Powered by
SOLARWORLD
REAL VALUE

pv magazine
PHOTOVOLTAIC MARKETS & TECHNOLOGY

The Array Changers

50 key components making PV shine

50 Array-changing technologies

Innovation abounds in the PV industry. To recognize this and identify some of the key innovations driving power outputs up and LCOE down, pv magazine has hand-picked 50 downstream technologies from around the world and across the supply chain that have the ability to make a major impact on solar arrays today and in the future.

Many of the top 50 technologies will be on display at the Intersolar Europe show this month in Munich, so make this your guide to the 50 top array-changing technologies.

1 Tesla Powerwall

Sleek, chic and unmistakably touched by that Elon Musk magic, the Tesla Powerwall turned more heads than a Wimbledon tennis final when it was launched at the end of April. Billed as the "missing piece" in the energy storage evolution, the battery pack is to retail at just $3,500 for the 10kWh version, and $3,000 for the 7kWh version – far below the price point industry insiders had expected.

The lithium-ion battery is designed to work with home PV systems, with the smaller Powerwall ideal for solar owners wishing to reduce their reliance on the grid when the sun goes down. The larger pack will double as a backup source of energy in the event of power outages, and both models can be "doubled-up" to provide even greater storage options for homeowners with larger solar arrays.

The array-changer: Cost, design and performance aside, Tesla's global profile has brought the spotlight of mainstream media attention on to the world of storage, which might just be the kicker required to get the industry moving.

Intersolar Booth No. B1.470 ees

2 Solar-Log on your Apple Watch

Take your PV monitoring everywhere you go with Solar-Log's Insight app. The German monitoring provider is now making its service available for iPhone, iPad and even the zeitgeisty Apple Watch.

The Insight app provides PV plant operators access to current and historical data on daily, monthly or annual bases. Production over the entire life of the plant can also be accessed. Add CO^2 savings and weather information and Solar-Log now provides a wristfull of info for the solar park operator on the go.

The array-changer:
Get your solar geek on at parties and impress friends with your mobile power plant monitoring.

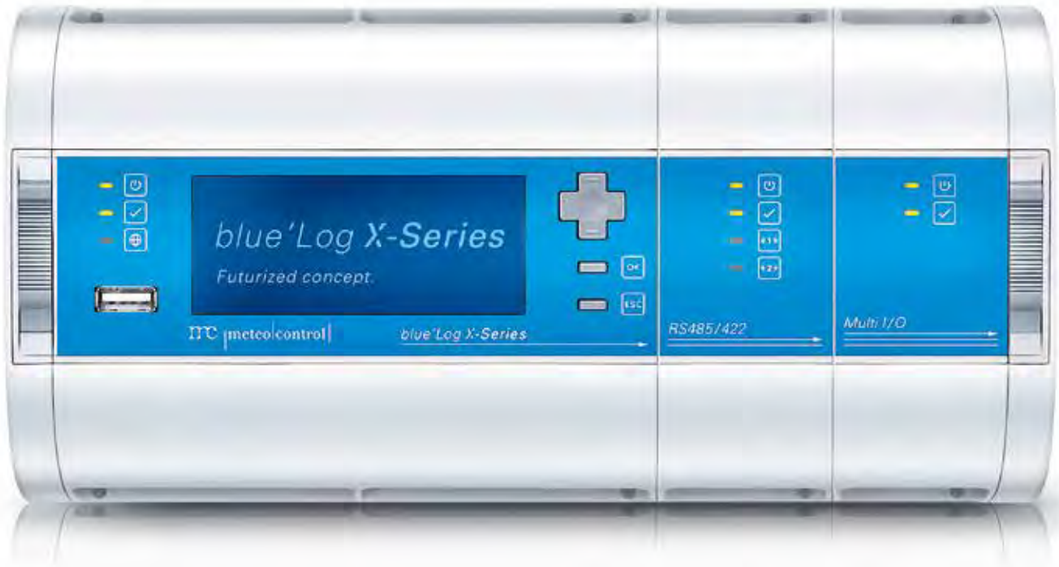
Intersolar Booth No. B2.570

3 Meteocontrol – blue'Log X series monitoring systems

Meteocontrol's blue'Log X is the latest in the series of data loggers and monitors to arise. The blue'Log all-in-one driver contains all the software for compatibility with inverters, sensors, meters and accessories. The system is capable of separate reports for the different component manufacturers it tracks, streaming to on-site control rooms through the company's Internet-based VCOM – Virtual Control Room, or dynamic communications channels. The system accurately tracked the March solar eclipse in Germany reporting that PV in the national grid dropped from 13 GW to 5 GW in 45 minutes.

The array-changer:
With over 10 GW of monitoring systems in the field, when size matters, meteocontrol is in the game. With Shunfeng now in the background, meteocontrol is poised to expand into China with its VCOM platform.

Intersolar Booth No. B2.419



CAB, EX2016
Case No. IPR2024-00178
2 of 13

Technology Highlights

4 Panasonic Li-Ion battery

A compact storage unit designed for small spaces, the new Panasonic Lithium-Ion (Li-Ion) battery storage system is designed to allow PV system owners to increase their energy self-sufficiency. The AC-coupled, single-phase battery system has a storage capacity of 6.8 kWh and uses the long-established Panasonic battery technology that has a proven track-record.

The battery boasts an emergency power function, which ensures homeowners have a steady supply of backup power should they suffer from an outage. During development, Panasonic said that they considered the needs of an ever-increasing decentralized energy supply landscape using third-party regenerative systems, creating this latest Li-Ion battery that offers reliable storage, load management capability and emergency backup.

The array-changer:
The battery's dimensions – 1,380 x 966 278 mm – mean that it can be installed in extremely small places, making it a good storage solution to all types of residential users.

Intersolar Booth No. A2.160

5 Self-powered tracking from NEXTracker

NEXTracker's single-axis SPT-Self Powered Tracker NEXTracker SPT eliminates central backup power (UPS) systems with seven days backup capacity per row, thanks to a separate solar panel perched above the motor. The system design also includes a self-balancing yoke. With its 120 degree tracking range, tasks such as module cleaning and vegetation management can be accomplished four to five times faster than competitor's systems, the company says. The company was spun out of Solaria in early 2014 and has since had no trouble raising capital or selling large installations.

NEXTracker, which is based in Fremont, California, last month signed an agreement with Flextronics to produce the NEXTracker SPT.

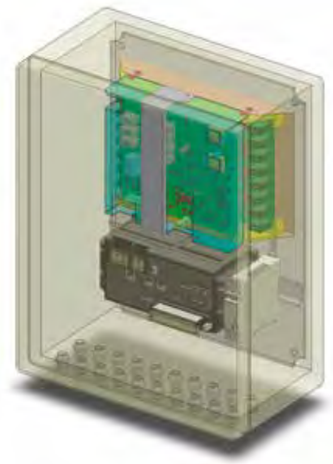
The array-changer:
Self-powered tracking delivered through affordable OEM production may strengthen the march of trackers into high irradiance markets.

6 Omrom DC fault monitor

Omrom's new DC fault monitor has been designed to improve O&M personnel's ability to quickly locate the source of a ground fault or open circuit on a PV array accurately at the module level. This latest model is particularly well-suited to aging systems located in harsh climate environments, where conditions can change rapidly, making system faults intermittent and difficult to pinpoint.

