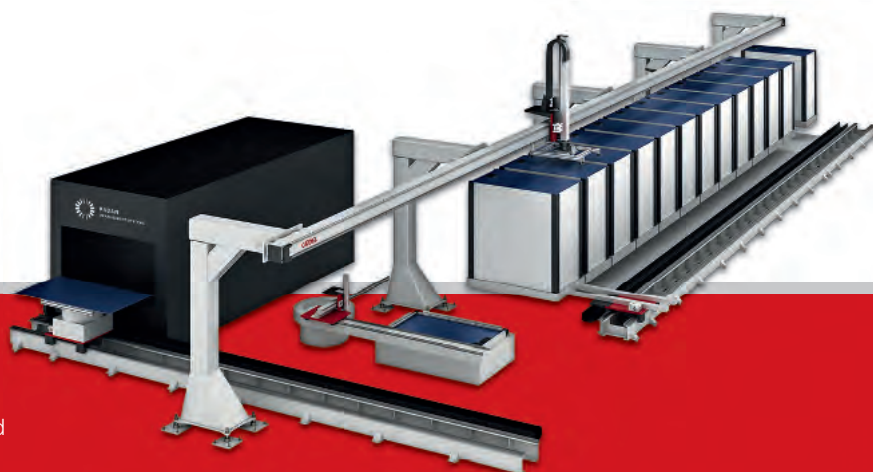
First class sun simulators

Pasan is the world reference for measurement equipment in the photovoltaic cell and module production. Our unrivalled technology in power measurement turns directly into your profit.

**Solar award
winner 2009, 2010.
TüV Rheinland
certified.**



 A member of Meyer Burger Group



Pasan SA
Rue Jaquet-Droz 8 / CH-2000 Neuchâtel / Switzerland
Phone +41 (0) 32 391 16 00 / www.pasan.ch



David Ridsdale
Editor in Chief

Global awareness

Solar and PV manufacturing as a global concern is made up of constantly changing dynamic areas that are at the whim of local expectations and offerings. While some in the industry focus heavily on the larger markets or the companies most embedded in the stock market system, many opportunities are appearing in areas not always expected. The difficulty for any company setting up as a global operation is to maintain an infrastructure sufficient to changing market needs. While larger markets of the last few years are changing subsidy and dynamics there are new geographical areas kick starting their local markets with subsidies of their own.

This moving market creates problems for companies that have targeted areas in parts of the world now in decline. The larger tier one companies are likely to tighten their grip on declining local markets. Locally set companies that have a larger parent company that is prepared to carry an expected slow down, for a time at least, have a major benefit over locally owned and operated companies. It doesn't matter where on the value chain you are this process will occur. Many companies are learning the difficulties of operating in a global market that is destined to follow an oversupply undersupply model and is also vulnerable to local decisions.

Many companies joined the solar gold rush as the financial returns were overcooked in the scope and longevity of such plans. Those that saw this as an opportunity to expand their existing business are more likely pulling back from the solar industry to shore up their traditional industry interests. Companies that began purely to access and benefit from a local opportunity only are finding how fickle such a market can be. A better understanding of how the market works lies between the global dynamics and the local opportunities. Installers in the United Kingdom faced this concern. Many had set up to take advantage of domestic Feed in Tariffs but the subsidies changed and due to local politics the bigger market was suddenly the larger scale solar farms moving much work into country areas and away from the installers more city based areas.

Any company developing traction in a local market needs to consider geographical expansion as much as expanding their services. Sometimes the opportunities are not so obvious. One example is the potential under supply of PV product in the Australian state of Queensland as it nears an end point in its subsidy scheme. This is at a time when over supply is the main cause of the industry slowdown. Now that the area has announced this concern there will surely be a number of players eager to fill the gap. The ability to react to such local concerns around the world would serve any company well but the danger will be that too many saviours arrive in Queensland reversing the situation and spreading the rewards too thinly between the competition. This is how the markets work and any company should gain an understanding of how many players are entering a market before committing.

The main focus will be on Japan and Italy for a while although China's announcement of more than doubling its renewable targets will help eat into the global oversupply and could potentially invigorate the market. There are a number of countries around the world introducing and/or changing subsidy structures. The opportunities along the value chain are not always easy to spot but any area, especially new markets, will desire the expertise and experience gained in another market.

David Ridsdale
Editor-in-Chief





When footprint matters

The Complete Solution

Apollo the integrated cell manufacturing metallization platform

What do you get when you combine ± 10 micron accuracy @ 2 Cpk capability, reliability and high performance? A low footprint, single line configuration that helps manufacturers meet the future challenges of the solar industry today. Featuring specifically designed systems incorporating next-generation technology, Apollo platform sets the standard in throughput and flexibility.

For more information:
www.deksolar.com



Solar Awards Winner 2011



Solar Awards Winner 2010



Solar Awards Winner 2009



2009 IPC Innovative Technology Centre Honours - PVP1200



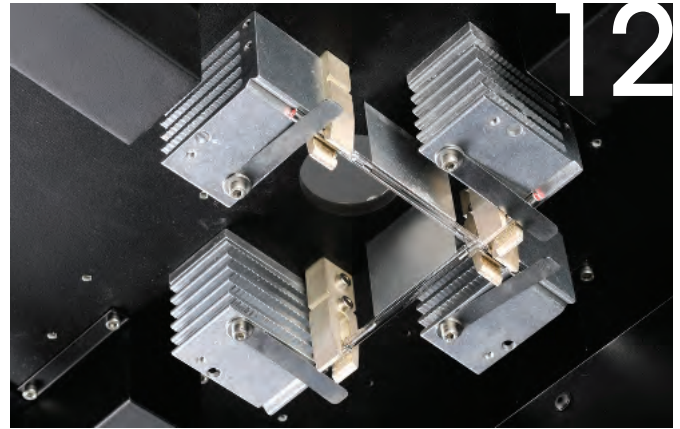
EM Asia Innovation Award 2009 - PVP1200

Think beyond equipment.

contents

12 Cover Story

As solar and PV manufacturers look to differentiate themselves in an increasingly competitive market they are seeking tools and methods to achieve this. This has put metrology and yield improving tools at the forefront. Pasan discusses how industry needs drove the development of an award winning inspection tool.



14 Fear and uncertainty in San Francisco

Normally in a volatile industry like solar and PV, a massive industry oversupply would be enough to create concern for the health of the value chain. At this year's Intersolar in San Francisco these issues were magnified by political decisions and the two super powers going head to head.

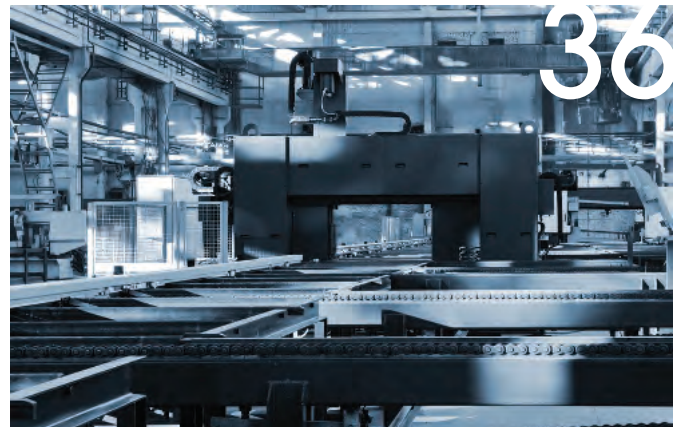


21 Award winning time

The annual Solar Industry Awards are almost upon and this edition sees the first list of those companies and products nominated to potentially receive one of the industry's most respected awards.

30 Innovation still expands PV potential

Financial realities has seen silicon based PV take the lion's share of the market with some commentators suggesting thin film and CIGS to be losing the race. A number of recent innovations has seen cheaper mass production of complicated PV designs.

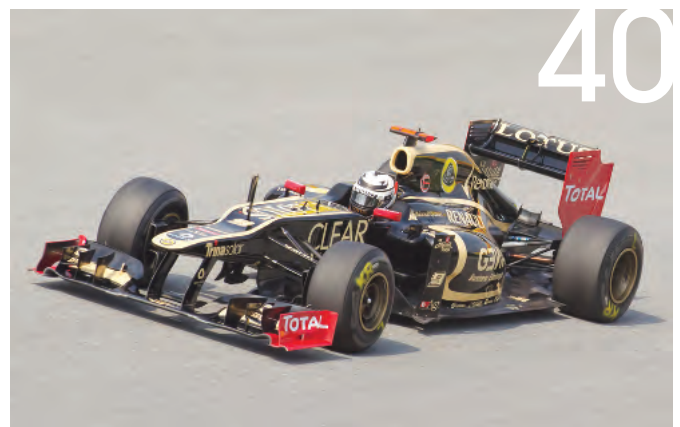


36 Machine makers sunny ride

German machine makers have had a boom time thanks to the growth of their local solar manufacturers but the industry is changing and the sector must respond to the growing global market they need to serve.

40 Building a global brand

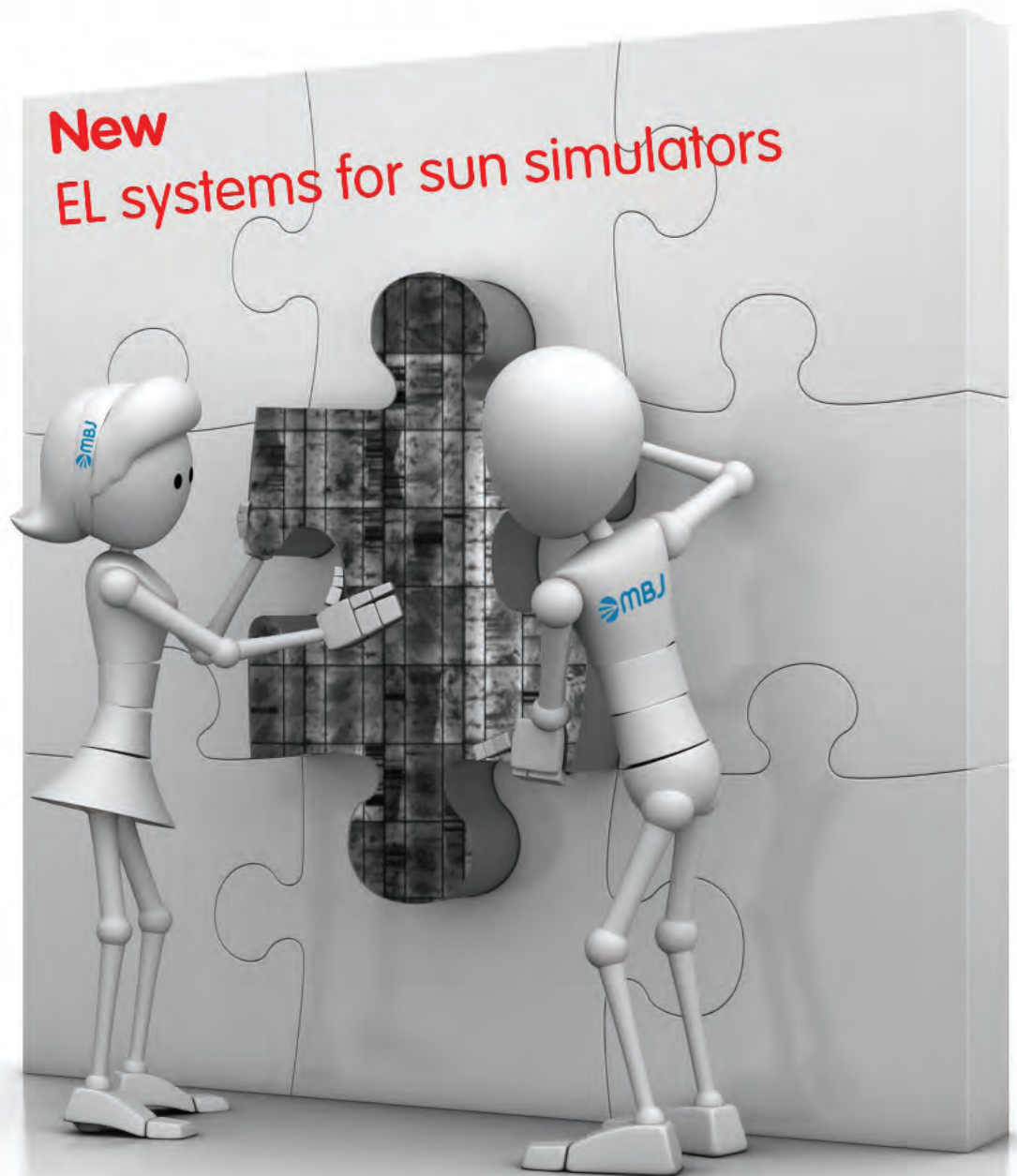
Manufacturers at the top of the solar tree are now discovering that future success will depend as much on getting their name known to the public as the quality of the panels. David Ridsdale spoke with one company intent on developing their global credentials.



Front cover

Image supplied by
Pasan SA
www.pasan.ch

Designed by
Mitch Gaynor



Electroluminescence imaging systems from MBJ ... the right module for your production!

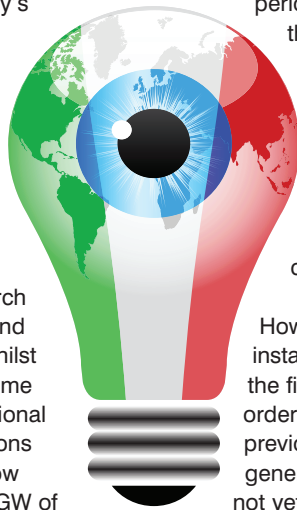
High resolution, high speed, fully automatic, reliable

- ⇒ better product quality, less customer complains
- ⇒ proven quality, higher profit
- ⇒ fully automatic, fast payback

Italian finances put solar subsidies at risk

THE budget available to for Italy's Conto Energia V PV incentive program could be cut to less than half of the intended amount, wiping out any FIT budget for 2013 and significantly reducing the outlook for installations in Italy over the next three years, according to the latest report from IMS Research. The research firm's latest quarterly PV Demand Database report reveals that whilst the new feed-in tariff (FIT) scheme could have supported an additional 7.5 gigawatts (GW) of installations over the next two years, it is now likely that it will result in just 3 GW of additional installations, with the FIT closing as early as 2013.

The Gestore dei Servizi Energetici (GSE) announced on 12th July that the annual cost of PV incentives had reached €6 billion, triggering the 45 day notice



period for the introduction of the country's new Conto Energia V (FIT) on 27th August 2012. The new scheme was intended to be accompanied by an additional annual budget of €700m and is due to end when the total annual cost reached €6.7 billion.

However, a large number of installations were completed in the first half of the this year in order to benefit from the previous Conto Energia's generous rates and these are not yet all included in the official GSE statistics. As a result, this official annual cost figure has continued to rise and already exceeds the €6 billion threshold by nearly €100m.

"Based on various supply chain checks, IMS Research estimates that around

3GW of installations will have been completed by the time Conto Energia V is introduced in August," commented Sam Wilkinson, Senior PV Analyst at IMS Research. "Currently the official GSE statistics show 1.8 GW of installations and a cost of €6.1 billion. Once these figures catch up with reality, this will take the annual cost of incentives to around €6.4 billion, and will reduce the additional budget available for new Conto Energia V installations to just €300m."

The report revealed that the reduced budget has led to a reduced outlook. IMS Research predicts that installations in Italy will now decline for the second consecutive year in 2013 and fall to less than 3GW for the first time in since 2009.

"Whilst Italy has consistently been one of the largest markets in the world, 2013 will see it fall outside the top-three markets for the first time in five years," added Wilkinson.

China raises PV target to support local companies

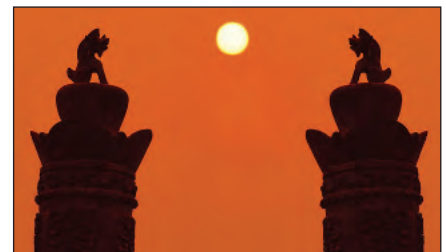
CHINA'S photovoltaic (PV) manufacturing base saw a major setback in the first and second quarters of 2012, with a severe slump in exports sparking the government to step in and further raise its PV installation target to 50GW according to the latest quarterly report on China's PV market from IMS Research. Tough competition in the global market place, vast oversupply and falling prices has put Chinese manufacturers' balance sheets under huge pressure and China's government has responded by more than doubling its long-term installation target from 20 to 50 GW by 2020.

