Array Changing Technologies – Europe

In 2017, **pv magazine** is changing format to its Array Changing technologies award and feature. Bringing together highlights from the swath of new modules, inverters, mounting systems, trackers, batteries, and PV array supporting equipment, Array Changing Technologies will continue to spotlight the innovations that continue to drive down LCOE and deliver reliable large and small solar array performance over the long run.

Since its launch two years ago, Array Changing Technologies has taken a global view, but in 2017 the feature is split into two sections, Europe and the Americas, across the June and July editions – bringing a selection of products either targeted towards or from companies in their respective regions.

In this first European selection, **pv magazine** has short-listed 10 entries representing the best in PV module, power electronics, and support structure technology. Entries that can ensure reliable performance and optimize plant output have also made it to this initial Array Changing selection.

As with previous years, an expert jury has been assembled to assess each of the shortlisted entries and to provide scores based on selection criteria: efficacy of the solution, sustainability of the solution, degree of innovation and economic impact. These scores form the basis of the ranking.

Of the 10 shortlisted entries, three will be considered by both the Europe and Americas juries in a final meeting, from which an Array Changing Technologies award winner will be selected. Be sure to pick up the July edition of **pv magazine** and check *pv-magazine.com* for the award announcement.

Until then, **pv magazine** and the Array Changing Technologies 2017 Europe award jury are pleased to present the following finalists:

ARRAY CHANGING TECHNOLOGIES 2017 AWARD FINALISTS

Hanwha Q Cells
Q.Peak RSF L-G4.2

SolarEdge
Smart Energy Management solution and S series optimizer

Wavelabs
Sinus-2100 Outdoor

Award Jury

Dirk Morbitzer
Supply Chain Manager, Sunrun

While based in the U.S., Dirk has a long history in the European solar sector. He is a two-time Array Changing Technologies juror. At Sunrun, he is responsible for the vendor selection, contract negotiations, and quality management. Dirk constantly evaluates new technologies on their impact on cost, reliability, and usability. During his more than 10 years in the solar industry, Dirk was Managing Director at Renewable Analytics, where he advised financial investors on renewable technologies, Director of Global Procurement at Trina Solar, and Head of Procurement at S.A.G. Solarstrom.

Anika Giller
Senior Business Development Manager EMEA & APAC, Clean Energy Associates

Anika leads Clean Energy Associates' (CEA's) business development initiatives for clients in over 15 countries across Europe, the Middle East, and Africa, as well as in the Asia Pacific region. She manages a cross-function team in Italy, Spain, India, China, and the Philippines to execute client engagements. Prior to joining CEA, Anika worked in a cleantech startup and at IT and marketing advisory firms in Germany. She holds a B.Sc. Business Administration from the Free University of Berlin, and a M.Sc. International Business Administration.

Dominik Fröhler
Managing Director, renerco plan consult

Dominik has held the position of MD at renerco, a subsidiary of BayWa r.e., since 2013. Previously he was a technical advisor for wind and solar projects for Renerco AG. He has worked in renewables project development and operational service since 2003, during which time he has advised on over 50 projects in seven countries, representing a capacity of 1.5 GW.

1 Hanwha Q Cells

Q.PEAK RSF L-G4.2

High power modules to meet utility-scale needs is a popular solution for high value markets like Europe, and Hanwha Q Cells is meeting the demand with a module that it claims will deliver "the lowest LCOE in the market." The Q.PEAK RSF L-G4.2 is a 72-cell, 1,500 V powerhouse, coming in at 375 Wp and 19.1% efficiency.