The DC fault monitor speeds up the detection process, and works between the ambient temperatures of –20 to +70°C. It can monitor a string voltage range of 500 to 1,000 V, and can handle a maximum current of 12.5 A/string. The monitor also has the IP65 environmental protection rating.

The array-changer: As systems age, pinpointing faults is going to become an important task, particularly in larger arrays that use central inverters. Omron's new DC fault monitor brings some much-needed efficiency to the O&M sector.



Omron are sponsors of the Intersolar Conference program.

7 A+ Sun Systems – SunNet Roof mounting system

A+ Sun Systems' steel cable-based mounting system enables roof mounting where weight is an issue, by supporting the net from parapet walls. Adaptable to an arched roof, a steep slope or even vertical mounting, the system is a streamlined fix for challenged sites. The company, based in Italy, says a 1 kW system can be installed by one worker in 50 minutes. No ballast is used, although the net utilizes non-penetrating easels in central spots to keep the system raised. The A+ Sun Systems cable-based system is able to sustain strong winds while at the same time adding very little weight to the roof. The A+ Sun Systems' ground-mounted system, the SunNet Ground, can be used on flat and pitched ground, with a slope of up to 50°.

The array-changer: Light, flexible and with quick installation, A+Sun Systems' approach can deliver flexibility and real advantages. On the downside, it's a long way from being a standard technology.

8 SolarEdge commercial inverter

The trend in the inverter landscape is increasingly tilting towards the use of three-phase string inverters at commercial scale. Israel's SolarEdge has extended its commercial offering in this space, launching the SE25K, SE27.6K and the SE33.3K three-phase inverters to the market at Intersolar Europe.

Fitted with standard SolarEdge-levels of safety, monitoring and communication features, each inverter is designed to operate with the company's commercial power optimizers, the P600 and P700, and allow up to 2.5 times longer strings compared to traditional inverters. Combined, this all adds up to a greater yield for your commercial-scale solar PV array.

The array-changer:
Each inverter is available for purchase with an optional integrated DC Safety Unit with a mechanical DC switch and DC surge protection.

Intersolar Booth No. B2.110, B2.111

9 REC TwinPeak Series – going all the way with half cells

The REC TwinPeak Series employs a series of efficiency-boosting technologies that demonstrate that the company does nothing by half. Except its cells, of course. The Norwegian manufacturer, in its Singapore production, is delivering a module with standard 156 x 156 mm cells that have been cut in two pieces (156 x 78 mm) to deliver 120 half-cut cells.

The panel itself is divided into two 60-cell series across three strings. The two sections are connected in series, resulting in a 120 cell module.

PERC cell technology, four busbar configuration and a split junction boxes has all been deployed to achieve, along with the half-cell design, a 10 Wp boost per module.

The array-changer: a 275 Wp polycrystalline module, with an increased power/m^2 can deliver reduced BoS costs and compete with monocrystalline modules. What is most impressive is the combination of half-cell technology, PERC cells, four-busbars and split junction boxes, all contributing to deliver the output boost.

Intersolar Booth No. A1.390

10 Ciel et Terre – Hydrelio floating mounting system

Ciel et Terre's Hydrelio water mounting system has taken to water like a solar duck. The HDPE floats are designed to support 60 cell modules, include a pin-connected walkway between floats and a quick rail attachment. The system yields an extra margin of electricity as a result of the cooling effect of the water on the panels. First launched in 2011 in France, the system has been broadly accepted in the US, Japan and other global markets for solutions at wineries, mines, wastewater ponds, fish farms and dairy farms. With major components recyclable, the system also cuts down on algae growth.

The array-changer: While floating PV arrays may have seemed a pipe dream, the growth in markets where space constraints may exist is opening opportunities for an affordable, secure and scalable solution. If only we could pronounce the company name.

11 Alion Energy – Rover rail extrusion and Spot cleaning robots

Alion's unique Spot robot glides along the proprietary cement-mounting rail that its larger brother Rover has extruded and adhered panels to, a patented solution to building and cleaning PV arrays in high-dust areas like Saudi Arabia and Chile. The system can lay a utility-sized field in half the time and with a quarter of the labor needed for standard arrays. Initially launched in 2013, the company's robotic system is now being developed through a strategic agreement with S&C Electric. By eliminating almost all metal from the racking design, the system is low-cost to install, and even fills potholes in front of it as it goes along.

The array-changer: There is a lot to like about less metal in the mounting structure and more robots. In high-labor-cost environments, Alion's dual-robot solution appears a high-tech solution to significantly reduce handling.

12 Kostal's Piko BA now lithium-ion compatible

Germany's Kostal now offers its Piko BA battery-ready inverter in a "Li" version, compatible with lithium-ion batteries. It consists of a storage inverter, battery unit and current sensor. The specially developed Piko Battery Li Switch Box protects against overvoltage, amongst other things.

The design of a PV system, along with the storage system, can be carried out with the updated and free planning tool Piko plan. The storage capacity can be further increased after the installation and the system can be retrofitted.

The array-changer: Lithium-ion, in its various forms, is emerging as a leading storage technology.

Intersolar Booth No. B3.150

CAB, EX2016
Case No. IPR2024-00178
4 of 13

Module technology advances gaining traction

Photo: Solarpraxis AG

Expert analysis: Cell and module technology innovation is flowing with increasing alacrity into products onto the market today. Whether REC's combination of cell and module innovations in the TwinPeak series (#9), to Jinko's Maxim optimizer tech (#19), and the giant Hulket's CIGS powerhouse (#23), Goetz Fischbeck, the CEO of Smart Solar Consulting sees today as an exciting time for module level tech.

pv magazine: Looking at the new technologies featured in this special publication, what do you think it says about the market?

Goetz: First of all what is noteworthy about this development is that finally manufacturers are willing to invest into upgrades of their production equipment at the production scale level. So while the new technologies behind the products being showcased at this trade fair have already been available over the last one to two years, their usage was mainly confined to pilot lines and evaluation purposes.

This year we begin to see the shift that the industry is deploying these technologies across a significant portion of their production volumes.

What has triggered the companies to move forward and role out these new technologies on a broader scale?

There are a number of reasons why we see this happening now: increased capacity utilizations have meant that new capacities had to be brought online. These new production lines are obviously equipped with state-of-the-art production tools, which are required to manufacture these higher efficient cells and modules. To a certain extent the trade disputes between Europe and China and the U.S. and China respectively also had a role o play. In reaction to the imposed import duties or minimum price requirements a number of Chinese manufacturers decided to set up new production capacities outside of China. Furthermore an important aspect that aided these investment decisions was the improved profitability many manufacturers were able to achieve over the past two years. Without this improvement many companies could not have afforded the investments in new or upgraded production lines. And finally the manufacturers had thoroughly evaluated these new technologies and came to the conclusion that the benefits clearly justified the necessary investments.

Why do you stress this latter aspect, hasn't this always been the case in the industry?

As long as new production lines could easily be financed manufacturers were willing to adopt and experiment with new production technologies at a much earlier stage. Yet the industry had to realize that in a number of cases these innovations didn't achieve the benefits expected. If you look three to four years back, the selective emitter technology was considered an important improvement and it was believed that all new cell lines would adopt this technology. With the improvements achieved in the meantime with the conventional homogenous emitter technology the relative advantage of the selective emitter technology is so small that this technology is becoming less and less important in the market.

How do you judge the level of innovation at the cell and module manufacturing stage in the new modules types showcased in out publication?