Chinese PV suppliers have continued to suffer along with the entire global supplier base amid highly competitive market conditions. Challenging conditions in the first half of 2012 and a bleak outlook in many major markets following incentive revisions and an on-going trade war in the U.S. and Europe have resulted in production stalling. Although a small number of manufacturers have been able to maintain reasonable utilization levels, a large number of polysilicon fabs remain closed, meaning that average polysilicon production utilization in China fell below 50 percent in the second quarter of 2012.

Cell production also fell, largely impacted by the USA's recent decision to impose import tariffs on cells manufactured in China leading to many suppliers increasing the amount of cells they source from Taiwan and other locations outside mainland China. Prices also continued to fall during the quarter, with module prices falling by a further 7 percent, bringing further bad news for China's suppliers whose profit margins are already under huge pressure.

"In an effort to restore confidence amongst its substantial PV supplier base and help meet its phenomenal energy requirements, China has more than doubled its PV installation target to 50 GW by 2020," commented Frank Xie, senior market analyst at IMS Research. "This highly aggressive target could be achieved given the rate of deployment that China has already managed to achieve in the relatively short amount of time since its national FIT was launched."

The huge potential of the Chinese PV market is attracting the attention of more than just the domestic supplier base and resulting in a diversifying range of products being sold into the market.



"Large MW-scale turn-key inverter solutions are forecast to increase their share of the Chinese PV market in 2012 driven by their highly competitive upfront cost, and ease of installation and maintenance," added Xie. Inverter solutions larger than 1 MW are forecast to double their share of the market over the next 2 years. IMS Research also forecasts that China will follow a similar trend seen in the European PV inverter market and begin to employ an increasing amount of small three-phase inverters in its fast growing rooftop installation.

IMS Research forecasts that PV installations in China will be a key driver in the growth of the global PV market. Installations are forecast to grow quickly in the second half of 2012 with over 10 GW installed over the next two years.

Cleantech investment to be inspired by innovation

A NEW Frost and Sullivan report suggests that despite the recent downturn in clean technology investment due to a range of external issues there is a range of opportunities developing as the clean technology sector begins to see the value in collaborative cross technology efforts as well as a growing awareness of geographically targeting market share.



After a healthy rebound in 2010 when the new investment in renewables grew by 30 percent, 2011 and beginning of 2012 were marred by waves of bad news: bankruptcies, profit warnings, staff layoffs. Furthermore, global cleantech indices showed a downward trend.

However, despite a short-term slowdown in demand and challenging conditions in financing projects, Frost & Sullivan believes that the long-term outlook for cleantech is positive.

Renewable Energy Programme Manager Alina Bakhareva explains: "We witnessed important solar manufacturers going bankrupt, tariffs cuts being accelerated, even retroactive cuts in feed-in-tariffs for already operating PV projects. This situation affected investors' confidence, and the current scenario does not look promising."

The sceptics may feel it is a moment of triumph, and their predictions on a cleantech bubble collapsing are coming true," continues Ms Bakhareva. "But are they indeed? Are we witnessing an inglorious end or a temporary slowdown? We believe that the cleantech industry holds the answer to a few looming global problems in the energy, food and water industries. A new wind of cleantech innovation will bring the answer and this will have a positive impact on the overall market."

Frost & Sullivan has identified three sectors that show promise for growth and investment opportunities

- Energy storage seems ready to move away from the dominance of pump-storage facilities. Batteries, molten salt for CSP projects, and creative distributed storage applications on the customer side

of the meter are being tried and tested in strengthening the grid.

- Energy efficiency is still the cheapest way to reduce carbon footprint and strain on the grid. Extensive commercial building retrofits can save up to 50% of energy through energy efficient windows, heat-saving radiator insulation, improvements to lighting and climate control systems.

- Smart water is emerging with opportunities in both hardware and software segments. Companies moving ahead of the market to define emerging segments, such as combined analytical control and automation systems, will have an advantage over the competition. Despite losing its first place to other clean sectors, green energy still abounds with opportunities.

"Even mature green energy segment may become interesting for VC/PE investors as new technologies and solutions emerge from the labs and testing grounds," explains Ms Bakhareva. "It is important to highlight that with roll-back in government R&D funding and feed-in tariffs, only those sectors identified as holding strategic long-term opportunities are safe to enter."

Investors will also need to continue to consider new geographies as part of their strategy. A larger number of countries are introducing targets and goals and enacting support mechanisms for green energy and energy efficiency. China, India and Brazil - followed by other counties in Asia, Latin America, and Africa - will all see more projects.

Government support holds the key to US solar thermal power future

SOLAR thermal power, or concentrated solar power (CSP), can make a sizeable impact on the world's renewable energy industry - if governments across the globe can maintain supporting policies, says a new report by alternative energy analysts GBI Research. The latest report cites government attitudes to CSP as a key determinant to the future success of this relatively young market. Presently, the CSP market is characterized by the high cost of power generation and the challenges of achieving economies of scale. However, government provisions can push forward technological advances and boost installations, which will in turn lower the expense of both project investment and power generation.

The regulatory framework in the US has also established mandates for utility companies to purchase electricity from renewable sources for domestic consumption. Similarly, the Spanish government has tax rebates for renewable energy investments, and as a result these two countries hold the greatest share of the global solar thermal power market.

GBI Research additionally highlights the emerging economies China, India and the United Arab Emirates as drivers of the CSP market. These nations are recognizing the importance of solar energy as a means of achieving energy security and stability - particularly at a time when fossil fuel reserves are depleting and becoming more costly with additional measures to reduce carbon emissions.

Solar thermal power projects in the pipeline mean the global CSP market is expected to grow from a 2011 installed capacity total of 1,546 MW to 47,462.9 MW in 2020, climbing at a Compound Annual Interest Rate (CAGR) of 44%.



27th European Photovoltaic Solar Energy Conference and Exhibition

The most inspiring Platform for the global PV Solar Sector



Photo © Messe Frankfurt GmbH

Programme Available - Register Now

Messe Frankfurt, Germany

Conference 24 - 28 September 2012 • Exhibition 25 - 28 September 2012

www.photovoltaic-conference.com • www.photovoltaic-exhibition.com

Maximise your results

20

More than
20 years Swiss Quality
and Experience

Connect to the net with SolarMax!

Solar plants are just like football: only the result counts. And the inverter is the champion that can make the difference.

SolarMax has been developing and marketing grid-connected solar inverters for more than 20 years. We provide top-class Swiss Quality: Our products stand out through optimum efficiency, maximum yields and absolute reliability. In addition, our Service Center will support and advise you throughout the entire life span of your plant.

Go for the champions. Get SolarMax on your team.

www.solarmax.com



 **SolarMax**[®]
SWISS QUALITY

The Philippines announce Feed in Tariff

THE Philippine's Energy Regulatory Commission (ERC) has approved Feed in Tariffs for renewable energy in a bid to kick start alternative energy sources for the region. The proposal covers a variety of energy options and should instigate fast growth as has been seen in other areas. Other areas have shown that managing the change and end of the tariff is as important as the initial kick start.

The major technologies to benefit will be Solar with a proposed (PhP/kWh) of 9.68 as well as Run-of-River Hydro with 5.90, Biomass at 6.63 and Wind at 8.53. The ERC, however, deferred fixing the FIT for Ocean Thermal Energy Conversion (OTEC) Resource for further study and data gathering. The proposed FITs are less than what the ERC was hoping for but the financial regulators have hopefully learnt from other areas and is trying to maintain a logical approach. The decision came after a series of public hearings ending in March this year, on the petition of the National Renewable Energy Board

(NREB) for the setting of the FITs.

In fixing the FITs, the ERC accepted the methodology used by NREB in calculating its proposed FITs, which takes into account, among others, the cost of constructing and operating the representative plants for each RE technology, the generation output or capacity factors of these plants, and the reasonable return on investment to be allowed the developers of these plants.

The ERC arrived at FITs substantially lower than NREB's proposed FITs for Wind and Solar after it updated the construction costs of the representative plants for these technologies to reflect the downward market trend of the costs of putting up these plants. It also adopted higher capacity factors for these plants to ensure that only the more efficient plants will enjoy the FIT incentive.

For all the RE technologies, the ERC revised other project costs such as those for the switchyard and transformers,

transmission interconnection cost and access/service road cost using the same benchmarks it had employed in approving similar projects of the regulated utilities. The ERC also adopted a lower equity Internal Rate of Return (EIRR) of 16.44% in calculating for the FITs, except for Biomass, which was allowed a higher EIRR of 17% to account for fuel risks.

Section 7 of the Philippine Renewable Energy Act of 2008 mandates, among others, the setting of the FITs to apply to wind, solar, run-of-river hydro, biomass, and ocean RE resources. Under the FIT system, the eligible RE developers will be paid the FITs applicable to them for the energy they feed into the grid. The FITs are subject to degression to encourage the developers to invest at the initial stage and hasten deployment of renewable energy and also to avoid substantial windfall from being enjoyed by developers especially in the technologies where significant cost reductions are expected in the future.

Australian solar rush sees lack of product

ENERGEX and Ergon have been flooded with over 100,000 applications to connect to the electricity grid after the Queensland Government shortened the eligibility for fixed-rate tariffs for solar panels, resulting in fears that some elements of the solar industry may either collapse or not cope with the demand. Solar industry expert Scott Andrews from Green Initiatives has grave concerns that it may become a repeat of last year where several solar businesses collapsed leaving consumers being left out of pocket.

"Over 200,000 Queensland households installed solar systems over the past four years and now we have half that number of households expecting to be installed in a quarter of the time," said Mr Andrews. "There simply isn't enough quality stock of solar panels in Australia to deal with that level of demand, and many solar companies chose to conduct cheap pricing tactics to sign people up with potentially no hope of servicing those agreements."

The Queensland Government set a cut off date for registrations to be eligible for a

feed-in tariff of .44c per kilowatt hour, after which the Feed-in Tariff dropped down to AUS\$ 0.08 per kilowatt hour. The rush to register and capitalise on the ability to earn money from solar panels created a significant volume of what had previously been thoroughly checked but now 'rubber-stamped' approvals by both Energex and Ergon.

The industry may not have the capacity to install all these systems by the one-year deadline due to a variety of factors including weather, availability of stock and most importantly, the availability of skilled labour to do solar installations.

Also, due to the high volumes of applications that were rubber-stamped in such a short period, the risk of overloading the grid in any one area is high and potential reviews may see some miss out.

"Solar consumers need to know that there is going to be a bottle neck and they need to question their current solar supplier and change suppliers if necessary," said Mr Andrews.



"Their application for the higher tariff certainly does not lock them in to any one solar company and does allow them to change, contrary to misleading information out there."

"Customers need to do their homework and ensure that they have chosen a reputable company, that will be around for warranty and service after the solar 'gold rush' has passed. Our buyer beware message has been prompted by a genuine concern for consumers and a disappointment that some elements of the industry bring trustworthy solar businesses into disrepute."

Consumers are being urged to question their solar suppliers and actively protect themselves.

Testing the solar future

The solar industry is at a point of drastic market change and manufacturers now seek to differentiate themselves from their competition. Quality of product has become one of the main themes in marketing departments and companies seek any tools that can help them achieve improvement goals. Pasan is a manufacturer of measurement equipment in the photovoltaic cell and module manufacturing business and is a previous winner of a Solar International Award. Here they discuss how they developed the recent award winning new tool in line with an awareness of industry needs.



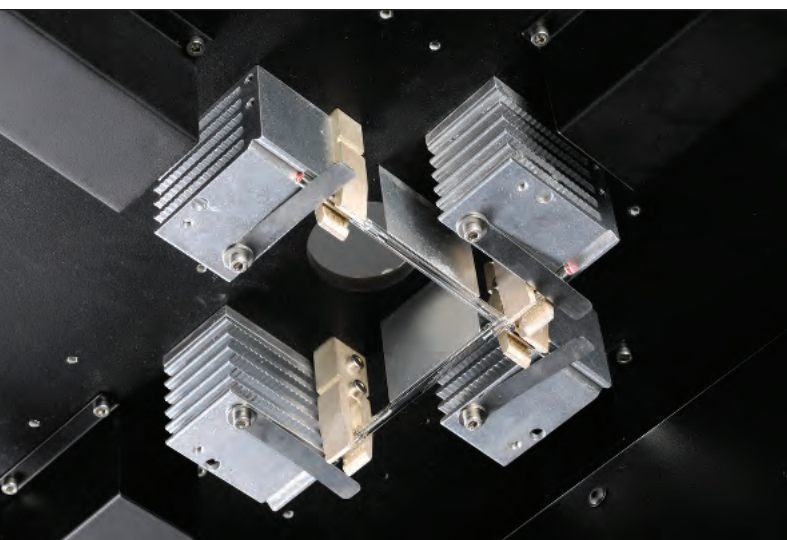
Over the past eighteen months the price of cells and modules has dropped dramatically. The upside of this has been that grid parity has been attained in several parts of the world faster than expected. However this fall in prices has also put enormous pressure on cell and module manufacturers to control their costs and innovate to produce cells with higher efficiencies.

A cell manufacturer requires two key characteristics from the tester that carries out a performance measurement at the end of the line. That it provides a measurement that can be relied on while at the same time keeping the total cost of ownership as low as possible. The correct performance measurement of a cell coming out of a line is vital for a cell manufacturer. A cell manufacturer needs to maximize the value of what is sold while at the same time not exaggerating the performance rating of the cells produced that would result in a loss of reputation. In a

nutshell: the cost of measurement inaccuracy can have a significant impact on the bottom line. This cost is as important as the material costs associated with owning a tester.

Achieving grid parity

Pasan has released a new generation of tester that has been engineered for grid parity. The SpotLIGHT 1sec, which was recently awarded the Intersolar Award in the category "PV Production Technologies" is a new generation IV cell tester. This tester addresses the market need of measuring cells with the highest accuracy possible and lowering the total cost of ownership (TCO) of the machine. This was achieved through the incorporation of a number of technological innovations that have resulted in a state-of-the-art product. Intersolar strives to promote the industry's power to innovate and its annual Intersolar AWARD recognizes pioneering products and services in the international solar industry.



To offer the most reliable measurement on the market the SpotLIGHT brings several innovations to the cell testing market. The optical design of the machine based on our module tester as well as the innovative patent pending contact system ensure that we afford our customers the most accurate measurement on the market. The SpotLIGHT cell tester is rated A+ for uniformity, A for spectral match to the AM 1.5 spectrum and A+ for pulse stability. The A+ rating puts this tester in class of its own and is what results in the reliable measurement.

Downsizing our module tester design required that we work on reducing lamp size while maintaining the spectral quality of the light using custom designed interferential filters. Customized design of contacts took us down the path of evaluating the current contact systems, identifying their strengths and weakness. We developed a unibody design that has multiple current measurement points but avoids the use of pistons which can cause measurement instabilities. By innovating in both these

areas Pasan provides a measurement system to the customer in which each component has been designed by taking into account the other components in the system. It should be noted that this increased reliability also reduces costs associated with the sorting. A reliable measurement will result in fewer false rejects that need to be retested thus improving the productivity of the sorting process. This process of innovation is continuous as Pasan is now on the brink of obtaining an A+ rating for our spectrum.