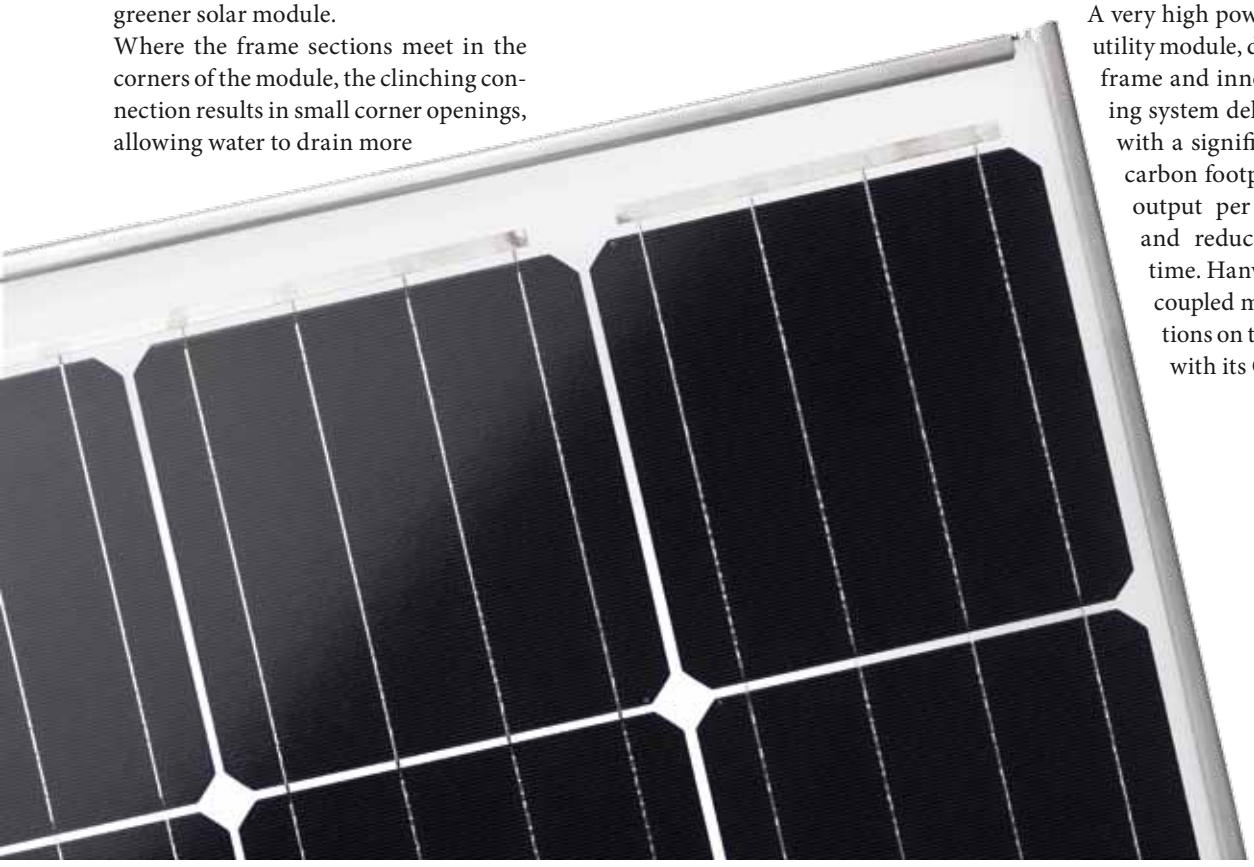
However, it's what lies behind and around the company's Q.ANTUM cells that is key to delivering on the company's bold LCOE claims. Hanwha Q Cells has mapped out the LCOE reduction that can be achieved with the new module, with a primary driver being its new frame design, which uses steel rather than aluminum, and mounting system. Hanwha Q Cells is deploying its in-house Reinforce Steel Frame (RSF) solution in the RSF L-G4.2, which takes the form of a folded steel sheet – rather than a hollow section – and clinched section connection. By deploying the folded steel sheet design, Hanwha Q Cells claims that the energy required to produce the frame is "significantly" reduced – making it a more cost-effective and significantly greener solar module.