The majority of the increased power output that the new modules exhibit is achieved at the cell level. There are two or three examples of modules which also sport innovations at the module level, which I find very interesting, but the major boost in terms of increased power-ratings of the modules, comes from advances in the cell technology. Examples are the wide spread adoption of PERC technologies or new wiring concepts that yield an incremental energy output boost.

Looking across the modules featured here, were there any standouts?

I would like to highlight that in some of the modules there is not just one or two innovations, but in fact a number of innovations combined into one product. I believe it is a good sign to see that technological advances are gaining more traction in the market. ◆

Interview with Jonathan Gifford

SOLARWORLD
REAL VALUE

REAL VALUE

QUALITY MADE BY SOLARWORLD – 30 YEARS GUARANTEED

Quality is the best basis for trust and the best guarantee for a decades-long partnership. Our products have repeatedly proven their exceptional quality over time in independent tests. We create real value for our customers. The Sunmodule Protect from SolarWorld sets standards in service life and mechanical durability. It offers even better protection against environmental factors and degradation by using the latest glass technology on the front and rear sides of the module.

40 YEARS OF SOLAR EXPERIENCE: As a PV pioneer, we have 40 years of technology experience. We turn this potential into top quality and future-oriented solutions for our customers.

SOLARWORLD QUALITY – VALUE YOU CAN COUNT ON

Find out more at WWW.SOLARWORLD.COM

Quality modules made in Germany
TÜVRheinland CERTIFIED www.tuv.com ID 0000039351
PV Test 2.0 EXCELLENT
GREEN BRAND 2014/2015
SOLARWORLD 1975 2015 40 YEARS REAL VALUE

Technology Highlights

13 Suntech goes four busbars, new HyPro PERC

Wuxi Suntech is continuing to re-invest in its production, with the major announcement that it is going four busbar across 2.4 GW of module capacity. It is also introducing globally its new HyPro product line this July, which employs PERC technology.

Suntech's HyPro module line can achieve 20.5% cell conversion efficiencies, delivering peak performance of 290 W with the Hypro 60 cell, and 345 W, on the Hypro 72 cell. Suntech has initially targeted the UK and Japan with its HyPro range.

The array-changer: Clearly a positive sign, Suntech's owner Shunfeng is reinvesting in Suntech's technology on the cell and module level.

Intersolar Booth No. A1.160

14 CAB Products – cable management rings and saddles

CAB's highly-rated cable rings and saddles are proving to be a low-cost alternative to cable trays, yet still cut BoS installation costs and avoid maintenance problems in the future. The 80-mil PVC coated products are manufactured from Class 3 galvanized high-tensile spring steel that supports a safe working load of over 290 kg. The PVC coating has a dielectric breakdown strength of 400 volts per mil, is flame retardant, UV stabilized and abrasion resistant. The company cites a five-second installation time for its rings.

The array-changer: An Intersolar 2014 Finalist, that the NGO Cambria County Association for the Blind and Handicapped turns out highly innovative and durable products is a reason to be cheerful.

15 Ecoppia – E4 Robotic cleaning system

Hailing from Israel, it should come as no surprise that Ecoppia's E4 robotic cleaning system was designed for high-soiling desert locations with little water. Utilizing microfiber cloth to clean panel glass, the system can achieve 99% dust removal with zero water use, the company claims. The plastic-wheeled robot moves up and down a proprietary rack frame that is mounted around a standing PV array. Two onboard motors move the robot vertically, two move it horizontally, and one does the hard work of cleaning. The bots have an onboard solar panel and batteries to isolate operating power from the array. The system can be operated remotely through an app.

The array-changer: With utility-scale PV arriving in desert environments, O&M and, in particular, module cleaning is growing in importance. And who does not love a robot? Some of Ecoppia's rivals have been snapped up by larger firms, meaning it finds itself in a prime position in the market as an independent supplier.

16 ArcelorMittal tackles corrosion

ArcelorMittal's Magnelis has been shown to slow zinc runoff in weathering galvanized steel by a factor of four. No rust, no bust. With a 3% magnesium addition, the coating shields against rust and lasts 25 years. Magnelis ZM310 sports a 25 µm coating that is two to four times thinner than the coating on conventional galvanised steel.

The array-changer: With O&M costs looming for PV arrays in new markets, a bit of preventative technology could save enormous costs in repair.

Intersolar Booth No. A3.338

17 Real-time monitoring from Gantner Instruments

Gantner Instruments has launched a new web portal to provide constant, solid and traceable PV plant monitoring data for owners, operators and O&M providers to access performance and optimize service provision. The Austrian company claims that the portal delivers some of the lowest-running costs available in the PV industry.

Gantner says that its responsive portal is available on all mobile devices and has been designed in accordance with E.U. data security regulations. It utilizes some of the same technology Facebook uses to handle large data parcels, without losing performance in real time.

The array-changer: Gantner's web portal can provide an array of performance and forecast data and allows for optimized O&M provision.

Intersolar Booth No. B2.371

18 Sungrow SG33/40KTL-M inverter

Chinese inverter specialist Sungrow has been expanding its international footprint with gusto in recent months. Revenues from European and U.S. markets make introducing tailored products too good a chance to pass up. This year Sungrow brings to Intersolar Europe the SG33/40KTL-M string inverter, which the company say is ideal for commercial- and large-scale PV plants. The inverter boasts a maximum efficiency of 99%, and a wide DC input voltage range that has a maximum of 1,000V.

This lightweight (40kg) inverter can be easily installed, and its three MPPTs will ensure maximum energy yield from the PV system. Sungrow's grid-friendly tradition is continued with the SG33/40KTL-M, which boasts a design aesthetic and performance to match its nearest European and U.S. rivals.

The array-changer:
Its integrated AC and DC lightning protection function and DC switch for safe and convenient maintenance prove that Sungrow's inverters are now well established for European safety standards.

Intersolar Booth No. B2. 230

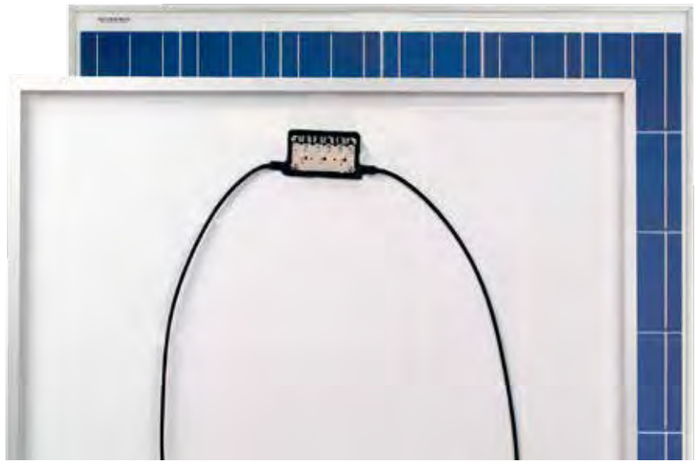
19 Jinko adds Maxim for cell-level optimizing

China's JinkoSolar has teamed up with Maxim Integrated to integrate power output tracking into the module itself. The Maxim Integrated JinkoSmart replaces bypass diodes, which the company says can help eliminate hotspots.

This new generation of JinkoSmart can be installed using standard techniques and requires no additional hardware. Rooftop and ground energy density can be increased by up to 15% to 20%, due to the reduced impact of row-to-row shading.

Jinko claims the Maxim technology can provide the highest resolution power tracking in the industry, with the MPP controller measuring each cell-string within the module.