Cost is paramount

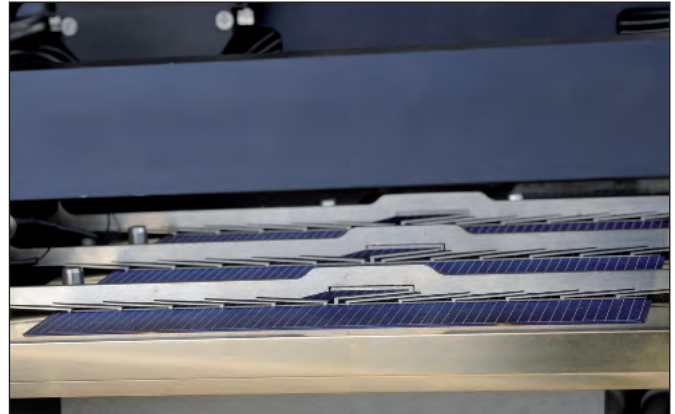
While designing the system the TCO was also a prime focus of the development team. Lowering the TCO has been achieved through multiple facets: reduced usage of consumables and increased throughput. The contacting system has a lifetime that is 10x longer than those currently available on the market thus substantially reducing the cost of this consumable as well costs associated with the down time. This can be guaranteed without any loss of the above mentioned measurement reliability. Pasan has also worked with the supplier of lamp bulbs to increase the lifetime of the lamps. This has resulted in a guaranteed lifetime of one million flashes. Another very important aspect is that the SpotLIGHT 1sec has been designed so as to minimize maintenance time. This reduction of the down time has been achieved by designing a lamp tray drawer. When the lamps need changing this drawer can be pulled out to facilitate and accelerate the lamp changeover. If the production take-time is balanced to circa 1s then the cell manufacturer can have a second drawer with new tubes pre-mounted and change the two drawers. In the latter case the down time for lamp changeover can be brought down to less than 1 minute.

Finally the very short measurement cycle time of 1 second, will enable a cell manufacturer to work test a higher throughput than is currently possible. Currently most print lines run at 1200-1600 cells/hour. The bottleneck is in the screen printing process. However, newer generations of printing lines have been developed and ultimately the throughput will pass to 2400 cells/hour and then to 3600 cells/hours. This will result in reduced CAPEX required (lesser number of machines) for printing and testing a given manufacturing volume. The SpotLIGHT has been engineered with this prospect in mind.

Market Potential

The market potential for the SpotLIGHT will be in line with the expected growth of the market for cell production that will certainly pick up after the current downturn. It is to be expected that the SpotLIGHT will take a significant part of this market share because the end customer will value this product both in terms of reduced cost of ownership as well the economic gains associated with the increased accuracy.

© 2012 Angel Business Communications.
Permission required.



Behind the gloss of trade show flaunting and the seriousness of conference presentations, the underlying feelings on the floor at the 5th annual Intersolar USA was one of fear. The uncertainty of the future was the main fear expressed but the sense was evident in discussions of the economy, of China, of the market, of subsidies. The list went on and despite the individual fears of whether the company will survive, the overall industry is actually becoming more robust as consolidation takes hold in a wildly over exposed industry.

Many companies still seem shell shocked by the rapid pace of industry change. Most seem to accept that a gold rush had

occurred but were surprised that so many others had thought it a good idea to enter the fray. Now the market is defining itself to more realistic parameters, the industry is starting to get an idea of the number of players that are required. You do not need a degree to see that there are more players than the market can sustain. This is a normal process in any industry. The pace of change depends on the number of players and options at the start of the rush.

Solar and PV has pursued a number of technology options whilst opportunity allowed but this wide focus has only increased the financial vulnerability and the fall out is evident as companies around the world begin to succumb. While the USA and European casualties, such as Abound Solar and Centrotherm are obvious, the number of companies declining in China is harder to fathom. John Lefebvre, president of Suntech Power's American arm stated at Intersolar that more than 50 lesser known companies have closed in China. The general consensus is the shake out will continue for another two to three years.

Although the atmosphere was dominated by the industry changes with no-one really knowing who will be left standing when the dust settles. A comparison to other industries shows that the companies with the largest reserves tend to be at the finish line. The PV industry may not be so easy to read with a number of competing technologies aiming to develop and maintain market share in the near and long term future. There were plenty of stories at Intersolar of companies increasing production or introducing new product onto the market. The difference now is how companies are defining their differentiators. The solar industry can no longer act as if it is selling unregulated financial products and must get on with the business of selling quality product.

The companies that left the best impression were those that described business plans that did not

Innovation behind the fear

The 5th outing of Intersolar USA was held in San Francisco. Held concurrently with Semicon West it is one of the larger shows with both exhibition and conference activities through the week. While the number of participants and exhibitors has decreased this is due to financial realities of an over supplied industry. David Ridsdale gives his perception of a show full of innovation despite the fiscal fears dominating conversations.

involve world domination but recognised the need to maintain some form of profitability over the next couple of years with expansive plans to kick in later. It will be a tough few years. Analyst feedback at the show suggested the global industry will produce around 60GW of solar panels in 2012 for a market demand barely hitting 30GW. This sort of oversupply is staggering and begs the question of why lessons are not learnt through the example of similar industries like the semiconductor market. It is a disaster for OEM tool manufacturers and suppliers. At their annual analyst breakfast, Mike Splinter of Applied Materials stated that the company had no new orders for the rest of 2012 which was a common tale and the main concern for tool suppliers. Companies need a solid war chest to survive such volatility and many are finding the coffers bare.

Silicon not the only player

Although silicon based PV has certainly moved ahead of the pack it is by no means the only option for manufacturers. CIGS PV continues to be popular and the smart companies continue to look for applications where silicon cannot go. SoloPower was one company who impressed with their flexible CIGS product and their measured approach to growth. Their flexible product has a number of potential applications and their mounting design is simple and reminiscent of the positive aspects of a recent failed USA company. SoloPower does not reveal costs but prefers to approach each market as a separate entity and tailor options to that region. Initially they are looking at Japan and Italy as their first market. The only potential hiccup goes back to the gold rush mentality. Japan and Italy are tipped to be the highest value markets for the short term and many others are also hoping to capitalise the highest value for their products while the subsidies remain strong.

TSMC Solar was also present and also have a CIGS based product. The company is learning that being a giant in the semiconductor industry means little in another industry where no-one has heard of you. Stephen McKenery was happy to discuss the realities of competing in a market with minimal technological difference between competitors. The focus is on building high quality panels with a strong roadmap for continual improvement. The company has had to reduce its initial plan to open three lines in its purpose built facility and has one line up and running. The focus for the moment is to research and develop technology at hand with the capacity to ramp up if required. McKenery was happy to admit the large fiscal support from parent company TSMC made the new couple of years possible.

There were plenty of other innovations being touted around the halls but too many production methods or manufacturing practices have yet to be tested in real world scenarios and I lost count how many times a company has explained to

Strong as a rock!

**Inverter-charger XTS,
the new Xtender
in IP54 enclosure.**

**Electronically protected
against reverse polarity.**



STUDER INNOTEK SA
Rue des Casernes 57
1950 Sion - Switzerland

Tel. + 41 (0)27 205 60 80
Fax + 41 (0)27 205 60 88

info@studer-innotec.com
www.studer-innotec.com

Swiss made power 



NEW!

**AC / DC FIELD
HALL EFFECT
MEASUREMENT SYSTEM**

Model 8400 developed with  **TOYO Corporation**

Measure mobilities down to 0.001 cm²/Vs

Typical Fields of Study:

Solar Cells—*a*:Si, CIGS, CdTe
Organic Electronics—OTFTs, OLEDs
Transparent Conducting Oxides—ITO, ZnO, IGZO
Semiconductors—GaAs, GaN, SiGe, HgCdTe, SiC

www.lakeshore.com/8400.html



LakeShore



me they have the lowest production costs for the highest production output. The sort of claims all companies have to make at the beginning. In such a competitive market the claims grow more distant from the current reality. It is as if companies begin to talk about where they imagine their company to be rather than where it is.

There was still plenty of promising innovation such as Solar3D and their much hyped nano-structured substrates that in the lab can capture enough additional reflective light to push a current panel beyond its expected output and reduce the problem of low angle light and shading. Despite the pronouncements of the spokespersons Solar3D have yet to hit market with a product. At least they loudly proclaim their offerings unlike a number of new starts that choose to keep everything secretive in the hopes the mystery will generate excitement and encourage investors in an unproven technology or process. Such secrets are harder to maintain in a connected world and the longer a company holds onto its secrets the less likely people will be to believe they have anything more than Emperor clothing.

Bonanza in the value chain

With the focus on manufacturers and the larger players it is easy to overlook the entire value chain and therefore miss out on areas that are seeing good business. Anyone in the consumables business is finding the overstretched market good business. Building greater than market capability is great for material suppliers who continue to benefit from over production. Their bubble will retract as the market moves towards sanity and from a bean counters perspective will be seen as a downturn.



The smart companies will be saving money now knowing that the market needs will shrink as the number of players do. The trick is to ensure you are aligned with the companies that survive to maintain business.

The real concern here is the amount of debt that some materials suppliers carry which will be exposed when sales decline. A good example is silicon supplier LDK which despite a remarkable beginning and current global positioning carries billions of dollars in debt which will be hard to maintain with declining revenues. Even in the heavily over populated silicon arena there are moves to continue expansion. Canadian Solar announced a ramp up of new capacity assuming the oversupply will not last long. Only time will tell if the plan works or not. The nature of the current economic outlook means that Canadian Solar has taken a risk that will be applauded if successful but derided if it is a perceived failure. Sometimes it takes a risk to differentiate.

With such pressure along the value chain companies should be more aware of how such things have worked out in comparable industries. With little differentiation in product offering companies will begin to seek greater value from their own food chain with price pressure downstream while maintaining options upstream. Of course materials and consumable companies tend to get the upper hand in the long run but in these formative years they are at risk from competition like anyone else.

Political fallout

With Intersolar held in the USA, the China and US trade war fallout was bound to be a topic of interest at the show. What was surprising was the lack of real information on the topic. Many seemed to believe it was a solar issue rather than understanding the broader context of on going accusations and counter accusations by both countries over a number of industries. The action of a single company dragged the entire industry into the quagmire and has done little to help the US industry in a time of economic crisis. When said company attempted the same thing in Europe they were unable to achieve the 50 signatures required to take such drastic action. In the US it only took one company and their perspective on the industry to initiate anti dumping regulations that have split the industry in half and spurred counter claim upon counter claim.

In the USA the solar fallout from trade wars and company failures is so great that when a homeless man (common in San Francisco) asked what I did and I then told him, his response was to ask about that Solyndra company and how they had Obama in their pocket. His take was slightly skewed in that he believed Obama gave a half a billion to Solyndra when he visited and only two weeks before the IRS visited. He was also knowledgeable about how the Chinese have 'interfered' with the US solar market. The negative stories about solar are filtering down to the masses confusing the issue of renewable energy for future generations. The industry needs to tackle the negative impressions being bandied about in the media.

The saddest part of the simplistic way in which international trade issues were perceived was the individuals and companies who felt that the Chinese were the entire cause of the current

industry crisis. A few went beyond commentary and were outright racist in their views. One interview was so inflammatory in the language that this editor walked out of the interview. In three separate interviews I pulled up a speaker for racist commentary. This sort of behaviour has no place on the international business table but the positives outweighed the negatives so I can only hope that the minority expressing such ignorance will continue to dig their own demise. The issues involved here are on going and will continue as the USA has to learn to share the top paddock in world finance with at least one more horse if not more with a few years.

Taiwanese companies on the other hand were making constant reference to Chinese companies and alluding to the political and legal ramifications of the Solarworld led anti-dumping concerns. Taiwan has benefitted impressively from the fallout and their ability to avoid punitive tariffs has seen the countries manufacturing capacity increase to 10 GW. That is one third of the planet's current market needs.

One Taiwanese company's entire presentation highlighted that their unique selling point was that they use no Chinese components in their products. A vast change in the business relationship between the region.

The general reaction to the USA imposed tariffs on Chinese produced panels has been that companies are finding ways around this. Mike Splinter from Applied Materials at the annual breakfast for analysts and journalists was asked what the impact on US solar activity based on the trade disputes. Splinter stated that there he could see no increase in US prices and stated that ways have been found around the restrictions. His comment was indicative of many companies I spoke to and did not reflect a country or industry unified on this issue.

Plenty of opportunity amidst the pain

The gold rush mentality of the last few years is entirely to blame for the current global predicament but has also accelerated the rate of industry maturation that all industries go through. Many companies seeking growth opportunities rushed to the promise of high returns in the solar market. Too many are inaccurately crying foul to the current situation as the opportunities still exist. The solar market will continue to grow and probably at a realistic rate. It is only the overcrowded market that makes the opportunities appear less than they are.

Intersolar continues to attract a large number of exhibitors and attendance but the organisers could not hide the fact that both have reduced year on year and most likely will for the next couple of years. Someone asked me if solar was doing better than semiconductor (Semicon West runs concurrently) as the booths seemed bigger and shinier. This is more evidence of companies hoping to appear more robust than they are as they attempt to encourage business their way. Despite the need to be slightly cautious for the next couple of years many companies chose to hope a big booth would encourage business. Any due diligence would soon be seen beneath the billowing capes of presentation.

Companies need to be proving their understanding of the technology. They need to prove to potential customers that they add value beyond providing a tool, service, material or product. Expect great synergies along the value chain as companies tighten their respective efforts whilst ensuring the companies around them are also sustainable.

Oerlikon recently found out that it doesn't matter how good you are if your customers go out of business. Expect manufacturers to begin (at last) to take a great interest in where their product



The solar industry needs to learn to promote and support itself in a more collaborative manner than it has. It must stop selling financial packages and get on with the business of providing renewable energy. Of course this would be helped if governments took the stance that recognised why they want alternative energy rather than get caught up in the whims and reactions of the financial markets.

With such conflicting competition the industry has allowed its detractors and competition to lead the public discussions and directions. Rarely to the benefit of the technological possibilities

ends up to avoid being connected to any potential scandal or loss making venture. With competition this tight choose your partners well.

Despite the changing subsidies in some areas of the world many companies have found there are often other local schemes where solar and PV can receive support. This has led to a renewed interest in solar power heating from investors. Another area of growing interest is developments between technologies and many tip that the real breakthroughs will occur with combined technologies. Whether it be wind and solar or semiconductors and PV, many future innovations will see multiple technologies deployed in seeking energy solutions rather than technology specific applications.

The future is in industry hands

The solar industry needs to learn to promote and support itself in a more collaborative manner than it has. It must stop selling financial packages and get on with the business of providing renewable energy. Of course this would be helped if governments took the stance that recognised why they want alternative energy rather than get caught up in the whims and reactions of the financial markets. With such conflicting competition the industry has allowed its detractors and competition to lead the public discussions and directions. Rarely to the benefit of the technological possibilities.

One direction that was mooted at the Intersolar event was defining and developing technological roadmaps to ensure clarity along the value chain before the message was so distorted that companies find no-one has been focusing on their particular needs in terms of manufacturing tools and materials. Although a roadmap like the semiconductor ITRS provides clarity to downstream companies making future plans it can also be very limiting to an industry if done too early or too strongly. There is still confusion and discussion within the industry as to what technologies will prevail in what areas. Or which production method should be the one of choice to pursue.

Done too early such roadmaps can leave strong technologies off the agenda and historical reference to other industries shows that larger companies attempt to dominate procedures to

support in-house, rather than industry, needs.

With different technologies competing – silicon and thin film to name but two- is there a need for separate roadmaps for different technologies?

How can companies ensure any roadmap process is not dominated by the largest companies?

Despite the positives that can come from a process such as road mapping there is an initial need for industry commitment to ensure a positive outcome for more than the few.

The future of solar and PV remains innovative and strong. The market is going through dramatic change that will re-shape the industry we see today and will ensure that a different number of players will remain in the market. Although many companies, technologies and jobs will vanish in the next year or so what we are left with will form the backbone for the future of the industry.

As the evolution of the industry unfolds it seems likely that industrial history will repeat itself. Those companies that adapt to the changing landscape will more likely survive but there is always room for innovation and clear business plans. Innovation and risk will continue to define the industry. Keep this in mind when analysts talk of unexpected changes in the marketplace. They are the only one surprised.