Where the frame sections meet in the corners of the module, the clinching connection results in small corner openings, allowing water to drain more efficiently off the module, preventing moss and dirt build up. Openings in the frame sides ventilate the module, helping it remain cool.

The steel frame is constructed of zinc-aluminum-magnesium alloy coated steel, which is claimed to be up to 10 times more resistant to corrosion, when compared to standard module framing.

Hanwha Q Cells has also taken aim at installation efficiency with the Q.PEAK RSF L-G4.2. Its Easy Mounting System is designed to reduce module installation time on a standing mounting structure by over 60%. In a simple design tweak, mounting keys fasten the module to the base structure allowing the module to be moved into position before being fastened in place with self-tapping screws. Modules can be placed immediately next to one another, resulting in increased power density at a given site.

On the power side, Hanwha Q Cells is using its split and cableless junction box in the new module, delivering a power boost, reduction in cabling required, and largely eliminating the risk of damaged cables during installation.



The array changer

A very high power mono PERC utility module, deploying a steel frame and innovative mounting system delivers a product with a significantly reduced carbon footprint, increased output per square meter, and reduced installation time. Hanwha Q Cells has coupled multiple innovations on the module level with its Q.ANTUM.

2 SolarEdge

Smart Energy Management solution and S series power optimizer

Underpinned by SolarEdge's reputation for innovation and quality, the Smart Energy Management solution is a vehicle for the firm's suite of home energy products to shine. The SolarEdge StorEdge – an LG Chem battery-compatible, DC-coupled inverter – is the lifeblood of the solution, offering customers backup power during times of grid interruption, as well as on-grid storage for use during times of peak prices.

For SolarEdge, the combination of PV, storage and building automation is driving uptake from consumers keen to take a firmer grip on their energy consumption. Many homeowners in places prone to natural disasters – particularly in wealthy parts of the world such as the U.S. and Australia – have a growing thirst for solutions such as this: affordable, reliable components that can not only lower their electricity bills, but also keep the lights on during hurricanes, floods, and other tumultuous weather events.

SolarEdge claims that its StorEdge inverter can not only minimize energy loss when compared to traditional inverters (because there is no need for any conversion from AC to DC), but can also deliver an improved return on investment (ROI). "Combined with SolarEdge's device control suite, the StorEdge inverter aligns consumption with PV production to use excess PV power, and thus increase self-consumption," says SolarEdge. "The single inverter, meanwhile, enables simpler design and installation."

On the software side, SolarEdge's Home Energy Management solution allows simple monitoring of battery status, as well as remote modular device control, meaning that homeowners can choose how and where energy is directed throughout their home. This could mean drawing from the battery to provide hot water prior to returning home in the evening, or increasing grid consumption while the battery charges. This solution invariably means homeowners can consume more of their solar energy, thus reducing grid-consumption and system payback time, while providing a valuable grid stabilization by lessening peak demand.

New at Intersolar Europe will be SolarEdge's S series power optimizer, which is 38% smaller than previous iterations, offering 40% higher power density, 0.2% more efficiency, and improved safety thanks to a new feature, which extends protection to the connector level. The new power optimizer also includes three temperature sensors, these detect heat build-up in the connector while filtering out thermal background noise, thus making the S series adept at separating absolute and relative temperature increases – a vital component of arc detection and an increasingly important feature in the safety-conscious solar landscape.

The array changer

By integrating three functionalities into one inverter – storage, DC-to-AC conversion, and device control – the StorEdge inverter is at the heart of the Smart Energy Management solution. As smart homes are likely to be a hot topic at Intersolar Europe, SolarEdge's technology will be situated at the very center of the conversation.

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3 Wavelabs

SINUS-2100 Outdoor

On-site testing is a rapidly advancing area in PV, as owners and investors become ever more aware of the value of detailed on-site data, and the ability to detect for faults with modules in situ.