The array-changer:
Cell level optimizing without bypass diodes may give a power boost without the extra hardware hassle.
Intersolar Booth No. A2.190



20 Huawei SUN2000-33KTL

China's ICT communications giant Huawei has enjoyed unprecedented success in the PV inverter market in recent years, and its latest product looks set to continue in this fine tradition. The SUN2000-33KTL inverter has a maximum efficiency of 98.6% and three MPPT routes to ensure maximum energy yield.

With no external fans required and weighing just 49kg, the SUN2000-33KTL is being marketed at the commercial rooftop and ground-mounted PV segments, with Huawei confident of its durability and peak performance in all environmental conditions. The inverter has also adopted Huawei's power line communication technology, which means it can communicate with the system via its power cable, thus lowering installation complexity and cost.

The array-changer: Light, lead-free, low-noise and self-cooling, the SUN2000-33KTL is being marketed as an eco-conscious solution, and a rather flexible one at that.
Intersolar Booth No. B2.430

21 Array – V3 tracker system with torsion dampening

Array Technologies' single-axis DuraTrack HZ Version 3 solar tracking system for utility-scale applications includes improvements ranging from a torsion damper device unique in the industry to fewer motors and controllers per MW. V3 uses 50% fewer motors and controllers per MW, with each motor driving 650–750 kW. This new single-bolt module clamp version also requires half as many bolts per MW compared to alternative solar tracking solutions. The power dense V3 which reduces module-to-module gaps down to one-quarter inch and eliminates gear box dead-space yields a 5% density advantage over their closest competitor the company claims.
The array-changer:
Fewer components means far less can go wrong with Array's latest V3 integration. Array's efforts to increase power density will also be welcomed.

22 Delta Flex E3 battery

Delta's new smart energy storage system, the Flex E3 battery, is touted as a highly-flexible storage addition for homeowners and small businesses keen on enhancing the returns on their energy investments. The Flex E3 has an energy conversion efficiency of 93% and a smart-grid controller platform that delivers optimal-cost storage and consumption. Aesthetically pleasing, Delta's latest product also appears to be user-friendly and easily integrated into a variety of system architectures.

The Flex E3 provides storage for PV systems ranging from 2.9 kWh to 3.7 kWh, or three batteries can be run in parallel to cater for an 11 kWh system, depending on whether the client opts for the lead-acid or lithium-ion battery.

The array-changer: The Flex E3 is embedded with Delta's AC inverter, which delivers more than 96% energy conversion efficiency and nominal continuous power output of 2.34 kW.
Intersolar Booth No. B2. 330

CAB, EX2016
Case No. IPR2024-00178
7 of 13

23 Hulket's 320 W CIGS module goes big

Hailing from Taiwan, there is little that is conventional about Hulket. The charismatic manufacturer has turned out a whopping 320 W CIGS module, going big on size and reducing BoS costs for PV power plants. The module, essentially three modules placed side-by-side, comes in at maximum conversion efficiency of 14%, achieved through what the company calls its Z-type CIGS, employing a zinc-oxide buffer layer instead of cadmium-sulphide.

Hulket claims that due to what it calls the 'power gain factor', its CIGS modules deliver considerably more kWh/kWp when compared to crystalline silicon. The power gain is delivered through the combination of superior spectral response in terms of both UV and IR light; a lower temperature coefficient; enhanced lower incident, scattered or diffuse light performance; and the positive light soaking effect, Hulket claims.

The array-changer: It is big, brash and bold and with a cadmium-free CIGS module, Hulket obtains TÜV Rheinland's ISO 14067 carbon footprint and RoHS certification. Handling with both hands recommended.

Intersolar Booth No. A1.120

24 Apollo II is a powerful roof tile

Progress in producing the best solar roof tile or shingle has been set by Saint Gobain company CertainTeed, which offers its Apollo Tile II roofing tiles as an aesthetic low-profile solution. The product features 56-watt monocrystalline panels and can be integrated into either an existing roof or a new roof that combines solar panels and flat concrete tiles. The products are warranteed for 25 years, are Class A fire rated and meet UL 790 and UL 1703 requirements. Apollo Tile II is also rated for wind resistance up to 110 mph and loads up of to 250 pounds per square foot; CertainTeed salesmen at solar trade shows often can be seen doing a war dance on top of their tough tiles.

The array-changer: Too long have solar shingles overpromised and underdelivered. The Apollo II takes the high efficiency route through utilization of mono, and its robust design may help it last the distance.

25 Zeversolar string inverters

SMA-owned inverter specialist Zeversolar is set to unveil six new products of its Zeverlution line at Intersolar Europe, ranging from a nominal power of 1 kW to 3.68 kW. String inverters in this new line weigh a maximum of 7.3 kg, around half the weight of their predecessors and an achievement that the company claims makes installation and transportation far easier and, therefore, more cost effective.

The Zeverlution 3000SE and 3680SE single-phase inverters are compatible with smart modules and DC optimizers, and can reach efficiencies of up to 98.7%, while the single-phase Zeverlution 1000S, 1500S, 2000S and 3000S have maximum efficiencies of 97%.

The array-changer: The Zeverlution range has a retrofitable integrated Ethernet and WiFi communication that enables remote update.

Intersolar launch, Thurs June 11, Room B21, 11am.

26 Sonnenbatterie's eco steps up to 10,000 cycles

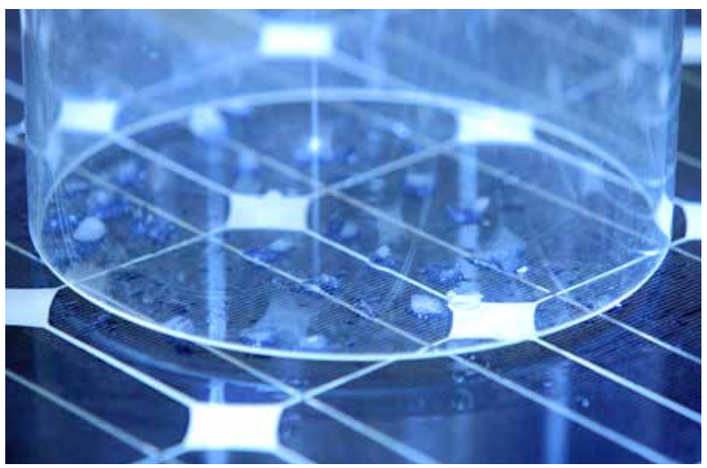
While Tesla hogs the limelight, Germany's Sonnenbatterie continues to push its technology further. Its latest generation of the Sonnenbatterie eco sports a life of 10,000 cycles, reducing the cost-per-kWh stored down to between €0.17 – €0.24/kWh (US$0.19 – $0.27/kWh).

Sonnenbatterie says that the long life of its fourth generation eco system can be used for grid-based services and can be aggregated into a virtual power plant, generating more income. Both electricity and heat provision can also be enabled through the more durable eco, with the company reporting that it can be tied to a micro CHP.

The new Sonnenbatterie eco is available with rated capacity from 4 kWh to 16 kWh in steps of 2 kWh. Sonnenbatterie says that along with increased cycles, the eco's depth of discharge has been increased from 80% up 100%.

The array-changer: By extending life, the new Sonnenbatterie eco can be used to supply additional services to the grid, along with the storage of rooftop PV.

Intersolar Booth No. B1.110 ees



27 JA Solar launches 1500V PV Module

Chinese module manufacturer is introducing a 1500V module onto the market. Launched in February the module meets the IEC 1500V system voltage bias, passed PID testing and has been tested and has been certified by TÜV. JA Solar reports that when unveiled at previous shows, the module has been met with an "overwhelming reception".