Nobody can accurately define the progression the solar and PV markets will take but there are plenty of historical comparisons to provide clues to how such things usually take place. This does not mean that it has to occur that way. The industry has more control of its destiny with collaborative goals that will become more useful as margins become tighter. The most likely scenario is that the next big thing will come from an unexpected quarter which is a timely reminder that while the industry faces the consolidation and removal of excess companies and technologies, a sharp eye should be maintained in case the next big thing passes us by.

inter solar

connecting solar business

| SOUTH AMERICA

SOLAR SUMMIT



August 15, 2012

South America's Premier
Summit for the Solar Industry

Expo Center Norte, São Paulo, Brazil

www.intersolar-south-america.com



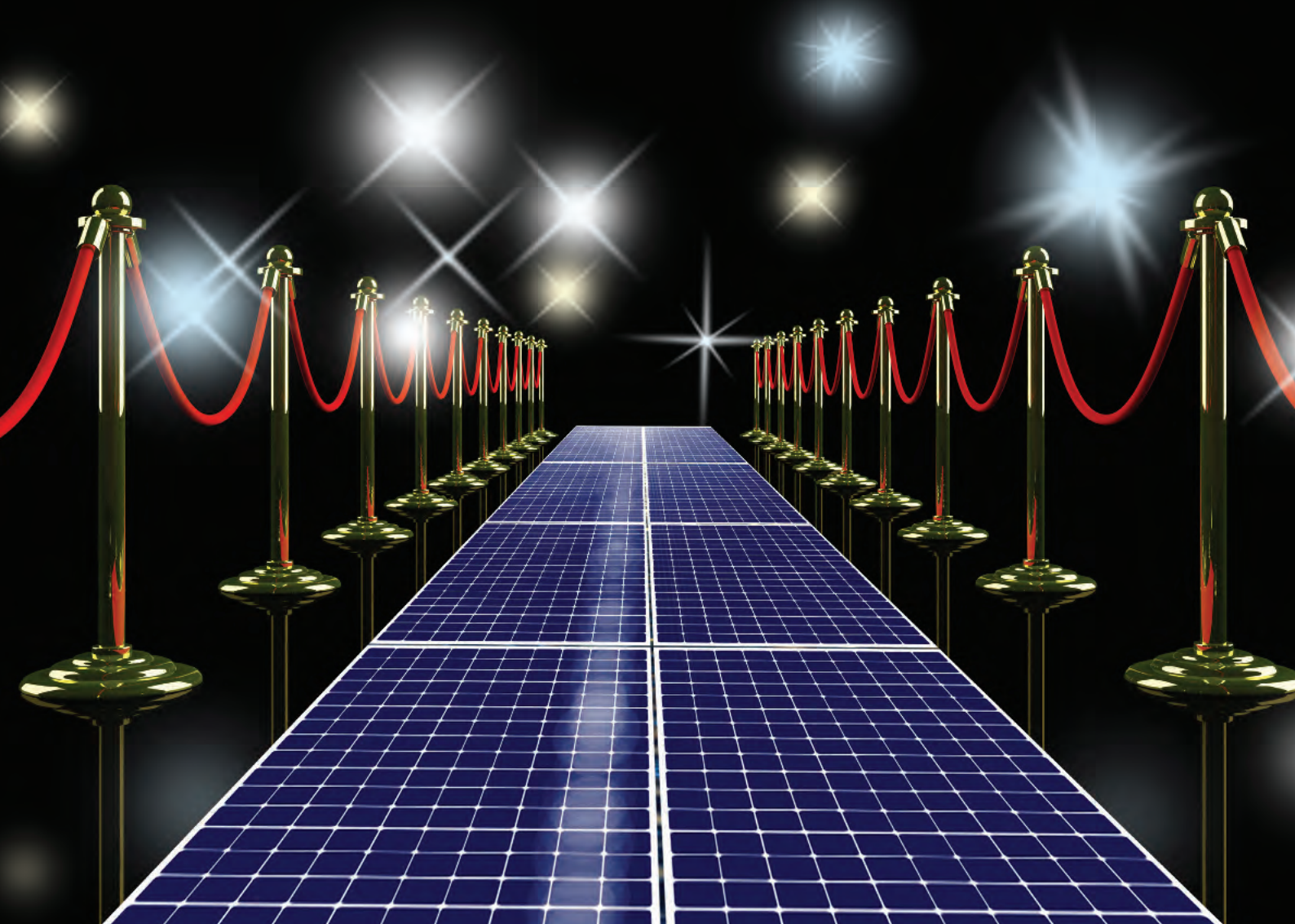
Co-located with
**XIV ELECTRICAL
INSTALLATIONS**
Exhibition &
Conference



solar awards 2012

Innovative Solutions

There may be uncertainty in how the market will progress through volatile economic times but there is no uncertainty when it comes to continued innovation in the solar and photovoltaic value chain. Once again the prestigious Solar Industry Awards will highlight and discover the most innovative people, companies, products and ideas that are shaping the future of the industry. Here is part one of the short listed companies and products.



Energy Usage
Enabling Award



ArrayPower Sequenced Inverter™

The ArrayPower Sequenced Inverter is the first solar module-integrated DC-AC inverter designed for the commercial-scale market.

While a variety of inverters are available on the market at the central string and module levels a clear need has emerged for a module-integrated inverter with a feasible price point for commercial-scale solar electric systems – one of the fastest-growing sectors of the solar energy market around the world.

The Sequenced Inverter combines the performance of a micro-inverter at a price point on par with string inverters. The Sequenced Inverter is the first to create the three-phase output required by commercial and industrial buildings ensuring the product meets both the performance and price needs of this market segment.

With the Sequenced Inverter ArrayPower offers a module-level inverter technology that encompasses all the system benefits of micro-inverters but is priced at the level of string inverters. The Sequenced Inverter is also the first module-level inverter to create three-phase output. Whereas residential and utility-scale solar systems utilize single-phase power three-phase power is required for commercial-scale solar installations. To implement a single-phase product on a commercial-scale system would require additional equipment and consequently additional cost to the end-user.



Sequenced Inverters are designed for integration into a solar module during the module manufacturing process. While micro-inverters can be affixed to the frame of a module ArrayPower works closely with module manufacturers to optimize the two technologies and allow for product combination in the form of a grid-ready AC module. This integration eliminates the need for previously standard components including the junction box facilitating cost reduction during the production process.

ArrayPower also teamed with Phoenix Contact to design a simple cable harness and three-pronged plug to connect each module resulting in a “plug and play” AC module. Not only does this method of connection increase worker safety by eliminating exposed wiring it also reduces the amount of time and capital required for system installation. Units can be easily replaced if needed equaling cost savings during any maintenance routines over the lifetime of a solar electric system.

Locus Energy LLC

Virtual Irradiance

Virtual Irradiance provides highly accurate solar irradiance data in real-time without the need for expensive on-site hardware. Data is available in 30-minute intervals at a 1 km resolution throughout continental North America and the

In order to fully understand the performance of a solar power project it is necessary to collect information on the amount of solar irradiance that was available to the project. Larger solar power systems often collect irradiance data in the field using costly specialized instrumentation such as a pyranometer or reference cell. These irradiance measurement devices are expensive and are often cost prohibitive to deploy for

residential or light commercial systems.

As with any physical hardware these sensors can break or experience downtime and require maintenance to remain properly calibrated. Wide-scale deployments of hardware magnify the problems and costs mentioned.

Virtual Irradiance alleviates the need for physical instrumentation to measure solar irradiance at residential or light commercial sites and compliments the physical sensor data at larger sites by providing high-accuracy solar irradiance estimates remotely. Virtual Irradiance estimates solar irradiance in real-time at a 30-minute time interval. Leveraging Locus Energy’s archives of solar production and environmental conditions data Virtual Irradiance can retroactively create a historical record of solar irradiance estimates.

SolarBridge Technologies

Pantheon II integrated microinverter

The SolarBridge Pantheon microinverter addresses a critical problem in distributed PV: the cost of solar adoption is still too high. A key targeted area for potential efficiency gains is the central inverter typically the weakest link in terms of system reliability. SolarBridge Technologies has developed a microinverter and PV management system that is changing the economics of solar. The SolarBridge Pantheon™ microinverter is factory-installed and mounted directly on the solar panel to create a “roof-ready” AC module. Power conversion takes place directly on each module rather than through the central or string inverter.



solar awards 2012

Solar Industry Awards 2012
will be presented on the
24th September in Frankfurt, Germany

Designed for reliability SolarBridge microinverters are backed by the industry's first 25-year warranty enabling module manufacturers to offer the maximum end-to-end warranty on their modules. This directly reduces operating costs and system downtime by eliminating the need to replace inverters.

SolarBridge Technologies has changed the game for solar module manufacturers and installers with its innovative revenue-enhancing solution that makes solar more cost-efficient more reliable and easier to install than ever before. The SolarBridge AC Module System enables virtually any homeowner or business to go solar.



Solar-Log Power Management for PV Plants

In Germany there are over 600 grid companies and each grid company uses a different technology to control the pv-plant. Solar-Log has to offer a universal method to fulfil nearly all requirements.



Another important thing is that at some location the grid is on the limit and no additional PV plants can be connected. Solar-Log is able to limit the power that is fed in with consideration of self consumption. So the plant owner can build a larger plant than allowed and still feed in the maximum allowed power.

Solar-Log has implemented different interfaces to get the commands of the grid company and can control the inverters of which protocols for power management has been implemented. By measuring the voltage e.g. on the 20.000 V side solar-log can control the reactive power based on characteristic curve of the grid company.

Finally for self consumption solar-log is measuring the power consumption and reduces this from the produce power based on the difference Solar-Log is permanently control the power of the inverter.

A standard monitoring device has changed to a complete control unit. We are the only company that can fulfil even the most complicated requirements of grid companies. No other monitoring company is able to considering self consumption.

PV TOOL AWARD



Apollo

DEK Solar is a global provider of screen printing equipment and processes for fuel cell and solar cell manufacture. Apollo - a next-generation integrated cell manufacturing metallization platform is DEK Solar's latest offering.

Apollo was designed with one primary goal – helping companies in the solar industry to create a more cost effective production line. Two major challenges that Apollo addresses are alignment accuracy and hardware footprint. Alignment Accuracy – Printer alignment accuracy becomes a critical factor with the introduction of newer metallization strategies like Print-on-Print and Selective Emitter. These technologies require that the printed metallization grid is perfectly

aligned to previously defined features on the wafer. Hardware Footprint – In the drive to reduce solar cell manufacturing costs a metallization lines throughput and footprint are two important considerations.

Apollo boasts market leading accuracy increased capability and advanced features and allows DEK Solar to now offer a comprehensive portfolio of metallization platforms for the complete spectrum of PV customers from entry level start up through to the multi-national cell makers.

Alignment Accuracy – The Apollo platform offers ± 10 micron accuracy @ 2 Cpk capability and advanced automated features to deliver repeatability and accuracy.

Hardware Footprint – The Apollo platform offers high performance in an industry leading small footprint single configuration line. Offering exceptional productivity per meter of floor space the Apollo platform sets the standard in throughput and flexibility.



Apollo's advanced automated features optimise accuracy for Print-on-Print and Selective Emitter processes and offer customers repeatability.

An innovative in process wafer alignment system has been designed specifically for the selective emitter print-on-print and metal wrap through process which delivers exceptional alignment accuracy and makes these next generation technologies practical.

The state of the art print engine design delivers the highest level of print quality through use of its closed loop control system and paste delivery systems. Print results are controlled through an SPC software suite for optimal performance.

SOLAR AWARDS SHORTLIST 2012



**WORLD
FUTURE
ENERGY
SUMMIT**
Abu Dhabi 2013

POWERING THE FUTURE OF ENERGY INNOVATION

15 - 17 January 2013, Abu Dhabi National Exhibition Centre

Your Access to Unrivalled Business Opportunities in the Alternative Energies and Sustainable Technology Industries

As the unique global meeting place bringing future energy business, policy and technology together, we give you access to:

- World leaders in policy from over **70** countries
- **40** renewable energy project developers
- **150+** world class speakers
- Over **3,000** decision makers
- **650** leading technology suppliers
- **700** media representatives

New for 2013 - Discover more about the critical water-energy nexus, as WFES runs in conjunction with the new International Water Summit.

Contact us now to book your space

For exhibition booking and sponsorship opportunities, contact Claude Talj on +971 50 452 8168 or claude.talj@reedexpo.ae

Organized by



Supported by



Platinum Sponsors



www.worldfutureenergysummit.com

Part of Abu Dhabi Sustainability Week



GXS dry pump

The GXS dry pump provides for reduced cost of ownership in a compact package with advanced control features to help ingot growing customers remain cost-competitive in a rapidly changing industry. The ability to control the pump suction provides headroom for process development for advanced crystal growth.



The pump is designed to rotate at a high speeds to avoid creating mechanical resonances between the pump the inlet piping and the crystal puller. This can lead to a reduced number of re-melts within the furnace. The performance results are what distinguish this product from others. The gains in operational efficiency and reduced maintenance requirements help customers lower their manufacturing costs of silicon ingots.

The GXS dry pump is a combination of a dry pump and mechanical booster pump in a single package. Precision engineering and high quality materials of manufacture are used to deliver a pump with fast rotational speeds and low mechanical vibration. It is incredibly compact with high pumping speed that can be positioned close to the crystal puller. Sophisticated on-board electronics provide advanced control features and internal monitoring to ensure high up-time and minimal energy use. Ethernet and serial interface ports enable interfacing to central monitoring systems to help plan maintenance and monitor performance to ensure high factory operational efficiency.

Although many customers have moved from using oil-sealed rotary or piston pumps to dry pumps there are a large

number of users that have yet to experience the benefits a dry pump brings to crystal growing. Not all dry pumps are alike. But the Edwards GXS pump has proven itself as a reliable work-horse for crystal growing with previously unseen advantages in ingot manufacturing. With advanced intelligence and monitoring capability users are able to move to an advanced level of manufacturing previously not achievable by using a generic pump without such control capabilities.



DragonBack™

Today's major challenge in PV is to reach grid parity. In order to achieve that goal efforts are made on the cell/module efficiency on one hand and on the TCO (total cost of ownership on the other hand. New-generation PV materials exhibiting higher efficiencies jointly reveals highly capacitive effect that disturbs their performance measurement by conventional method. Such solar cells/modules require new solution for accurately determining their electrical performance in production environments.

The DragonBack™ method introduced by Pasan is the solution for efficiently determining the performance of highly efficient modules with economical and high quality pulsed light source.

The DragonBack™ measurement method is the solution for the final power measurement of production of highly-efficient modules. It is used in conjunction with standard Pasan HighLIGHT pulsed solar simulator enabling accurate measurement within one flash at high tact-time while keeping low TCO.

Technically the DragonBack™ measurement method is a dynamic sweeping methodology. Instead of applying a continuously increasing voltage ramp the DragonBack™ works by steps during which the module response is stabilized thanks to an adapted overshoot. It consequently diminishes the stabilization time and accurate values

forming the current-voltage curve can be measured during a short illumination period (10 ms).

The DragonBack™ measurement method gives an answer to modules producer looking for reliable accurate and cost-effective solution for the measurement of advanced PV technologies. The noteworthy aspect of the DragonBack™ method is the combination of a highly accurate and highly repeatable measurement process for HiCap modules with industry requirements including tact-time low TCO and easiness of use. Up to now the various proposed approaches for testing such material never includes and solved both aspects of measurement accuracy and cost of the solution.

From a technical point of view such dynamic sweeping method was never applied to solar cells or modules before Pasan developed it together with the Swiss university and PV reference laboratory SUPSI within a research project funded by Swiss Confederation. It is the only approach which solves the dynamic problem induced by the new high performance technologies through an adapted measurement process.

NanoFocus, Inc.

μsurf solar

μsurf solar is a high precision optical measurement solution for the broad range of solar applications in laboratory and production. Its flexibility allows all measurement tasks to be performed with nanometre accuracy using the confocal technology. This evolution delivers stability of data

As a business solution, the μsurf solar is adapted to the requirements of solar industry from hard- to software. The positioning tables are available up to the metre range which is required to measure whole solar modules. A vacuum chuck with a bearing area of 210x210mm² guarantees the safe fixture of the solar cell while moving the stages without damaging it.

μsurf solar by NanoFocus enables non-destructive analyses without preparation of the samples. For the 3D inspection

system, it doesn't matter if the surfaces possess etched structures or an anti-reflective coating. Also for samples with awkward characteristics such as steep slopes, complex geometries and structures in the nanometre range, μ surf solar delivers exact and repeatable 3D measurement data within a few seconds.