When a PV plant's performance drops unexpectedly, finding the fault is the first priority. Previously, this would mean disconnecting entire rows and carting them off (at great expense) to be tested in a lab. On-site testing is an innovation with the potential to quickly and accurately discover faults or damage without the need to disconnect or dismantle a power plant, saving time and money for project owners.

The Sinus-2100 outdoor allows flash testing of modules to be carried out in the field, with no need for disconnection. The tool is lightweight, transportable, and battery powered, so testing can be conducted even in remote locations. The light weight of the tool, says Wavelabs, also allows for modules to be tested in situ.

Wavelabs says that it has the only mobile flashing solution to utilize LEDs instead of xenon, which contributes to the light weight and portability, as well as allowing for flexibility with flash times and testing different light spectrums. LEDs have long life expectancies, and Wavelabs states that the Sinus-2100 outdoor can be expected to perform for years with no need for bulb changes. The tool can achieve the longer flash times required for testing high-efficiency modules, and can also perform bypass diode testing if required. Based on an estimate of testing 20 modules per hour, Wavelabs states that the Sinus-2100 could reduce the time and cost of post-installation module testing by more than 80%. Conducting testing on-site also means no downtime in the module's power generation, and no risk of causing further damage during transport to and from a testing site.

The array changer

Accurate on-site testing could dramatically bring down the cost for testing modules that are already installed and operational, and allow plant owners to optimize their generation and quickly spot any issues arising. As well as this, testing modules in 'real world' conditions will generate valuable data on how modules are performing once deployed, and particularly on how microcracks evolve over time, allowing further innovations to ensure future performance.

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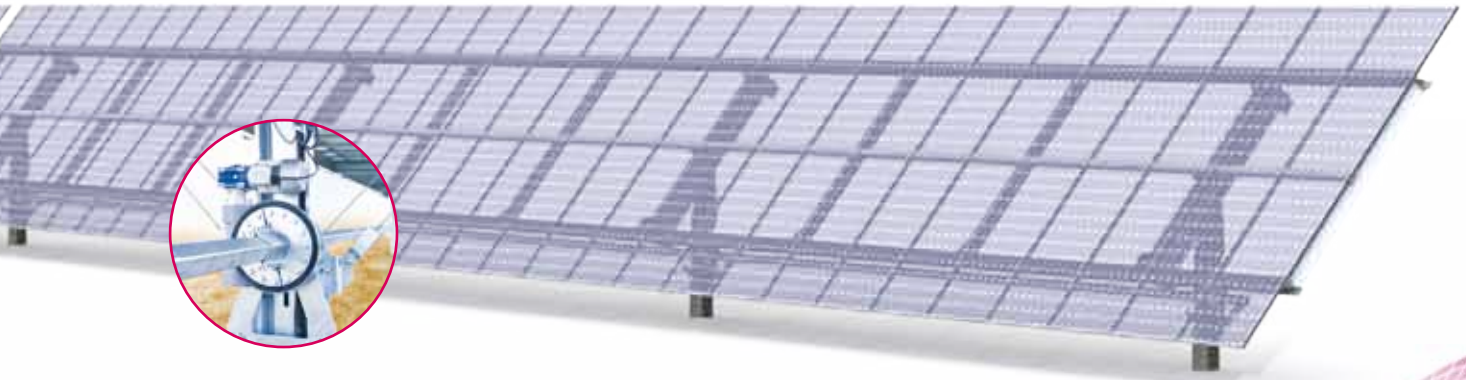

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4 Ciel et Terre Hydrelio floating PV platform

As demand for PV installations increases worldwide, solar power plants must increasingly compete with agriculture and other industries for land use, particularly in space-strapped island markets such as Japan and Taiwan. While many of PV's most recent innovations have been focused on maximizing generation on limited space, floating solar arrays open up a raft of new opportunities to build PV on unused surfaces.