The array-changer: By increasing system voltage to 1500V, major BOS costs reductions can be achieved.

Intersolar Booth No. A1.170

CAB, EX2016
Case No. IPR2024-00178
8 of 13

28 SolarEdge's storage solution

The StorEdge from SolarEdge will provide energy independence for homeowners keen on maximizing their solar self-consumption. The DC-coupled storage solution is versatile and large enough to act as a backup power unit, and can be easily paired with a SolarEdge DC optimized inverter that will manage the PV array and the storage.

With a shared PV and battery DC bus, the StorEdge is designed to reduce conversion losses as PV power is directly stored in a battery. Equipped with SafeDC architecture, the system is safe and high quality, requiring no special wiring and utilizing the same PV cables, and also coming equipped with a full monitoring solution that allows system owners to see their PV production, consumption and battery status in a single view.

The array-changer: The StorEdge solution is designed to be compatible with Tesla's new home battery solution, the Powerwall.

Intersolar Booth No. B2.110 B2.111

30 Simulation down to the minute from Valentin Software

The latest versions of PV * SOL and PV * SOL premium can now provide PV array production simulation down to the minute, giving granular data for park designs. The new versions of the software has had around 500 different batteries and battery system integrated taking simulation to the next level.

The array-changer: Data is power and the additional sophistication from the widely used software keeps park design ahead of the curve.

Intersolar booth No. B3.170

29 Tesvolt's bidirectional BMS delivers boost

Germany's Tesvolt is continuing to develop its storage units, incorporating its Active Bidirectional Battery Management System (BMS). The modular storage solution is available in capacities of 10, 20, 40, 60, 120, 240 kWh, right up to large MW storage systems. The accumulators can be used in combination with Sunny Island charge controllers from SMA on low-voltage grid.

Through a master/slave function, additional cells can be integrated any number of Tesvolt storage units.

The array-changer: By using a bidirectional BMS, excess energy can be spread across a number of cells reducing losses that incur through passive balancing (resistors) from 10% to 8%. The targeted control of individual cells enables faster charge balance with a minimum efficiency of 92%, Tesvolt claims.

31 Black and white NeON 2 from LG

Korea's LG is introducing a black and white backsheet version of its LG NeON 2 modules. Employing its multi-busbar Cello technology, 12 wires replace 3 busbars, demonstrating that LG is staying at the cutting edge of the cell connection trend. Thinner wires boost output through capturing electrons more effectively, while exposing more of the cell surface to the sun's rays.

With output of between 305 W – 320 W in the white and 300 W in the black, both modules utilize n-type mono, 6 x 6 inch cells.

The array-changer: Having turned heads at previous PV shows in 2015, the LG NeON 2 range employs the cell and interconnection technologies that form the 2015 solar zeitgeist.

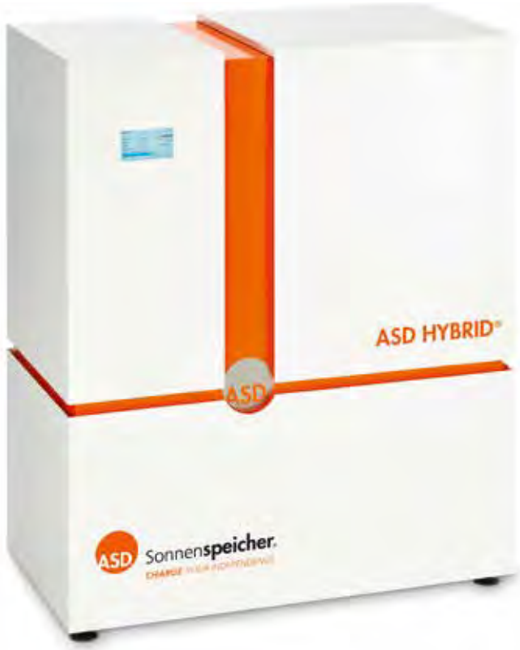
Intersolar Booth No. A2.170

32

34 ASD's long-life hybrid battery

German energy storage systems manufacturer ASD Sonnenspeicher has updated its hybrid battery and will present the new and improved version at Intersolar Europe. The company is confident that its longer lifespan – made possible by a specially-developed software with an integrated feature that compensates for degradation – will help set it apart from the field.

According to ASD, the cells age more slowly than other storage systems, extending their lifecycle. The battery is based on lithium-iron-phosphate technology, and is a hybrid suitable for both AC and DC coupling. ASD has also simplified its architecture, reducing the number of cables required for connection to just two, and has smartened-up the aesthetics.



The array-changer: ASD's hybrid battery is available in four sizes, ranging from 5 kWh to 13 kWh, thus delivering storage flexibility for a range of clientele.

Intersolar Booth No. B1.130 ees

33 SolarWorld does storage with the SunPac LiOn

Storage is so hot right now and SolarWorld is not missing out the action. At Intersolar Europe, SolarWorld is launching its SunPac LiOn scalable storage system, employing lithium-ion phosphate battery technology. The system will be rolled out from Q4. This second storage system from the German company starts at 2kWh and can be scaled in 2kWh blocks. SolarWorld claims that the storage units can be connected easily in series with a simple plug.

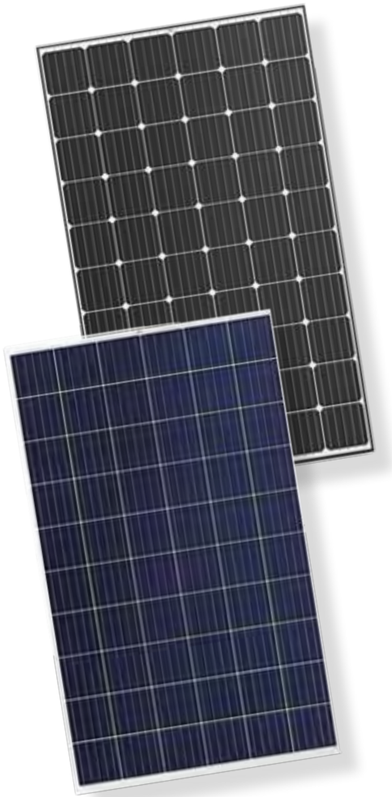
The SunPac LiOn has a depth charge of 100%, with a lifetime of 10,000 charging cycles. Connected on the AC side, the SunPac Lion can be retrofitted to existing PV arrays. The Suntrol eManager systems controls the storage system and monitoring provided by the Suntrol MyHome portal.

The array-changer: Scalable battery units makes sense for the 'storage curious' household, allowing capacity to be scaled up with as needs require and budget provides.

Intersolar Booth No. A1.190,A1.191

CAB, EX2016
Case No. IPR2024-00178
9 of 13

Technology Highlights



35 Dow Corning's adhesives replacing clamps and rails

Dow has been providing a host of PV manufacturers with unique solutions to mounting as well as panel assembly. Among a portfolio of PV products, the company's PV-8301 Fast Cure Sealant provides a substitute for clamps and rails, as well as adhesion for PV substrates, with a two-part mix, allowing for a customized cure rate. The adhesive performs well in hot and humid temperatures over the long term, and also protects against vibration, environmental degradation and mechanical and thermal shock. The product has been certified for IEC 61646 by TÜV and has met the aging standard of the European construction industry, ETAG 0002. Dow Corning also produces PV-5802 electrically conductive adhesive and PV-6212 cell encapsulant.