SILICON INNOVATION AWARD

AEG Power Solutions

Thyrobox™ PI

For over 60 years, AEG Power Solutions has been a worldwide supplier of industrial AC and DC power supply systems.

AEG Power Solutions (AEG PS) Thyrobox™ PI power system sets efficiency standards in polysilicon production. Using proprietary technology developed by AEG PS, the Thyrobox™ PI allows manufacturers of polysilicon, to increase the production output of their existing polysilicon reactors by 10% to 20%, depending on reactor configuration and process condition.

Polysilicon is the base material used in the manufacturing of solar cells. With decreasing polysilicon prices, manufactures are under ever increasing pressure to lower operational manufacturing costs. Thyrobox™ PI can easily be added to existing AEG Power Solutions Thyrobox power systems. That way it allows for permanently lowered operational costs with minimal investment as no new or additional deposition reactors are needed.

In addition to increased polysilicon productivity the Thyrobox™ PI reduces internal thermal stresses thus preventing rod cracks, allows for more uniform growth, improves rod joint bridge shaping

and minimizes hot spots. The vision is to deliver sustained value to customers by lowering the cost of PV manufacturing.

MEI LLC

FlashDry Polysilicon and Material Drying

MEI's FlashDry is a unique patent-pending rapid drying process that is capable of drying all form factors of semiconductor solar and metal grade polysilicon in minutes with significantly less energy use less material damage and complete drying.

Flash Dry solves a vexing problem for materials processing how to completely dry polysilicon without wasting energy time and creating additional contaminants. Extremely fine form factors of polysilicon such as slurries muds sands and fines have been considered nearly impossible to dry on a production basis.

Lab methods such as heated trays ovens and vacuum chambers where time-to-dry is irrelevant can't compete on a production basis. FlashDry is more than ten times faster than these archaic methods when used on polysilicon muds sands and fines. It can even dry polysilicon slabs placed face-to-face where the surface to be dried is completely occluded.

FlashDry is a product based on a unique process model. This model allows the FlashDry process to remove the optimum amount of water through a mechanical coalescence process followed by a vacuum evaporation process. By using MEI's unique process model FlashDry is able to completely remove all of the water present in a variety of form factors of polysilicon from chunks and slabs to muds and fines in the shortest possible time.

In any evaporative drying process typically 85% of the energy input is used to overcome the latent heat of evaporation of water. Since FlashDry is a non-evaporative process it uses only 10-20% of the energy used by evaporative processes and is ten times faster. Since FlashDry can dry polysilicon fines and slurries not dryable by other production-

scale means it allows for the wet chemical processing cleaning and purification of these same fines and slurries. At least two major polysilicon manufacturers had given up after spending years trying to develop such a unique process capability without success MEI is the first to achieve this breakthrough in technology.



Aegis® Wafer for Silicon Photovoltaic Products

Aegis® Wafer is designed to meet the strong desire of a cost-effective solution at the solar cell industry simultaneously driving high performance and low cost (e.g. loss. In particular ultra-high fracture strength for low loss without hampering the conversion efficiency has topped the desired technology list of the PV community.

SAS invented nano-texturing technology to extensively enhance the fracture strength on the fourth generation of SAS high efficiency A-series wafers. High PV conversion efficiency is achieved by ultra-low bulk defect density while ultra-high fracture strength is enabled using nano-texturing shielding surface defects from crack propagation. The Aegis® Wafer perfectly arranges both surface and bulk effects of silicon for the best interest of customers.

The SAS Aegis® Wafer is designed for highly strengthening multi-crystalline silicon substrates combined with impressive efficiency improvement. The Aegis® Wafer technology platform is combined with SAS A-series silicon growth technology of high cell conversion efficiency and nano-texturing technology.

By nano-texturing technology the Aegis® Wafer is enhanced dramatically by over 200 % than conventional multi-crystalline wafer. Accordingly the greatest reduction of in-line fracture loss by over 75 % is undoubtedly instrumental in manufacture loss and provides customer user-friendly

solar awards 2012

Solar Industry Awards 2012 will be presented on the 24th September in Frankfurt Germany

thinner wafer solution. Furthermore the Aegis® Wafer possesses cost-effective high throughput and its feasibility of batch production to achieve lower manufacturing cost with more than 80 % and energy consumption reduction with more than 50 %.

The SAS Aegis® Wafer has excellent efficiency performance on a global scale to advance two-steps ahead on the dramatic high efficiency photovoltaic market by SAS A-series silicon growth technology. The Aegis® Wafer achieves over 18 % median PV conversion efficiency by more than 1 % enhancement and raises product value premium by more than 20 %. The Aegis® Wafer meets customer's requirements by the greatest gains in efficiency of solar power and cost-effective solution making it more competitive with other means of electricity generation.

SOLAR MATERIALS ENABLING AWARD

Heraeus

SOL200 Series

Silver metallization pastes have become one of highest material cost parameters in c-Si solar cell fabrication due to the dependence on the core market price of silver (Ag). The need for both high-performance silver-based pastes for improved cell performance and cost-effective conducting materials is a critical requirement for PV manufacturers. Heraeus develops front-side and backside pastes that lower the silver content per cell. Heraeus addresses the need to reduce that cost by producing silver pastes that allow for up to 40% reduction in silver usage. Heraeus SOL205S, the current product for the back-side, is produced using 52% silver content.

Heraeus' line of back-side pastes are especially formulated to provide high coverage for reduced usage on wafers. Heraeus continue to reduce the silver content of back-side pastes, while also

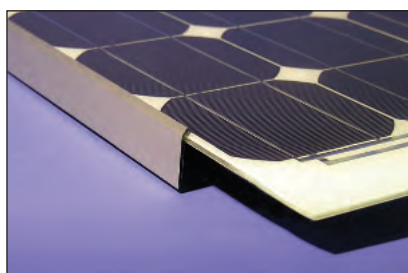
maintaining excellent adhesion to the silicon cell. With Pb- and Cd-free material options, Heraeus' back-side pastes offer excellent solderability in both leaded and lead-free solders. All back-side pastes are co-fireable with back-side Al and front-side Ag pastes.

Silver bullion prices have eased over the last nine months, as increased silver bullion production has resulted in an oversupply. Whether this is a permanent situation or not, Heraeus will continue in the direction of reducing the silver usage in cells. The low laydown of the SOL200 series helps customers save money while maintaining good cell performance.



SolarBond® InFrame

SolarBond® Readyframe is a custom tape-in-frame solution designed to streamline the module framing process by removing the extra steps needed to add a sealant or a tape to the frame. The solution facilitates high-quality frame assembly process while enabling cost savings and consistent output results. Pre-applied tape makes the PV module framing extremely easy and fast without the need to alter existing procedures and production lines. SolarBond® Readyframe can be used both on manual and automated operations. This innovative solution helps solar module manufacturers remain competitive in the current economic environment.



The main challenge module manufacturers are facing today is downward pressure on pricing and the necessity to maintain healthy bottom line while reducing selling price of modules. To address this challenge module makers

need to evaluate their production process and find opportunities to create cost savings. SolarBond® Readyframe targets small to medium module manufacturers that cannot invest in full automation but can benefit from a cost-effective solution to reduce their labour costs while improving quality.

Today module manufacturers need to apply a sealant or tape to the module laminate before assembling the four frame sections. With SolarBond® Readyframe the frame sections are available with the tape already in place without the liner.

The module manufacturer only needs to place them in their framing table and complete the process. This eliminates the cost of labour associated with applying a frame-sealing material and assures consistent quality of the tape used on every module each and every time.

Cost reductions are also achieved through eliminating material waste curing time production downtime due to cleaning and need to train an operator.

Saint-Gobain is the only company to develop a pre-applied tape solution and the first to bring such product to the market. All alternative solutions require an additional step of applying a tape a silicone sealant or a foamable sealant to the frame.



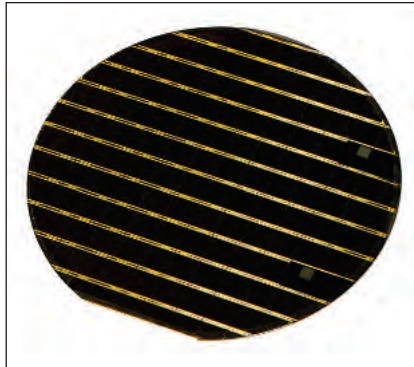
Solar Junction

SJ 3 Cell

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 is only company that 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 tuneable 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 band gap 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.



production cells and manufactured entirely in-house on its production line in San Jose, California. February 2011 Solar Junction reached 41.4% efficiency on a production cell that was once 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.

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.

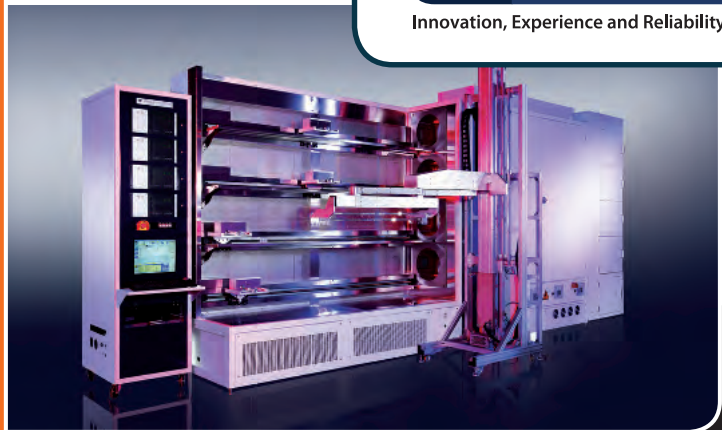
The cell structure maintains pure while other companies are using innovations that use different processes that do not maintain a lattice-matched structure.

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

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 in the USA was a standard 5.5mm x 5.5mm production cell that is available to customers.

Choosing a diffusion furnace supplier for your PV process isn't easy ... but at Thermco Systems, we make peace of mind part of the specification...



Thermco Systems
Spring Gardens
Washington, West Sussex
RH20 3BS, United Kingdom

T. +44 (0) 1903 891700
F. +44 (0) 1903 893888
E. info@tetreon.com
W. thermcosystems.com

A Division of Tetreon Technologies Limited

- High Reliability and uptime
- Full range of products from small R&D to full size production tools
- Automation including back to back cell loading cassette to cassette
- Load sizes of >400 cells
- Throughput of 1600 wafers / hour*
- Worldwide service and support
- 45 years of thermal expertise
- Industrial computer control with advanced SPC analysis software.
- Process guarantee on PV films:
 - Pcl_3
 - BBr_3
 - Nitride for ARC
 - Oxidation
 - Anneal
- Peace of mind with your decision

*process dependent

Asia's largest event on renewable energy

6th RENEWABLE ENERGY INDIA 2012 EXPO

India Expo Centre, Greater Noida
National Capital Region of Delhi, India
7 - 9 November 2012

Solar PV | Solar Thermal | Wind
Bio Fuels | Bio Mass | Small Hydro Power
Geothermal | Energy Efficiency

Supported by



Government of India
Ministry of New & Renewable Energy



Knowledge Partner

ERNST & YOUNG
Quality In Everything We Do

Ernst & Young Pvt. Ltd.

Supporting journal

solar^{international}
A PV Management Magazine

Organiser



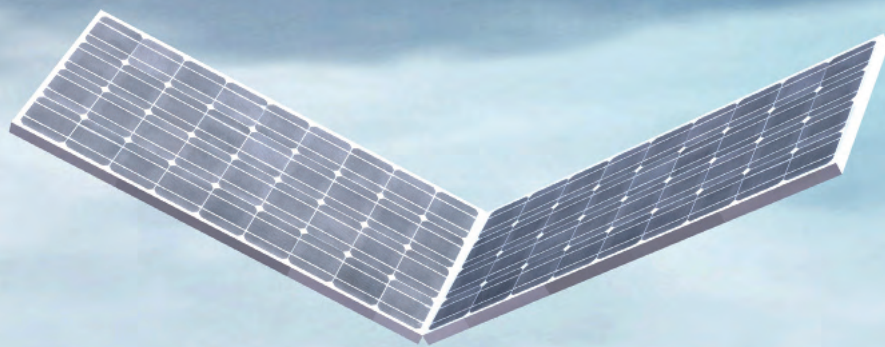
Rajneesh Khattar | +91 98717 26762 | rajneesh.khattar@ubm.com

www.renewableenergyindiaexpo.com

CODE: REWIN06

*Register using the above Code to win a Conference Pass
*before 31st July 2012





Lifting limitations in photovoltaics

Traditional triple-junction photovoltaics are marred by brittleness, inflexibility and an efficiency that is limited by the germanium cell. To address all of these issues MicroLink has developed a whole-wafer, high-volume epitaxial lift-off technique for producing ultra-thin cells on GaAs. Richard Stevenson reports.

Developers of multi-junction solar cells tend to try to and improve device performance by inserting new materials and boosting efficiency. But there are many other ways to make the cells more appealing, such as trimming weight, increasing robustness, cutting material costs and enhancing flexibility.

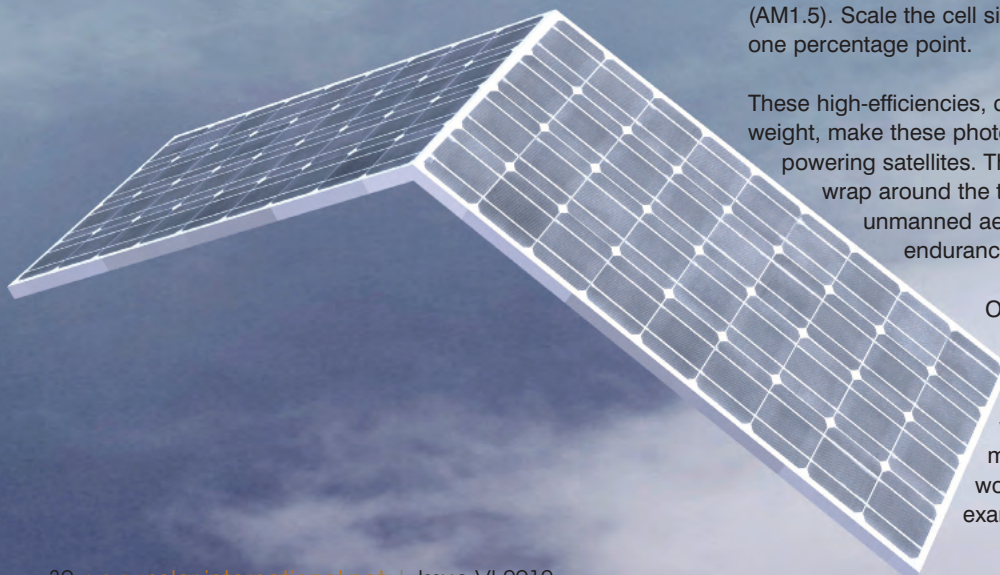
One company that has developed a technology that allows high-efficiency cells to excel in all these regards is MicroLink Devices, which is based in Niles, a northern suburb of Chicago, Illinois. Founded in 2000, MicroLink is best known for its MOCVD growth of epitaxial wafers for handsets and other wireless products, but over the last five years it has also been developing a wafer-scale, epitaxial lift-off process for manufacturing ultra-light, solar cells with one, two or three cells.



The performance of these cells, which are mounted on a flexible metal backing, is very promising. Measurements replicating the sun's spectrum yield efficiencies for MicroLink's best 1 cm² cells of 31 percent in space (AM0) and 33.9 percent on the ground (AM1.5). Scale the cell size to 20 cm², and efficiencies fall by just one percentage point.

These high-efficiencies, combined with an incredibly low cell weight, make these photovoltaics attractive candidates for powering satellites. These cells are also flexible, so they can wrap around the topside of the wings of battery-powered, unmanned aerial vehicles (UAVs), increasing their endurance.

One organization starting to look at doing just this is the US Air Force Research Laboratory, and it is funding a project involving MicroLink. If this project has widespread success, it could do far more than just aiding the military – those working in the real estate sector, for example, also view UAVs as an attractive



approach to surveying vast areas of land. MicroLink’s cells could also be a competitive product for the terrestrial concentrating market, thanks to relatively low production costs that stem from multiple re-use of GaAs substrates, which just require a polish before they re-enter the MOCVD chamber. Using re-polished substrates makes no impact on device performance.