French developer Ciel et Terre saw this potential early on, and developed its Hydrelio floating PV platform. Hydrelio employs a simple, modular design made from high-density polyethylene (HDPE), which it says is resistant to UV corrosion and able to withstand winds of up to 210 km/h, as well as being independently confirmed as drinking-water compliant.

In a typical installation, the platform is anchored using aluminum spreader bars, to maintain a static position while accounting for water level changes. PV modules are held at an inclination of 5 or 12 degrees, with rows separated by a secondary float for additional buoyancy, as well as to allow maintenance access. According to Ciel et Terre, floating solar installations achieve more efficient generation, with a longer average module life span, thanks to the natural cooling effect of water. On top of generating power for system owners, the Hydrelio platform can also reduce both water evaporation and algal bloom, which are prominent issues in areas prone to drought.

Ciel et Terre is exclusively targeting artificial bodies of water for its floating solar installations, and is particularly keen on developing hybrid PV/hydroelectric power plants, where it says PV can boost generation during daytime and, where water storage is possible, allow more hydropower to be produced at times of peak demand. The first such hybrid plant was created in March, when Ciel et Terre added a floating PV installation to the Alto Rabagão Hydroelectric Dam in Northern Portugal.

Hydrelio, and floating solar more broadly, also has a range of industrial applications – combining energy production with reduced water evaporation could provide a solution for water treatment plants, or industries using large amounts of water for cooling. Agricultural industries, where land use is always a key concern, could also benefit from floating PV on irrigation reservoirs.

The array changer

While floating solar is not an especially new idea – the Hydrelio platform itself has been commercially available since 2011 – Ciel et Terre has proven itself a market leader in this area. Its current strategy targeting hydro dam reservoirs as installation sites – where grid infrastructure is readily available – could open up a major new market. Ciel et Terre estimates that covering just 10% of the world's 50 largest hydroelectric dams could add as much as 400 GW of PV capacity.

5 SMA

Sunny Tripower CORE1

In the last financial year Germany's SMA recorded 27% sales growth in the commercial inverter segment – impressive performance in a market segment often considered secondary to the company's core utility and residential-scale sectors. Looking to build on this momentum, SMA is introducing at Intersolar Europe this year its Sunny Tripower CORE1 string inverter, which is the world's first standing commercial PV inverter. Why is this important? Well, it means installers can reduce the time taken to fit the inverter by as much as 60%, SMA claims, and it also means that it can be installed on rooftops or on ground-mounted arrays at commercial and even small utility-scale.

An additional design innovation that the Sunny Tripower CORE1 string inverter boasts is integrated DC and AC disconnectors, which negates the need for additional racking – thus delivering further savings on cost.

SMA claims that this fully-integrated design, combined with six maximum power point tracking (MPPT) channels that use the firm's OptiTrack Global Peak technology, makes for a rather compelling price point for the Sunny Tripower CORE1 inverter. "As the cost of solar equipment continues to come down, the industry is dealing with reduced margins," SMA told **pv magazine**. "Current industry practice requires the need to buy additional equipment, but the CORE1 is a fully integrated solution without any additional components and eliminates that practice completely, reducing BOS costs."

The CORE1's integrated plant control also allows for simplified grid management functionality without the need for additional software or hardware. According to SMA, this new commercial inverter can deliver savings of several thousand dollars when installed on a 200 kW installation. "The solution allows installers to use aluminum wiring instead of copper, which saves tens of thousands of dollars on a 1 MW installation," SMA added.

Furthermore, post-installation field serviceability is also more cost-competitive because the CORE1 contains components that can be replaced or repaired in the field, without having to be sent back to the manufacturer – a process that can result in several hours of downtime. "This leads to extensive opex savings and increased lifetime power production."

The array changer

A string inverter that is free standing? That is the very definition of an array-changing piece of technology. This design breakthrough from SMA could transform how system integrators plan and install commercial-scale solar systems, and promises to set solid foundations for what is expected to be a global growth market in the coming years.