The array-changer: The roll out of adhesive requires technical support, which Dow prides itself on. It can reduce mounting material costs, Dow claims.

36 Multi and mono PERC in mass production from Trina

China's Trina Solar is introducing its Honey Plus and Honey M Plus modules in "select markets" this year, with a global launch scheduled for 2016. The Honey Plus and Honey M Plus employ PERC technology, with a five-busbar configuration. Trina claims that lower series resistance has been achieved in both modules, along with an increased cell-to-module ration.

The M in the Honey M Plus stands for mono, delivering an output of 285W, achieved from 20.4% cell efficiecies. The multicrystalline Honey Plus achieves 275W with 18.7%.

The array-changer: Reducing BoS through conversion efficiency gains is the order of the day and PERC application in both mono and multicrystalline cells indicates Trina's mastery of the technology.

Intersolar Booth No. A2.290

37 ABB PVS980 central inverter

ABB's new PVS980 central inverter is a low-maintenance, high power output update of the previously successful PVS800 central inverter, and will be showcased for the very first time at Intersolar Europe. Delivered in cost effective packaging, the central inverter has a power rating of up to 2,000 kVA and increased DC input voltage up to 1500 VDC.

A key feature of ABB's updated central inverter is its self-contained cooling system, which uses phase transition and thermosiphon technology to avoid external air entering its critical compartments. The PVS980 can operate in temperatures below freezing and is fine with extreme heat and 100% humidity, too.

The array-changer: ABB's central inverter appears to be extremely low maintenance, with no fillable liquids, pumps, valves, inhibitors or leaks, making it a rather simple, high power addition to an array.

Intersolar Booth No. B3.310

38 Qbotix – Monorail-based robotic tracking system

Qbotix's evolving RTS and its SolBot are still the most-visible robotic system in the solar industry today. One pair of the bots can service up to 378kW of panels on a proprietary dual-axis tracker, continuously moving panels five degrees ahead of the sun for optimal yield. The elimination of most motors and controllers makes the system low cost and less expensive to maintain. SolBot also can climb grades and bridge difficult terrain, one of the few industry solutions for challenged locations. Wireless communication and a web-based interface make the system attractive to off-site operators.

The array-changer: Mono means one, rail means rail. Add robots = awesome. Qbotix's robotic trackers can be deployed in locations otherwise closed off to trackers.

39 SMA MV power station

Billed by SMA Solar Technology as "the world's most compact utility-scale PV system solution", the medium voltage Power Station 2500SC is a plug-and-play, DC-to-AC system with a 2.5 MW central inverter built-in. The system also includes a MV transformer and MV switchgear, installed and pre-commissioned inside a 20-foot shipping container.

Sounds big? The Power Station is actually ground-breakingly compact for its output, and thus delivers substantial cost savings to system owners keen on SMA reliability and build quality. Using Sunny Central inverter technology, the system works seamlessly with SMA's new generation of 1,500 VDC inverters, while its stable operation in a wide range of ambient temperatures makes it suitable for most global markets.

The array-changer: Delivered as a full turnkey solution, the Power Station 2500SC arrives pre-assembled, meaning commissioning and installation time is greatly reduced.

Intersolar Booth No. B2.210

CAB, EX2016
Case No. IPR2024-00178
10 of 13

40 Fronius Primo inverter

An upgrade in Fronius' successful SnapINverter range, the Fronius Primo is the single-phase counterpart to the three-phase Fronius Symo inverter. The transformerless Primo is offered in the 3 kW to 8.2 kW power range, and can be used in both new PV systems and as a repowering inverter.

Fronius is proud of the Primo's new Dynamic Peak Manager MPP tracking algorithm, that the company claims ensures the inverter constantly operates at the point of maximum output, delivering the highest levels of system yield available. The Primo also has a built-in energy management relay and digital energy management output tool, designed to allow system owners to consumer as much energy at source as they would like.

The array-changer: Fronius' optimized energy management and data communication feature should have a positive impact on monthly electricity bills.

Intersolar Booth No. B3.230

41 GPS precision with the KRD 60

German mounting system provider Krinner has begun deploying its new KRD robotic ground screw machine, to apply GPS position to ground mounted projects. The tool ascertains precisely where ground screws should be installed. The KRD can also be monitored remotely, to check on the prevision of application and the progress of installation teams. It is currently being deployed on what will be Europe's largest utility scale array, Neoen's Cestas array in southwest France.

The array-changer: The KRD 60 teams precision with speed and is completing the 300 MW Cestas project ahead of schedule, Krinner reports.

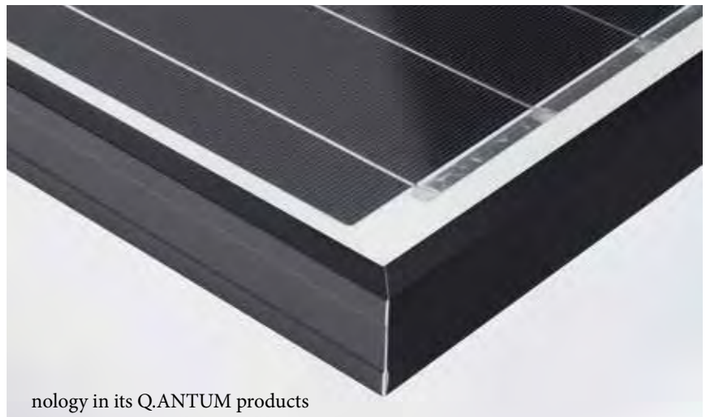
42 PERC, but not as you know it from Q CELLS

Hanwha Q CELLS continues to optimize its Q.ANTUM technology, to deliver high-performance cells and modules. Its latest Q.PLUS-G4 modules achieve a power class of 270 W – 280 W, with a conversion efficiency of 17.1%.

The Korean company, with German technology and Malaysian production, also offers the Q.PRO-G4.1, which employs 4-busbar connection and the Q.PRO-G4, which is the high performance multicrystalline Q.PRO-G4 for business kit customers.

The array-changer: While PERC is becoming increasingly mainstream, Q CELLS has been pushing the technology in its Q.ANTUM products for some years. It claims stable and reliable performance in a range of weather conditions and climates.

Intersolar Booth No. A1.290



43 Sika – BIPV adhesives

BIPV applications have long underperformed when compared to the wider solar market. Adhesive supplier Sika believes that bondings can open up the market. Its Sikasil AS-785 has certification pending for UL 94 V-1, at RTI 105 °C, as well as the facade certification EOTA ETAG 002.

The array-changer: Sika claims that bonded BIPV solutions are a cost effective way to integrate PV modules onto building facades and into the building envelope. If something helps BIPV get off the ground, then it surely must be a good thing.