“The substrate is a considerable fraction of the bill of materials for the device,” explains Chris Youtsey, Fab Director at MicroLink. “The limitations on how many times you can re-use the substrate come down to how much material you remove from the polishing and [the frequency of] breakages.”

Youtsey claims that a reasonable goal is to re-polish the wafer ten times. He points out that polishing removes as little as 10 μm, and says that thinning a GaAs substrate by 100 μm or so should have no impact on the deposition of a high-quality epitaxial structure. Even higher rates of substrate re-use are theoretically possible, but they produce ever diminishing returns. Enter this regime and the rewards do not justify the efforts.

Peeling it off

The epitaxial lift-off technology that MicroLink uses is certainly not new. Reports of such efforts date back to 1978, when a Japanese team from Tokyo Institute of Technology published a paper on the fabrication of high-efficiency GaAs solar cells with a ‘peeled film’ technology. Progress in the 1980s and 1990s included efforts by Eli Yablonovitch from Bell Communications Research, who revealed the extreme etching selectivity of AIAs compared to GaAs. And further strides on epitaxial lift-off technology have been made during the last 15 years, with John Schermer’s group from Radboud University reaching a new level of understanding of the process, and devising new ways to increase the etch rate.

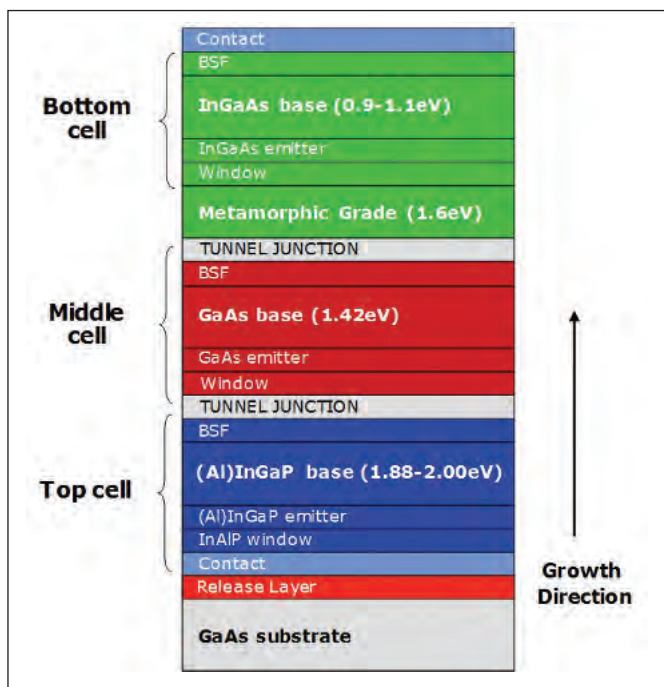


Figure 1: MicroLink forms its metamorphic cells on a GaAs substrate. Etching a sacrificial, AIAs layer about 5 nm-thick with hydrofluoric acid allows separation of substrate and epilayers

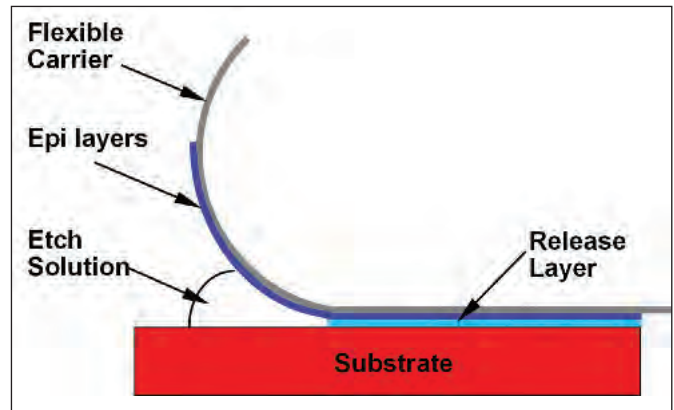


Figure 2: After a flexible metal carrier is attached to the solar cell epi-structure, the GaAs substrate is removed by etching in hydrofluoric acid

However, epitaxial lift-off is still an intrinsically slow process, according to Youtsey: “It’s not seconds or minutes – it’s hours. So if you want to get high throughput, you have to do it in batches.”

Switching to batch processing is one of the two big breakthroughs in epitaxial lift-off technology made by MicroLink Devices, whose team has a background in high-volume GaAs fabs, including TriQuint. Running in pilot product, MicroLink processed 1400 4-inch wafers in 2011, and it could increase this throughput substantially – each etching bath that it uses is capable of processing 1500 wafers per month.

Youtsey says that another significant breakthrough made by his team is the simplification of the process – no longer are weights used to separate substrates and epilayers: “Our approach uses a proprietary support layer, which allows us to efficiently batch process.”

At MicroLink, photovoltaic production begins with MOCVD growth of an inverted metamorphic structure featuring InGaP, GaAs and InGaAs cells (see Figure 1). This epitaxial stack contains a 5 nm-thick AIAs layer sandwiched between the substrate and triple-junction cell.

After attaching a thin, flexible metal carrier layer to the uppermost epitaxial layer, the resulting composite is immersed in a bath of concentrated hydrofluoric acid, which selectively dissolves the release layer – the etch selectivity of AIAs relative to the GaAs epitaxial structure exceeds 105 (see figure 2 and 3). After etching for 12 hours or so, the metal carrier and solar cell epilayers are completely separated from the GaAs substrate. Engineers at MicroLink mount these epitaxial lift-off foils to a temporary, rigid carrier, so that they can process the wafer into devices. This involves evaporation and lift-off of a metal ohmic contact, wet etch isolation, evaporation of an anti-reflection coating made from a bilayer dielectric stack, and dicing of the processed wafer into individual devices. Following that, the solar cells are removed from the temporary carrier.

Epitaxial lift-off does not degrade the material quality of the cells. Transmission electron microscopy images from the National



Dedicated exclusively to compound semiconductor, silicon semiconductor and solar recruitment

To find the right professionals with the training and experience tailored to your industry can be difficult

To be the market leader you need the best people working for you

By using CSS-Jobs.net you can reach 100,000 industry professionals globally

Find your new recruit today from the lab to the fab to the boardroom through **CSS-Jobs.net**

E: info@css-jobs.net

W: www.css-jobs.net



Supported by



Flexible solar sheets have been produced at MicroLink by interconnecting 30 large cells with silver-based foil ribbons and laminating the structure between transparent sheets to yield flexible solar sheets. The resulting composite is highly flexible, and can wrap around curved structures, such as the wings of solar-powered planes

Renewable Energy Laboratory fail to uncover any delamination, cracking, threading dislocations or voids in the cells. An absence of cracks and defects holds the key to the fabrication of cells with very large areas.

A better base

MicroLink’s metamorphic structure features: An InGaAs bottom cell with a bandgap that can be tuned from 0.9 eV to 1.1 eV; a 1.42 eV GaAs middle cell; and an (Al)InGaP top cell with a bandgap that is adjustable from 1.88 eV to 2.00 eV. “I think that’s pretty close to optimum,” claims Youtsey.

To evaluate the impact of device quality on re-polished GaAs, engineers at Micolink have compared the efficiency of 1 cm² cells formed on 25 substrates that were initially pristine, and then re-polished once, twice, three and then four times. Their conclusion: The average cell efficiency on the three re-polished device populations is comparable to that of cells grown on original, prime GaAs substrates.

If these cells are to be used in space applications, they need to be able to withstand bombardment from various forms of radiation. Youtsey believes that the cells can meet this demand: “The radiation hardness of individual epitaxial lift-off junctions, such as InGaP, GaAs and InGaAs, follows the expected trends for these materials. ”

Scaling cell size also appears to have no impact of device performance – typical conversion efficiencies of 29 percent were recorded for 1 cm² cells and 20 cm² equivalents, which were

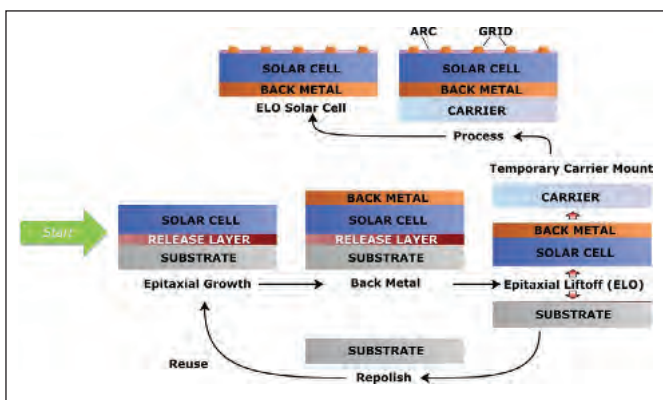


Figure 3: Processing begins with the growth of an AIAs release layer and a solar cell structure on a GaAs substrate. After etching in hydrofluoric acid the GaAs substrate is re-polished and used again, while the solar cell and back metal composite is temporarily bonded to a carrier wafer for device processing

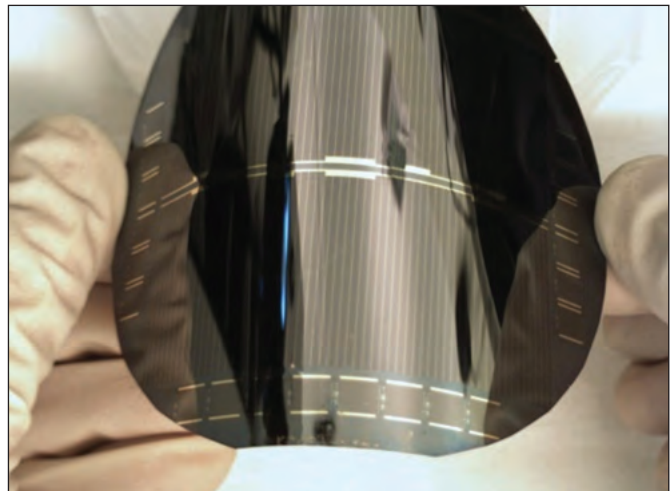


Figure 4: A 4-inch film produced by MicroLink’s epitaxial lift-off process features two, 20 cm² solar cells on a thin, flexible metal backing

both measured at NASA Glenn using the AM0 spectrum. Flexible solar sheets have been produced at MicroLink by interconnecting 30 large cells with silver-based foil ribbons and laminating the structure between transparent sheets to yield flexible solar sheets. The resulting composite is highly flexible, and can wrap around curved structures, such as the wings of solar-powered planes. One great attribute of this solar sheet is its incredibly high specific power, which exceeds 400 W/kg.

According to Youtsey, triple-junction germanium cells with a 150 μm thickness are at least four times as heavy: “From an application point of view, that is a big deal.” In addition, cells on from form of germanium substrate are very brittle. “You have to build a wafer fab to accommodate them,” explains Youtsey.

Bigger and better

MicroLink has also fabricated 61 cm² cells from 6-inch GaAs wafers. Part of the motivation behind producing such large cells is to demonstrate the quality of MicroLink’s process. “But there is interest, in terms of panels assembly, in working with large cells: Fewer part counts, fewer interconnects,” explains Youtsey.

Today, however, MicroLink’s primary focus is not on making bigger and bigger cells. Instead, it is setting its sights on increasing efficiency and streamlining process flow. Success will simplify ramping to production volumes and it will also increase yield. To boost efficiency, efforts will focus on increasing the open-circuit voltage and fill factor. Improvements in material

quality will underpin these programmes. Further efficiency gains could result from increasing the number of junctions to four or five, but Youtsey acknowledges that this step is not easy to execute in high-volume production.

MicroLink is currently in pilot production, and it plans to progress to full commercialisation within the next two years. When it hits that milestone, customers of multi-junction cells will have some head scratching to do. Up until that point, selecting a device has been based on efficiency, reliability and price, but from then on factors such as weight, flexibility and robustness will come into the play.

© 2012 Angel Business Communications.
Permission required.

Thermophotovoltaics

MicroLink's epitaxial lift-off process is an attractive approach for making any type of device that has a large proportion of its cost associated with that of the substrate. One such example is thermo-photovoltaics, devices built on InP substrates that convert heat into electricity. Reducing the number of InP substrates needed to make thermo-photovoltaics could lead to massive cost savings, because InP substrates are nearly an order of magnitude more expensive than GaAs equivalents.

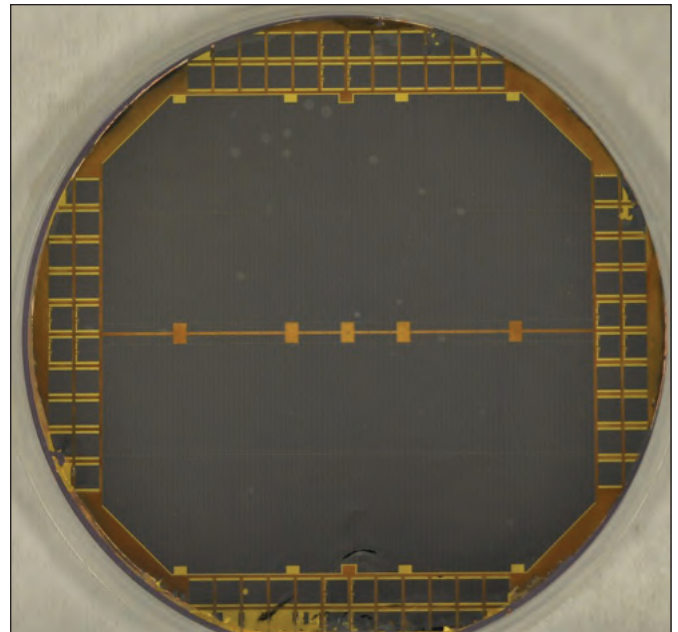


Figure 5: Two 61 cm² triple-junction cells formed by applying MicroLink's epitaxial lift-off process to a 6-inch GaAs wafer

Reprints are a valuable sales tool

Benefit from a reprint featuring your company

They can be ordered after publication and can be customized to your exact needs.

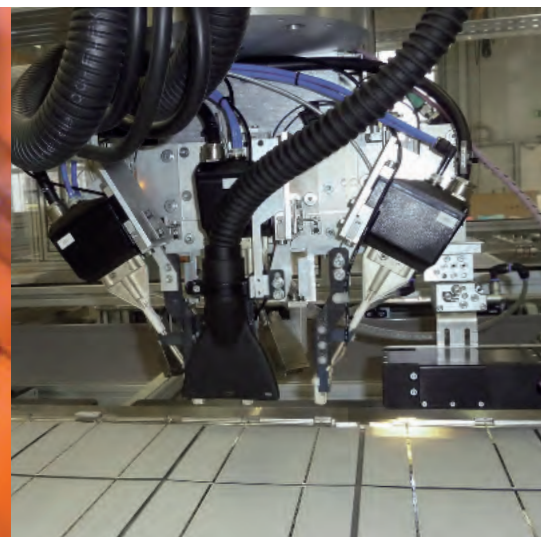
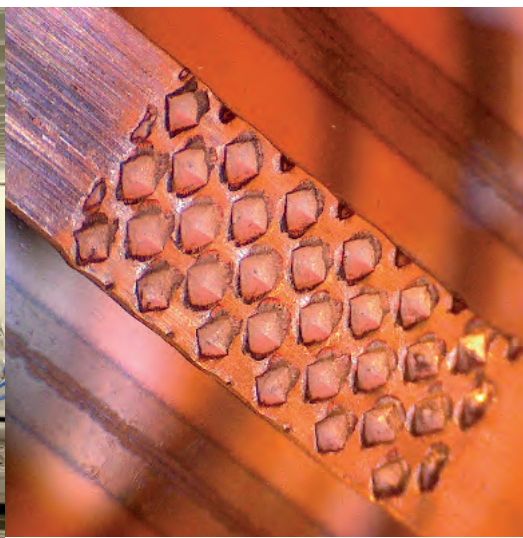
For more information and prices, contact the sales team now

Jackie Cannon
T: +44 (0) 1923 690205
E: jc@angelbcl.co.uk

Shehzad Munshi
T: +44 (0) 1923 690215
E: sm@angelbcl.co.uk



glass handling expertise
automation specialist
cost-effective production cells
PV-tested integration skills



TFPV

frontend automation

- carts & auto-loader
- process tool handshakes
- automated buffer systems

backend automation

- ultrasonic bus-bar bonding 'BBB'
- bulk-butyl edge-sealing 'HMA'
- encapsulant sheeting & lay-up
- module marriage
- custom-built line automation

c-Si

backend automation

- string lay-up
 - interconnection
 - encapsulant sheeting & lay-up
 - edge trimming
- pv-savvy-fab



Solar growth for machine makers

The oscillations of the solar and PV industries in the last year or so have seen wild swings of supply and demand. The uncertain market place has an impact along the value chain that is felt both globally and locally. The machine manufacturing sector in Germany has had a boom time on the back of solar in the region and was hit hard by changing market dynamics. Despite suggestions of difficult times the sector has developed new markets and sectors to bolster the industry beyond PV.