6 Regalgrid Europe

Platform

The increasing grid penetration of both residential and commercial solar installations raises a few big questions for energy management. Energy sharing platforms are seen by some as a solution that will play an increasingly important role in future electrical infrastructure.

Italy-based smart grid developer Regalgrid Europe, a joint venture between Regal Grid, Archeide Empower, and Upsolar, has developed a hardware/software platform aimed at optimizing energy usage through a peer-to-peer platform where users share unused power generated from residential and commercial PV installations and storage facilities.

The system relies on a Smart Node Control Unit (SNOCU), where each user's energy data are uploaded in real time to a cloud-based application, and the SNOCU crunches the numbers and calculates optimal working conditions.

In an example given by Regalgrid, if user 1 is generating more power than they are consuming, while user 2 is consuming more than they generate at a given time, the system will send a command to user 1 to share over-generation, for which they receive an energy credit.

Regalgrid aims to take a bottom-up approach to the question of what will happen to the grid as renewable energy gains higher penetration, one that sees customers as prosumers, highly aware of their energy production and consumption levels.

Currently, many different iterations of energy management software are appearing on the market, aiming to increase reliability and reduce the curtailment of small rooftop solar installations up to utility-scale. Regalgrid stresses that its platform is designed to be flexible, and to evolve alongside the market

Economically, the impact of this solution will depend on energy prices and other market forces, however, Regalgrid provides PV and energy storage system owners with a way to get the most out of their generation and reduce reliance on the grid.

The array changer

Platforms like this are seen by many as a vital tool for our energy future – from the creation of energy communities trading rooftop generation, to utilities using such software to balance supply and demand. Technology is making up for the intermittencies inherent to renewable energy.

7 REC

TwinPeak 2S 72 Series

Big performance on a utility-scale format, using multicrystalline technology. REC has weighed in on the high output module race with its new 72-cell TwinPeak module, which the company claims sets a world record for multicystalline module performance, coming in at 350 W.

As with previous iterations of REC's award-winning TwinPeak range, the 2S 72 Series deploys a combination of efficiency and output boosting technologies. The end result is a high power module, with a weight of only 22 kg – which REC says is 4 kg lighter than standard 72-cell modules.

On the cell side, REC has stuck with its multi PERC technology that has a long track record in the market. The difference with this latest TwinPeak module, according to REC, is that the wafer format is 156.75 mm, larger than standard cells, delivering higher current production.

On the module side, REC stacks up a number of innovations: It has increased the number of busbars from four to five, used half cut cells to reduce cell-to-module resistive losses, and utilized a split junction box (JB). Coupled with the "twin" panel design, it increases output in environments in which shading may be a problem. The split junction box is spread across the middle of the panel, rather than the top, reducing the temperature behind the JB, thus increasing efficiency. REC says that a new frame design has been incorporated into the 2S 72 Series, allowing for more compact packaging.

The TwinPeak 2S 72 is available worldwide and is suitable for both utility-scale and C&I applications. The module is IEC and UL certified and is available in both 1,000 V and 1,500 V configurations.

The array changer

Bringing the innovations well established in the TwinPeak series together in a 72-cell format brings REC's multi PERC technology to utility scale. The lighter weight should ease installation and bring down shipment costs. High power delivers reductions in BOS costs, and 350 W with a multi cell is hard to beat.

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8 Kipp & Zonen

DustIQ soiling monitoring solution

On-site monitoring of PV plants is a key issue for project developers, as investors look to leverage more and more data to reduce risk. Soiling, as well, is a major factor affecting performance, and one that must be closely managed: IEC standards for PV performance recommend that soiling be monitored at least every minute by a high accuracy system.

In 2017, Netherlands-based monitoring expert Kipp & Zonen is introducing an innovative technology to measure soiling at PV power plants in real time. The DustIQ solution relies on unique optical technology to continuously measure transmission loss through soiling.