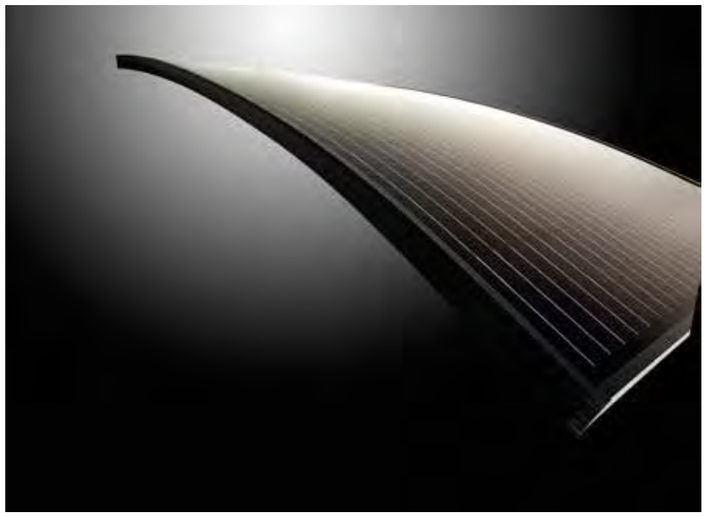
44 Cool vertical solution from Renusol

Mounting system provider Renusol has released its MS+ Portrait solution, which allows modules to be installed in portrait orientation. The system allows for good rear ventilation, keeping modules cool and therefore power output. The MS+ is suitable for trapezoidal sheet metal roofing, and Renusol claims to have trialed the MS+ Portrait with 270 different types of roofing.

Renusol claims that the MS+ Portrait can be employed on roofs with inclinations anywhere between 3 and 70 degrees. The system weighs 3kg.

The array-changer: Renusol says that the installation time with the MS+ Portrait is just 10 minutes/kWp, cutting down time on a hot tin (steel) roof.

Intersolar Booth No. A3.331



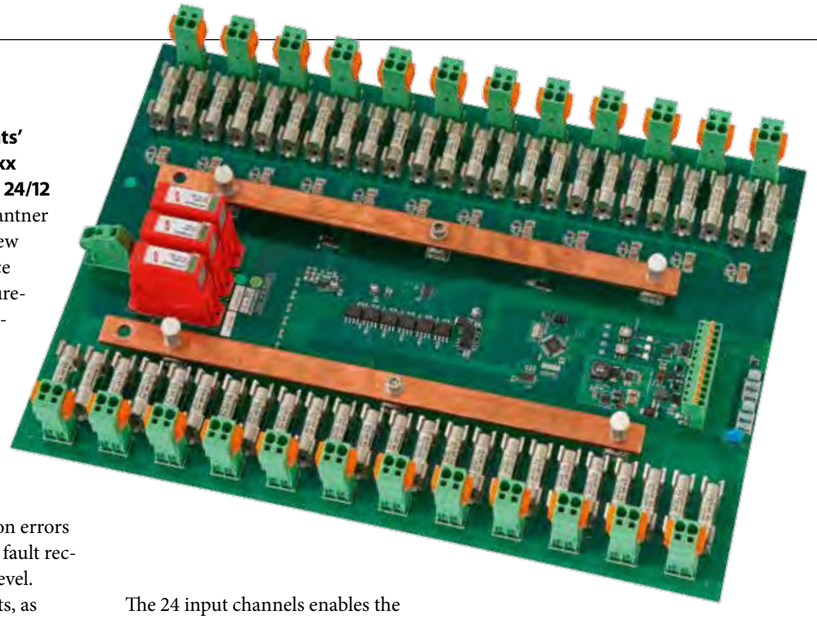
45 SI Module's bowed panel

With five busbars, 2mm dual-glass encapsulation, mono cells and bowed appearance, there is not much that is standard on SI Module's latest module offering. Produced on its 30 MW production line, a part of parent company M10 Industries' Technology and Service Center, the SI Module bowed panel has an ouput of 290 W – 300 W in a 60 cellconfiguration.

The array-changer: The dual-glass SI Module offering can be incorporated into BIPV applications and onto curved roofing or façade construction. Its bold, different and is all about pushing technological limits.

Intersolar Booth No. A1.350

CAB, EX2016
Case No. IPR2024-00178
11 of 13



46 Gantner Instruments' string.bloxx All-In-One 24/12

Austria's Gantner Instruments is introducing a new concept to the monitoring space that unifies accurate DC measurement, fuses, overvoltage protection and communication.

Gantner Instruments claims that the significant reduction in interfaces reduces risk while decreasing installation time, while allowing for PV module strings to be monitored and design and production errors identified on the DC side, with fault recognition down to the module level.

Through the use of DC shunts, as opposed to Hall Effect sensors, Gantner claims that its string.bloxx can provide measurements that are up to ten times more accurate (0.25%) and that are not susceptible to temperature variance.

The 24 input channels enables the most effective plant design and comprises the newest requirements of PV module configuration. The string.bloxx employs industry-standard Modbus protocols for communication and is available for 1500VDC systems.

The array-changer: Gantner claims that its string.bloxx All-In-One can deliver a 30% cost reduction and 35% reduced format factor. Impressive if true.
Intersolar Booth No. B2.371

47 Kaco's bi-directional battery inverter

Kaco New Energy is presenting its new, upgraded bi-directional battery inverter at Intersolar Europe – the blueplanet gridsave 14.0 TL3. This battery inverter can be coupled to an AC source – such as the inverter in a PV system – in order to store energy. When required, the blueplanet gridsave 14.0 TL3 can discharge battery power and feed it into the the local three-phase grid.

The product has been developed with commercial buildings in mind.The blueplanet is available in a 14 kW rated output, with a min. and max battery voltage of 260/700vdc.

The array-changer:
Kaco has ensured that the blueplanet gridsave 14.0 TL3 battery is adapted to the high-voltage Li-Ion batteries made by SAFT, offering safe and reliable operability.

48 Kaco's 1 MW central inverter

Developed as a smaller, more compact alternative to the blueplanet 1000 TL3 central inverter, the blueplanet 875 TL3 central inverter (not pictured) possesses the same characteristics that have stood its predecessor well: IP54 protection, digital control for user-friendly O&M, comprehensive monitoring and communication options, and internal redundant power supply.

The blueplanet 875 TL3 also has temperature-controlled cooling.

The array-changer: As with much of Kaco's output, the monitoring, communication and operation capability of the blueplanet 875 TL3 will ensure greater yield and less downtime for system owners.

Intersolar Booth No. B2. 310

49 Electro-luminescence testing in situ from Suncycle

Germany's Suncycle is introducing electroluminescence (EL) testing on site with a new piece of kit, that allows testing to be carried out, without removing the modules. The Suncycle CTU flexEL has a high resolution EL camera that can produce lab-level readings in the field.

Suncycle says that the CTU flexEL can detect cell micro-cracks and breaks, potential PID, hot spots and other damage. Suncycle says that its readings will stand up to examination in court.

The tool weighs less than 20kg, with measurement durations of less than 30 seconds, Suncycle claims.

The array-changer: With Europe's large installed PV base, assessing and addressing park faults is a growing sector. To carry out EL testing on site can speed up the process and save on transportation costs.

Intersolar Booth No. A3.154

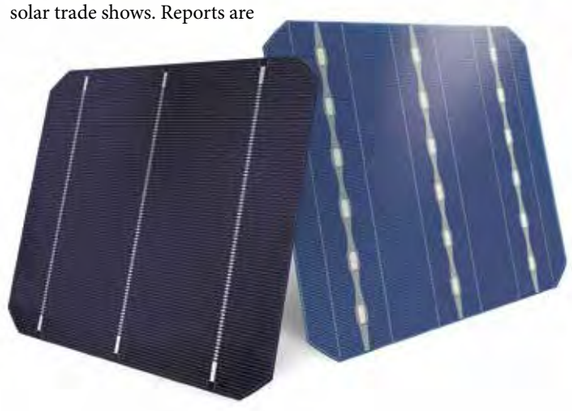
50 SolarWorld introduces bifacial module

Germany's SolarWorld is the first major manufacturer to introduce a dual-glass, bifacial module onto the market. The Sunmodule Protect 360° duo builds on SolarWorld's extensive experience in glass-glass module production, now combining it with bifacial cells in a 60-cell configuration.