The worldwide stop on production capacity extension for solar modules is proving to be a heavy burden for solar machine manufacturers. Nevertheless, no company wants to quit the photovoltaics sector, because the solar energy market is set to pick up again. Until this happens the equipment suppliers are strengthening other sources of sales and income.

That sounds like hard times. For 83 per cent of the PV suppliers in Germany the orders have declined compared to the previous year. That is why companies are expecting an average sales decrease of over 20 per cent in 2012. This is having a negative effect on employment. Almost two thirds of companies are making use of short-time working reducing their work force while business is down. The current business climate survey conducted by the German Engineering Federation (Verband Deutscher Maschinen- und Anlagenbau - VDMA) leaves little doubt that in just a few months solar machine manufacturing has gone from order boom to sales crisis.

“The investment readiness of the cell and module manufacturers has noticeably declined”, explains Eric Maiser, Executive Director of the Photovoltaic Production Aids platform within the VDMA. On the one hand manufacturers have developed surplus production capacities and analysts estimate that in 2012 around 30 gigawatts (GW) of PV output will be installed worldwide – in the context of global production capacity of 50 GW. On the other, the trend in key PV installation markets is uncertain. Many countries with solar energy feed-in charges have in some cases drastically reduced their subsidy tariffs because the installations were getting out of control. For the world’s current largest solar market, Italy, for example, the experts are expecting expansion of only two GW – that would correspond to a market decline of three quarters compared to 2011.

On top of this, there is the fact that China, the main sales market for European suppliers, is gradually establishing its own powerful solar machine manufacturing market. Europeans can no longer do business there as easily as previously.

“The technological independence of foreign companies should be reduced to a minimum in China”, explains management consultant and China expert Frank Haugwitz.

Within the framework of the current 12th five-year plan (2011 to 2015) implemented by the Chinese government, photovoltaics is right at the top of the political agenda.

Less demand in China

Despite the current problems, the machine manufacturers are remaining optimistic. Solar crisis or not – in two to three years the PV market will pick up once again, believes Jürgen Weiss, head of Marketing at German special machine manufacturer Gerold. “The prices of solar modules are falling dramatically, so that photovoltaics is approaching competitiveness in many parts of the world”, says Weiss. Growth will no longer be mainly a feature just in Europe, which is becoming less significant due to the subsidy cuts, but in new markets in Asia and the USA.

Gerold builds material-handling systems and process facilities for the production of crystalline silicon and thin-layer modules, these include stations for panel framing, edge sealing and trimming. In 2011 the company from the Lower Rhine generated three quarters of its turnover in the solar technology sector. This share will probably shrink to half this year, estimates Weiss.

Gerold reflects the mood of most solar machine manufacturers: they clearly feel the slump, but are continuing to bank on PV. In recent years, in each case, the German supplier Primus Centrotherm for example generated more than 80 percent of its sales in the Far East and is suffering badly from the factory construction stop in China. In 2011 the company had to contend with an operating loss of 19.8 million Euro. Nevertheless, head of technology, Peter Fath, believes in a positive turn-around. “We are working flat out on solutions, which make photovoltaics competitive with conventional energy sources”, says Fath. Centrotherm are focusing on innovative machine and production concepts as well as on compliance with the highest quality and environmental standards.

East German company Firma Jenoptik Automatisierungstechnik, a specialist in the manufacture of laser machines for the production of thin-layer modules, also believes there will be a quick end to the consolidation phase in the PV market. “The growth rates in the area of CdTe and CIGS technology are putting us in a confident mood”, says Jenoptik-Product Manager Gabriele Eberhardt. CdTe and CIGS stand for thin-film modules on the basis of semiconductor cadmium-telluride along with copper, indium, gallium and selenium.

Jenoptik is offering two laser facilities aimed at further efficiency improvements and cost reductions: “Jenoptik Votan Solas” enables us to strip the coating from the edge of modules in all sizes and cut it to length, “Jenoptik-Votan Multi Solas” can even be used for all structuring processes in the CIGS sector. In the production of thin-film modules conductive and photoactive layers are gradually being applied to synthetic material or glass. After each individual coating, the surface is structured. This process leads to the creation of individual cells and their relay in

the transformation to modules. From 23.10.2012 to 26.10.2012 in Düsseldorf, at the International Trade Fair for Solar Production Equipment, solarpeq, and the parallel event glasstec, leading world fair in the glass sector, manufacturers can obtain an exact impression of the innovations presented by the suppliers as well as PV in architectural applications.

Solar energy storage

“No one wants to shut down the solar energy sector”, said VDMA expert Eric Maiser. “We assume that the international markets will pick up once again and also that the retrofitting business will become increasingly significant”, says Maiser. Moreover, in order to get through the crisis, the companies could also build on other sectors. “Only a few companies exclusively manufacture machines and components for the solar industry”, explains Maiser.

Gerold for example is once again focusing increased intention on its core business, equipping the automobile industry with glass machines. The major market-leading, solar energy suppliers such as Italian glass specialist Bottero, Centrotherm or Meyer Burger from Switzerland are relying on tried-and-tested sectors. At Centrotherm the semiconductor and micro-electronics sectors, which led to the creation of the company in the first place, are helping to reduce the company's dependence on solar energy. Saw specialist Meyer Burger is compensating for cuts in its solar energy business through the expansion of its opto-electronics business.

Jenoptik in turn is also opening up new theme areas. Since the end of last year, the company in Jena has been offering laser systems for the manufacture of high-tech glass for energy-saving “smart windows”. These windows can be electronically adjusted to the external lighting conditions. As a result, the users can regulate light incidence and the room temperature themselves thus controlling their own energy consumption. As the production of the high-tech glass is similar to that of the thin-film manufacturing process, Jenoptik can offer the same laser technology for this process.

Maiser recognizes a further trend among the suppliers. “An increasing number of our members are entering the storage technology business.” The companies have developed their own storage solutions for solar energy and the appropriate production machines for this purpose, such as for example the southern German equipper Schmid. According to its spokesman, Christoph Kübler, the company is conducting research into liquid fluid storage capacities facilities for various areas of application such as PV, electro-mobility and the health service.

Germany has rounded off the energy turnaround with an increased share of renewable energies. To ensure that solar and wind power is not fed uncontrolled into the sensitive electricity networks on very sunny or windy days, the surplus eco energy must be stored in the interim for periods of high demand. This is made possible among others by using large pump storage units, the conversion of eco-electricity in hydrogen and methane using electrolysis and methanization as well as batteries. “Anyone who is placing their faith in storage technology, definitely has positive prospects”, says Maiser.

Jenoptik is offering two laser facilities aimed at further efficiency improvements and cost reductions: "Jenoptik Votan Solas" enables us to strip the coating from the edge of modules in all sizes and cut it to length, also "Jenoptik-Votan Multi Solas" can be used for all structuring processes in the CIGS sector

Driving to the top

Trina Solar has become one of the world's top manufacturers and despite its beginnings in China it is Europe that has allowed the company to reach the top tier. With a changing market structure the company is keen to present itself as a global organisation and spreading its technical and marketing capabilities worldwide. David Ridsdale of Solar International spoke to Ben Hill, Head of Trina Solar Europe to discuss Formula 1, market positioning and global plans.



Q Trina has recently announced an installation at the Lotus F1 team's headquarters. Formula One has not historically been seen as a very green sport. What made Trina decide to develop such a partnership, and how important is it that energy-rich activities like Formula One take the lead in developing more renewable sources of energy?

A Formula One has a much stronger record than it is credited with when it comes to delivering environmentally relevant technologies and policies. In recent years Formula One has introduced regulations to ensure that the technology it develops has immediate and direct relevance to future improvements in road car efficiency. For example, technology such as KERS (Kinetic Energy Recovery System) recovers and repurposes the kinetic energy the car produces into new usable horsepower, and from 2014 onwards teams will be required to reduce fuel consumption each year.

The technological expertise and innovative thinking within a Formula One team is enormous, and committing at least some of this to developing greater energy efficiency not only improves their chances of podium places, but also feeds directly into innovation for the cars you and I drive every day. Entering into a partnership with Lotus was an excellent opportunity to use our innovative technology to support further innovation in Formula One and reduce its environmental impact. The installation of Trina Solar modules on the simulator building at Lotus F1 Team HQ in Enstone is a clear demonstration of the team's continuing dedication to environmental responsibility. Our "hi-tech meets hi-tech" partnership has already seen us introduce the solar-powered helmet concept, whereby silicon is

blended into composite and laminate materials to produce a panel with the flexibility to form part of the helmet's outer shell. Again, the innovation created in Formula One has a reach far beyond the racetrack.

Q Trina has developed its own mounting system and I was wondering if you could tell me what was different about your offering? What specific advantages does it have for the consumer and the installers?

A Trinamount makes the installation of solar panels quicker and easier by reducing the number of parts and tools required to do the job. Special grooves in the panel frame enable individual panels to be easily connected to each other in much more flexible arrangements than are possible using conventional mounting methods, enabling installers and consumers to make optimal use of roof space. Trinamount frames also contain an integrated earthing element that can earth up to 72 panels at the same time, further reducing the time and cost spent on installation. And there are different Trinamount systems to suit any kind of roof, whether tiled, pitched, or flat.

Trinamount connects panels using a special nut that only requires a quarter-turn using a bespoke tool. This ease of assembly means that installers can work several times faster. In fact, when we installed our panels at the Lotus F1 Team HQ, the project was completed in just nine hours, instead of the five days that had been budgeted for. This simplification of the installation process is especially important in the UK market, where demand for solar PV systems is rising fast and there is a particular need to help the growing community of installers to work more



efficiently to meet this demand. Any support we as manufacturers can give installers as they look to expand their businesses must be good for the industry as a whole. But the benefits of Trina are not just limited to speed and efficiency – the necessity of the special Trina mount tool to assemble or disassemble an installation offers the consumer improved protection from theft. Where I think Trina really stands out from the competition, though, is in the fact that the physical mounting is only part of the solution. The Trina Online Design Tool enables installers and customers to plan and design their solar arrays, calculate costs, and determine all the required parts and tools. We also offer free on-site support on their first Trina installation to any installer signed up to our Partner Plus programme.

Q Trina has made excellent strides in becoming a global company and its position as a top tier company has been acknowledged by industry, market, and your peers. The standards the company sets itself are evident in awards such as the STVC Green Scorecard results. One way to look at this is that Trina practices what it preaches. As head of the European, and largest, section of the global company, what challenges have you seen for Trina in establishing itself as a recognisable and admired global brand? How important has the company ethos being in this success?

A I think our company ethos has been instrumental in establishing our brand reputation in Europe. There are a number of aspects to this, but I would highlight our high

standards of innovation and product quality, our transition away from being solely a manufacturer to providing full PV solutions to our customers, our financial position as a reliable and bankable partner, and our commitment to being a responsible and sustainable company.

Innovation is at the heart of our approach – our R&D investment is best-in-class, and we have a really strong track record when it comes to increasing the efficiency of our products. Our Honey technology platform achieved a world record 274Wp in September 2011, extending this to 284.7Wp in May this year. We are also proud of our ability to get our products' real-world performance closer to the lab testing results quicker than anyone else.

We have taken the conscious decision to move away from simply being a manufacturer of solar PV products, expanding our business offering to provide solutions as part of a full-service package. Innovative products like Trina, along with our Partner Plus programme and our Training Academy, have enabled us to build much closer relationships with installers than we could as a pure manufacturer. This has not only extended the reach and strength of our brand, but also insulated us against some of the financial difficulties that have affected other solar PV companies.

Our financial management practices are another side of our ethos that has undoubtedly helped us to achieve our position in Europe. Our policy has always been to maintain sustainable



growth, with focus on strong liquidity, positive operating cash flow and relatively low net debt levels by industry standards. Add to this the financial transparency required of us as a stock market listed company, and I think this gives both investors and our partners added confidence in our brand.

Finally, as you say, it has been a big boost to be repeatedly shown to practise what we preach. It is

vital for the credibility of any renewable energy company that their own operation is as environmentally responsible as possible, so we are proud to have topped the SVTC's 2012 scorecard. We have also been a member of the PV Cycle scheme since 2010, committing for the long term to the recycling and green disposal of end-of-life PV modules.

Q The solar and PV industries have moved faster than many predicted a decade ago and not all in the imagined directions. One area of concern has been the proliferation of solar companies within the lower tiers accused of dumping stock to regain losses thus artificially deflating prices. Of course the reduced prices actually enabled the industry to grow towards self-sufficiency faster than expected prompting governments to reduce subsidies around the world. With your experience with Trina and BP and others beforehand can you comment on the impact of such dumping concerns on a top tier company like Trina?

A I am confident that our company ethos, with its emphasis on innovation, high-performance products, and financial security, marks us out as fundamentally different from companies in the lower tiers. Our business strategy has always been to provide customers with high-quality, affordable products and solutions, utilising efficient production structures and economies of scale. Consumers within our target market are looking for high-quality, reliable products from an established manufacturer, and I don't expect this market need to change.



Trina Solar factory and Ben Hill, Head of Trina Solar Europe

Q Related to the previous question which countries do you feel have handled subsidy issues better than others and why? Do you think subsidies will continue in the industry?

A For all the agitation and anxiety that has surrounded the recent reductions in the level of subsidy offered by the Feed-in Tariffs, I think the model on the table in the UK actually offers a very sensible balance between consumer incentivisation and government support of the solar PV industry. The current rate of 16p per kWh still represents good value for the consumer. The plans announced by the Department for Energy and Climate Change to implement a stepped reduction programme of 3.5 per cent every three months should ensure a more stable and predictable outlook for the market as it moves towards true self-sustainability.

Consumers will benefit from a rate that is in line with reductions in technology costs, the government will not over-subsidise, and businesses will benefit from greater transparency in the marketplace. Obviously, though, the ultimate goal is for subsidies to become redundant, for solar PV to be an economically viable option in its own right – and I think that point is not far down the line. The rapid pace of technological development in the industry, and increasing efficiency in manufacturing processes, will ensure that solar PV will in the near future become sufficiently cost-effective to cast aside the need for broader government support.

Q What do you see as the main thrusts and outcomes for the global PV and solar industry over the next five years?

A Aside from the decline of Feed-in Tariffs and the drive towards grid parity, one major trend I think we will see develop over the short to medium term will be the increasing importance of energy storage solutions.

Storing solar energy is a relatively new concept in the context of residential installations, but as FITs continue to fall and are eventually ditched altogether, it will become increasingly important that end users can store the surplus energy they generate. Developments in solar energy storage will also benefit the utilities sector, as companies will be able to smooth over the peaks and troughs created by sudden changes in generation capacity. That is why Trina Solar will be looking to partner with leading storage solutions providers as part of our holistic approach to delivering value from the services surrounding module manufacturing.

Looking at the industry more widely, I would expect to see a number of interesting markets develop in the next few years. China is set to move from being primarily a manufacturing base to being a much more significant sales market; India is growing; we are seeing lots of interesting projects in South America based on hire purchase models.

As technological advances improve the cost-effectiveness of solar PV, I think we will see substantial growth in markets where grid power can be unreliable and expensive.

SOLAR POWER 12 INTERNATIONAL

September 10–13, 2012
Orange County Convention Center
Orlando, Florida
www.solarpowerinternational.com



Generating Business

The solar energy industry is in high gear, and it's time for you to grow with it. At **Solar Power International 2012**, plug in to the technologies, personal connections and professional insights that give rise to new opportunity. Growing your energy business begins at SPI.