Currently, most soiling measurement systems are expensive, reliant on reference panels, can only operate in sunny conditions, and themselves require cleaning on a daily basis.

Kipp & Zonen gets around these issues by utilizing a sensor beneath a glass surface with properties & coatings common to PV panels. According to Kipp & Zonen, its solution is considerably cheaper to buy, install, and maintain than previous approaches, having no moving parts and requiring only the same cleaning as PV modules. The company also states that DustIQ requires no light source and can operate in overcast conditions and even in the dark. Kipp & Zonen says DustIQ can easily be integrated into SCADA systems, thanks to the use of industry standard Modbus RTU systems.

NREL estimates losses from soiling at $1 billion for every 4%, and there may also be contractual penalties for output that falls below agreed parameters. On the other hand, Kipp & Zonen estimates cleaning costs at $0.80 – $1.30/kW per clean (based on U.S. examples), and notes also that repeated cleaning can wear away glass coatings and cause etching and abrasions.

The array changer

Having real-time data on the soiling ratio at various points within a PV plant could greatly improve a site operator's ability to implement an optimized cleaning schedule, both reducing costs and increasing output. This solution could also allow for other, longer-term anti-soiling measures to be more effectively implemented.

9 Soltec

SF7 Tracker

Manufacturers in the large yet crowded tracker market must innovate and tweak their trackers to be able to differentiate themselves and give power plant owners an edge in their output. Soltec, recently named in the Financial Times as the fastest growing solar company in Europe, is ready to launch a new tracker which it says features various improvements over their previous offering and their competitors.

The SF7 allows for complete module fill on the tracker. This innovation, according to Soltec, can result in a 5% higher yield potential than other trackers.

Soltec also says its new tracker does not use linked rows or linear motors, and can be deployed on slopes of up to 17% gradient. These factors, say Soltec, allow for a greater site fill, even on irregular land. SF7 also uses fewer parts than other trackers, for faster & easier installation.

The array changer

Trackers are adopted by project developers as a way to increase output without increasing land use. As trackers spread into more space-strapped markets, squeezing out the maximum possible output will become ever more important. Removing gaps over mounting locations, as well as optimizing installation and land use, could prove straightforward yet effective innovations for Soltec.

10 Elecdan Converter

Analog MPPT

Digitalization is the phrase on the solar PV world's lips this summer, but French firm Elecdan Converter has adopted a different tack, with its analog maximum power point tracker (MPPT) for solar installations.

The device performs the same function as typical MPPTs found in string inverters: It determines the ideal operating voltage/current point during all weather conditions, thus identifying the most efficient path towards greater PV harvest. However, this analog MPPT eschews microcontrollers and current sensors, which serves to dramatically bring down the purchase price.

The converter can be directly integrated into PV panels, which allows for parallel installation of identical modules on scalable installations. The device is lightweight and low-impact, and the removal of current sensors means a lack of predictive and disturbing currents.

In terms of performance, Elecdan Converter claims that its MPPT has an improbable failure rate and is immune to overheating, removing the risk of system shutdown because of BOS component failure. The MPPT meanwhile, ensures there is no undue loss of energy during installation. Elecdan states that this tracker "eliminates current sensors and microcontrollers, ingeniously maintaining the maximum power point with a control resulting from analog analysis of the current/voltage curve in the vicinity of V_{MPP} [voltage at maximum power point]."

The company sees scope for market adoption of its MPPT in the developing world, particularly from the 1.2 billion people on the planet currently deprived of a reliable energy supply. "Our MPPT is inexpensive, miniaturized, and climatically insensitive." Elecdan is searching for partnerships to accelerate commercialization.

The array changer

The ability to offer an efficient analog MPPT as a standalone device or embedded directly into a module is an interesting approach, and one that could bring down the cost of MPPT technology, thus increasing uptake and boosting the energy harvest of a typical solar array.

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