The company reports that it should deliver a 25% energy yield boost over its mono-facial Sunmodule Protect. SolarWorld continues to put these modules under considerable stress, with trick bicycle performers completing jumps, hops and flips on the modules at solar trade shows. Reports are the cells exhibit no micro cracks after the performers have done their worst!

SolarWorld claims the modules will last 30 years in the field. The first Sunmodule Protect 360° duo will be available as of Q4 2015.

The array-changer: The move towards bifaciality is seen as logical progression from glass-glass encapsulation, with SolarWorld's entry into the space indicating that it has the potential to move into the mainstream.
Intersolar Booth No. A1.190, A1.191



CAB, EX2016
Case No. IPR2024-00178
12 of 13

The storage story

Photo: IHS

Expert analysis: Led by the charge of Tesla's headline-hogging Powerwall announcement, the selection of storage technologies set to be unveiled at Intersolar Europe is refreshingly innovative, says IHS's Sam Wilkinson.

pv magazine: Tesla's ability to generate excitement in energy storage is unprecedented. Do you see this translating into a win for the wider storage sector?

Sam: There has always been, economics aside, a large part of the population of the world that would be interested in, and have enthusiasm for, the idea of generating and storing their own electricity and relying on their own sources. That self-sufficiency desire, when paired with the accessible idea of Tesla's product at a price point that starts to become quite compelling, is what you see now, with people moving forward on it. Many of the cynics – myself included – still think that the economics don't really seem to make sense as yet, particularly in the U.S. There is no real reason to install the Powerwall other than as a secure power backup supply. But then one of the analogies I've heard regarding this is that people don't need televisions any longer, but people still own them, people still want them. The price point is fast moving to that consumer product, whereby people will buy the Powerwall not just for the economics, but because it is a desirable thing to have. This is interesting for the industry, and is not something that we necessarily see very often.

I actually think that the bigger opportunity long-term for Tesla will be outside the Powerwall, and will actually be the Powerpack, which is the commercial-scale product that hasn't had anywhere near as much media attention.

What other storage products from the list most intrigue you?

The ASD Sonnenbatterie product (#26) is quite interesting – they've got a pretty leading position in Germany right now in terms of volume installed. They have quite a significant share of the German market. The company seems to be pushing longer life times and aggregated depths of discharge, which are both interesting things for the people that could potentially buy these batteries. These are key parameters that people want to see improved. I am surprised that Sonnenbatterie is claiming 100% discharge – typically you would expect a battery that has been discharged to 100% of its depth would have quite a short lifetime. So if they've managed to move the depth discharge to 100% and increase the cycles then that is a significant improvement. But I am slightly cautious of that.

Overall, have you been impressed by the levels of innovation on display?

Generally speaking, it is important to point out how important innovation is at the moment in storage. We've been through a period of significant cost pressures, throughout the entire industry. Really we've moved into what most would call a commoditized market. Differentiating yourself within that environment – which comes down to innovation of products and innovation of business models – is becoming increasingly important. All of the storage offerings in the list are examples of interesting ways that companies are doing that, without picking out a specific one. Collectively, they are all important developments for the market.

Which products/approaches to technology do you feel might prove well-suited to the European solar market, and why?

All of the storage products included here are mostly aimed at residential systems. From an energy storage point of view, that's certainly what's going to make sense in Europe. If we are going to talk specifically about storage paired with solar, then the majority of those systems in Europe will be paired with residential homes. Whereas in many other parts of the world you're seeing storage paired with larger ground-mount systems and commercial buildings. All of the systems seem a very good fit for the European residential market in places like Germany, the U.K. and Italy.

In Europe, what kinds of incentives are there at residential and commercial scale to actually invest in energy storage?

Increasingly the business case for residential solar relies on self consumption. Once the price of storage gets low enough, that will enable systems with a maximum amount of self consumption. So I think storage is going to help residential solar to return to growth in Europe as opposed to benefiting from growth. ◆

Interview with Ian Clover

Innovation is mounting

Photo: IHS

Expert analysis: Cormac Gilligan from IHS examines pv magazine's 50 array-changing technologies selection and finds that while innovation in mounting technologies remains slow-paced, the signs are positive that change is coming. In the area of power electronics, the usual suspects are leading the way for change.

pv magazine: What particular mounting and module-level power electronics (MLPE) products from the top 50 list most intrigued you?

Cormac: Market leader Array Technologies has announced for Intersolar Europe a V3 tracker system with torsion dampening (#21) that is interesting. The unique selling point here is the reduction in the number of motors, and the enabling of a higher density of modules because they've decreased the spacing between the modules. This reduction in the number of components required is a good development. This all results in a decreased level of O&M, and Array Technologies has stressed that there is limited maintenance required with this product, which results in a lower cost for the consumer.

Similarly, the list reveals a lot of innovation from other suppliers, not least NEXTracker, which has introduced a self-powered tracker that runs on batteries (#5), meaning the tracker can still be powered should the cabling come loose. This is really helping to grow the market for trackers, and chimes with IHS forecasts that fixed-tilt arrays will be used less and less in the coming years. Jinko partnering with Maxim on the JinkoSmart power optimizer (#19) caught my eye. This collaboration is to negate the effects of shading to allow for higher densities of modules in installation. This is where we are expecting installers and homeowners to want to really optimize their space on the roof and get the most out of their system. SolarEdge's new commercial power optimizer (#28) sees the company going from strength to strength. We have seen huge momentum for this particular product in the U.S., where they are the leading supplier in this space and we expect this to continue.

Overall, have you been impressed by the level of innovation on display this year?

Yes, generally. One trend that I have seen is epitomized in SMA's 1,500 V inverter. These are their large 2.5 MW central inverters (#39). And we've also seen that ABB will release its own 1,500 V inverter (#37) at Intersolar Europe. In line with that we've seen that leading suppliers are typically keeping the same size footprint for their inverters, but increasing the power density. So going from 800kW to 1 MW, and this will lead to improvements on the overall cost and improvements in the LCOE for EPCs. I see this as a key development, especially in the utility-scale market.

One of the issues with the drive towards 1,500 V is the availability of 1,500 V modules, or modules that can handle the higher voltages. JA Solar's (#47) 1,500 V module is assisting with the market adoption by increasing the number of module suppliers offering 1,500 V, because that was a bottleneck in itself.

How much of a role can BOS components continue to play in delivering lower LCOE in the future?

Certainly for inverters, we're still forecasting that prices will decrease by around 10% over the next five years. We are expecting the price decreases to be a little bit more aggressive this year, maybe in the teens – 15–20% – in certain segments, because there are a lot of suppliers still operating within the marketplace. The two leading Chinese suppliers are featured, Sungrow (#18) and Huawei (#20) with their string inverters, which are aimed at the commercial and ground-mount market. These are significant suppliers in domestic markets and they are adding to price pressures across the international inverter landscape.

What further developmental and design processes are you seeing in the mounting systems industry?

Dow Corning's adhesive (#35) is an interesting product, as a replacement for mounting rails. Although the trend is some time away, and this is very much a niche application at the moment, it certainly shows that significant global suppliers are looking at total system costs and are devising ways to lower BOS costs. That is their proposition – to lower upfront costs compared to the classic mounting systems that are on the market right now. This is where the market certainly needs to go. ◆

Interview with Ian Clover