Presented by:



REGISTER NOW AND SAVE.
www.solarpowerinternational.com



SOLAR ARABIA SUMMIT

SEPTEMBER 16TH - 17TH 2012
AL FAISALIAH HOTEL, RIYADH, KSA
WWW.SOLARARABIASUMMIT.COM

TAP INTO SAUDI ARABIA'S \$109BN INVESTMENT INTO SOLAR POWER

INDUSTRY EXPERTS SPEAKING AT THE SUMMIT

His Excellency
Dr Abdullah
Mohammed
Al-Shehri



Governor
**Electricity and Co-
Generation Regulatory
Authority (ECRA)**

Professor
Ghassan
Jabbour



Director - Solar and
Alternative Energy
Research Center
**King Abdullah University
of Science and
Technology (KAUST)**

Gerhard Stryi
Hipp



Head of Energy Policy
and Coordinator Smart
Energy Cities
**Fraunhofer Institute for
Solar Energy**

Waleed Ali
Ahmed Salman



VP Business
Development
DEWA UAE

Eng Mohammed
Al Ta'ani



General Manager
**Jordanian Renewable
Energy Society (JRES)**

CONFIRMED SPONSORS INCLUDE



FOR MORE INFORMATION, CONTACT SHARATH RAVI
ON +971 4455 7956 OR AT REGISTER@SOLARARABIASUMMIT.COM

ENERGY & ENVIRONMENT SERIES

SUCCESS IS A CHOICE
naseba

To promote your Products and Services cost effectively to all our buyers and specifiers, take advantage of the Sources of Supply section. A Sources of Supply entry is effective, and an easy way of promoting your products and services for the full year. Additionally your entry will be seen at major exhibitions and events throughout the year. For further information, please contact: **Shehzad Munshi on: T: +44 (0)1923 690 215 E: sm@angelbcl.co.uk** Entries in Sources of Supply @ £1,500 per heading per year.

SOURCES OF SUPPLY

Adhesive Tapes/Bonding

High Performance Technical Adhesive Tapes

High Quality Bonding Solutions for the Solar Industry

Frame bonding for modules, junction box mounting


Thin film back rail mounting, cell fixing and laminate fixing



Hi-Bond Tapes Ltd
 T: +44(0)1536 260022
 F: +44 (0)1536 260044
 E: sales@hi-bondtapes.co.uk
 W: www.hi-bondtapes.com

Furnaces

SEMCO ENGINEERING
 OVER 20 YEARS EXPERIENCE & PROVEN EXPERTISE



New, upgrade and refurbishment of **Horizontal Furnaces**

Using patented processes, we reach higher uniformity, doubling the throughput on processes for:

- Phosphorus and Boron Doping (LYDOP®)
- Very Thin Oxidation (LYTDX®)
- Pure H₂ Annealing (LYSINTER®)

Equipment and Processes for MEMS Applications

Wafer Transfer & Furnace Automation

SEMCO Engineering, FRANCE
 Tel: +33.467.610.990
 Fax: +33.467.526.993
 Email: info@semco-engineering.com
 Web: www.semcoeng.com

Gas (High Purity) Process Control

Bionics Instrument



Gas detection systems
 selective & reliable detection systems for toxic, corrosive and flammable gases

Bionics Instrument Europe B.V.,
 Maxwellstraat 7,
 1704 SG Heerhugowaard, The Netherlands


Tel: +31 72 5765630
 Fax: +31 72 5721818

www.bionics.net

Semiconductor Equipment

BERLINER GLAS
 Photonics-Systems

Advanced Chucking Solutions



Electrostatic Chucks
 Single or double side chucking
 Extreme contact area reduction
 High clamping force
 Chucking/de-chucking time down to 0.1 sec.
 Uni- or bipolar customer designed electrodes

Vacuum Chucks
 Wafer chucks up to 12" wafer size
 Several separated vacuum segments
 Anti-sticking coating
 State-of-the-art flatness performance
 Many years of experience

www.berlinerglas.com
chucks@berlinerglas.de
 Phone +049 30 60905-0
 Fax +049 30 60905 100

Fan Filter Units

ENVIRCO™
 CORPORATION
 Innovators in clean air technology

- Mac10 Original Fan Filter Unit (AC)
- Mac10 IQ Intelligent Fan Filter Unit (EC)
- FFU control systems (AC and EC)
- STD, Room side replacement Filter and motor versions
- Stock service
- Ducted Terminal Filters


Fax: +44 (0) 1962 840465

Fax: +44 (0) 1962 828619
 E-Mail: rflaherty@airsysco.com
 Web: www.envirco.com

Furnaces

THERMCO SYSTEMS

MEMS, PV, LED and Carbon Nano Tube systems



Bench style R&D Furnaces

- Atmospheric and LPCVD processing
- Wafer sizes up to 200mm
- Manual or automatic wafer loading
- Mini furnaces with 1-4 tubes per stack
- Process guarantees for all processes

Thermco Systems
 A Division of Tetraon Technologies Ltd
 Tel: +44-1903-891700
 Fax: +44-1903-893888
 WWW: Thermcosystems.com

Metals

Goodfellow

For Metals & Materials for Research & Industry

Pure Metals, Alloys, Polymers, Ceramics, Composites and Compounds

Goodfellow Cambridge Limited
 Huntingdon, UK
 Tel: +44 1480 424 800
 Fax: +44 1480 424 900

E-mail: info@goodfellow.com
www.goodfellow.com

Vacuum Equipment

HIDEN ANALYTICAL

Solutions in Mass Spectrometry and Surface Analysis Worldwide

- Plasma Characterisation
- UHV Surface Analysis
- Gas Analysis
- RCA

www.HidenAnalytical.com
 t: +44 (0)1925 445225
 f: +44 (0)1925 416518
 e: info@hiden.co.uk

Furnaces

AMTECH

TEMPRESS®
 The expert source in horizontal furnace technology

- Horizontal Diffusion & LPCVD Furnace Systems
- Atmoscan Processing Tool and Ibal Furnace Automation

Amtech Tempress Systems, Inc.
 Brugstraat 2
 8181 VH Heerde
 The Netherlands


Tel: +31-578-699200
 Fax: +31-578 693693
 Email: sales@tempress.nl
 Website: www.tempress.nl

Furnaces

THERMCO SYSTEMS

Horizontal Diffusion and LPCVD Furnace Systems by Thermco Systems.

All major processes supported for use in **PV, MEMS, LED and Semiconductors** applications



- New systems for production or R&D
- Automation and wafer transfer
- New PC based TMX Control system with data collection, SPC and recipe management tools.

Thermco Systems
 Tel: +44-1903-891700
 Fax: +44-1903-893888
 WWW: Thermcosystems.com


RF-/DC-/MF-Power Supplies

SEMCO ENGINEERING
 OVER 20 YEARS EXPERIENCE & PROVEN EXPERTISE

E-CHUCKS
 COULOMBIC TECHNOLOGY

Applications

- PVD / CVD
- Long Etch / RIE
- Metrology
- Ion Implant



Features

- Custom design from 3" up to 12"
- Operating temperature -250°C up to 850°C
- Polarities monopolar / bipolar / multipolar
- Clamping / unclamping < 2sec
- Embedded heater capability
- Plug & Play design
- Reworkable

SEMCO ENGINEERING, FRANCE
 Tel: +33.467.99.47.47
 Fax: +33.467.99.47.48
 Email: c.chuck@semcoengineering.com
 Web: www.semcoeng.com

Wet Benches

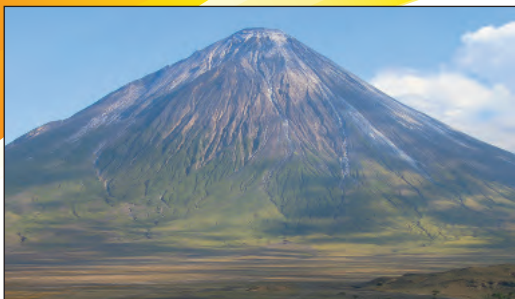
arias
 wet benches & more



arias gmbh

- wet process equipment
- laminar flow units
- chemical supply systems
- acid and caustic cabinets

www.arias.de
 Phone: +49 (0) 2304 971 12-0



Student invention brings energy to Tanzania

Oregon Tech renewable energy engineering students bring electricity to Tanzanian villages

Oregon Institute of Technology students will join their professor, Dr. Slobodan Petrovic, in Tanzania, where they will install solar energy systems for schools and hospitals. This adventure of learning and humanitarian outreach is part of Oregon Tech's BS in Renewable Energy Engineering (BSREE) degree program, the only ABET-accredited energy engineering program in North America. Like much of the region, 70 to 80 percent of Tanzania is without electricity.

After volunteering there in 2009, Dr. Petrovic teamed up with students from Oregon Tech's Department of Electrical Engineering & Renewable Energy (EERE) in Portland to help build a sustainable new model for changing the energy outlook in Africa, and provide hands-on experience in the design and installation of renewable energy technology. Each year since 2010, another batch of 10 students travels to Tanzania to continue Oregon Tech's work there, which provides energy to power lights that allow Tanzanian students to study after dark and medical professionals to perform surgery with adequate illumination.

The solar panels also power refrigerators for vaccines, sterilization equipment and charging capabilities for cell phones and computers. The students also will take eight laptops with them this trip to leave with villagers, allowing access to the Internet as connections allow.

This year, the group will spend the first week of the trip revisiting past installation sites, performing maintenance and updates to address the biggest problem of providing solar aid in developing countries – making sure it stays working. The students then will install equipment invented by last year's seniors in the form of sensors with remote data transfer capabilities to allow them to continue to monitor the solar systems online.

"This is going to be absolutely revolutionary in the world of solar, as well as international development because nobody is doing that," Petrovic says.

The initial inspiration for the program came about during Dr. Petrovic's 2009 trip to Tanzania, when a terrible accident changed his perspective forever. "There was a girl in the dormitory in one of the schools using a candle hidden under her blanket so she could read. She fell asleep, and her blanket caught fire," Petrovic says. "Thirteen girls died that night. It was totally needless, and it happened because they didn't have a light bulb. I want to prevent these tragedies."

In addition to installing solar panels, which will include three hospitals and three schools near the town of Iringa, about 500 km from Tanzania's biggest city, Dar es Salaam, Dr. Petrovic and his students will build a large solar water pump to provide drinking water for a village of 3,000 people in southern Tanzania.



Editor-in-Chief David Ridsdale
T: +44 (0)1923 690210 E: david.ridsdale@angelbc.com
Director of Solar & Semiconductor Publishing:
Jackie Cannon
T: +44 (0)1923 690205 E: jackie.cannon@angelbc.com
Sales Manager: Shehzad Munshi
T: +44 (0)1923 690215 E: shehzad.munshi@angelbc.com
Director of Logistics: Sharon Cowley
T: +44 (0)1923 690200 E: sharon.cowley@angelbc.com
Design & Production Manager: Mitchell Gaynor
T: +44 (0)1923 690214 E: mitch.gaynor@angelbc.com
Subscriptions Manager: Debbie Higham
T: +44 (0)1923 690220 E: debbie.higham@angelbc.com

Published by: Angel Business Communications Ltd
(London Office), Hannay House, 39 Clarendon Road,
Watford, Herts WD17 1JA, UK

USA Representatives: Tom Brun, Tom Brun Media
T: 724 539-2404, E: tbrun@brunmedia.com
Janice Jenkins, Tom Brun Media.
T: 724 929-3550, E: jjenkins@brunmedia.com

Japan Representative: Katsuhiro Ishii, Ace Media
Service Inc., T: 81-3-5691-3335, E:
amskatsu@dream.com

China Representative: Parker XU, Unionbandy Limited,
T: 86-755-83753881, E: xp@unionbandy.net

Directors:

Bill Dunlop Uprichard – CEO
Stephen Whitehurst – COO
Jan Smoothery – CFO
Jackie Cannon, Scott Adams, Sharon Cowley,
Sukhi Bhadal

Registered Office:

Angel Business Communications Ltd (Coventry)
Registration Number: 1972952



Solar International is published ten times a year on a controlled circulation basis. Non-qualifying individuals can subscribe at: £110.00 (UK & Europe), \$140 pa (USA). Cover price £5.50. All information herein is believed to be correct at time of going to press. The publisher does not accept responsibility for any errors and omissions. The views expressed in this publication are not necessarily those of the publisher. Every effort has been made to obtain copyright permission for the material contained in this publication. Angel Business Communications Ltd will be happy to acknowledge any copyright oversights in a subsequent issue of the publication. Angel Business Communications Ltd © Copyright 2012. All rights reserved. Contents may not be reproduced in whole or part without the written consent of the publishers. The paper used within this magazine is produced by chain of custody certified manufacturers, guaranteeing sustainable sourcing. Printed by: Pensord Press Ltd. ISSN (Print) 2040-8714 (Online) 2040-8722. © 2012.



Advancing Photovoltaic Manufacturing and Growing Solar Markets

PV Group advances PV manufacturing standards, connects PV supply chain stakeholders, and advocates our members' interests on global opportunities, shared challenges and critical manufacturing issues that impact innovation, promote investment, and growth in the solar market. Today, PV Group serves the global PV manufacturing supply chain with an international network of trade events, international standards development, public policy initiatives, research, and information that work together to expand opportunities in solar energy for our members and contribute to the overall growth of the industry.

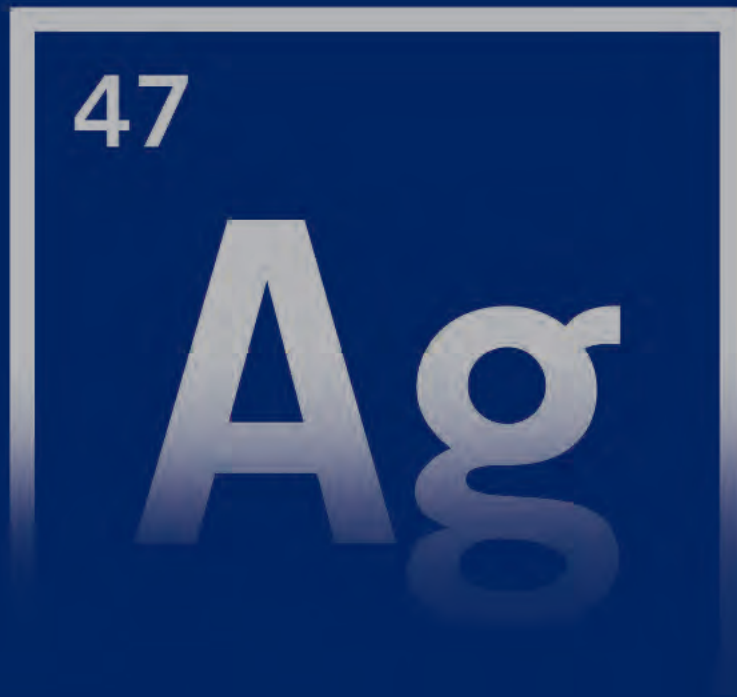
STANDARDS • EHS • MARKET DATA • ROADMAPPING • PUBLIC POLICY • EVENTS

SEMI PV Group is a proud co-organizer of the PV Production and Technology Halls at Intersolar Europe and Intersolar North America.

Visit www.pvgroup.org for more details.



Low Silver. High Efficiency.



Introducing Heraeus' new line of low-silver usage pastes.

As the industry leader in metallization pastes, we're constantly developing new formulations to meet our customers' needs. Today, we're addressing the rising cost of silver with new formulations that use less per cell—without sacrificing efficiency. With less silver, you'll decrease your cost-per-watt, while increasing your profits. And it's only the beginning.

Talk to a Heraeus engineer today. Let us increase your bottom line with our new line of low-silver pastes.

Visit our booth at these upcoming trade shows:

27th EU PVSEC (2012)

September 25 - 28 • Hall 3.0, Booth G16

PV Taiwan

October 3 -5 • TWTC Hall 1

Heraeus Photovoltaics Business Unit

www.pvsilverpaste.com

China | Singapore | Taiwan | Europe | Americas