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ON THE COVER

Eaton's B-Line Ground Mount Racking System is a fixed-tilt mounting structure with only five main components, integrated grounding and two clamping options.

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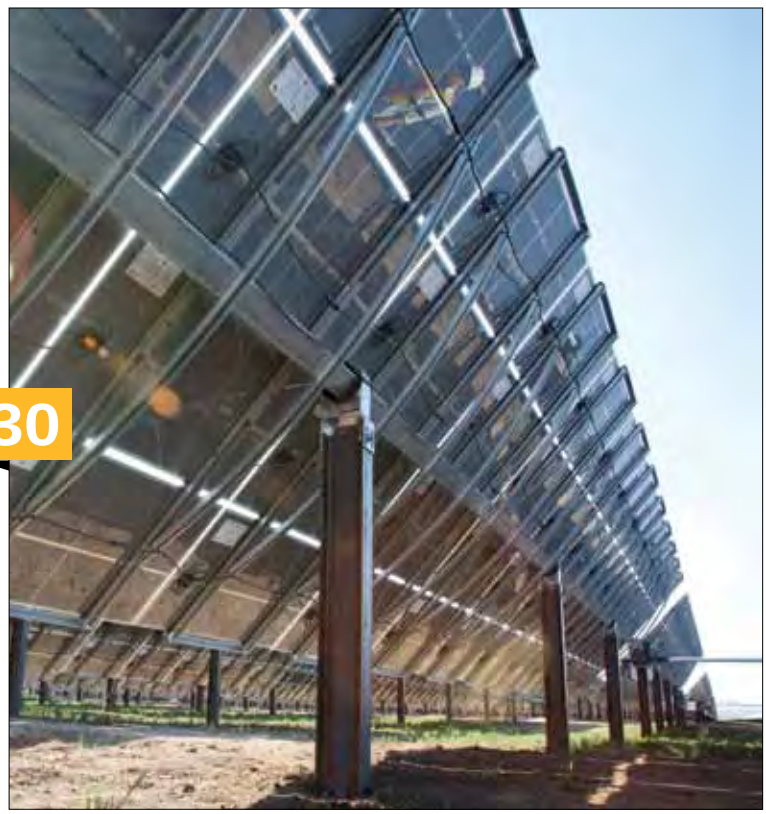

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FEATURES

KEY INDUSTRY ABBREVIATIONS

- ***PV:*** ***photovoltaics*** *(using solar cells to produce electricity)*
- ***V:*** ***volts***
- ***W:*** ***watt***
- ***kW:*** ***kilowatt or 1,000 W***
- ***MW:*** ***megawatt or 1,000 kW***
- ***GW:*** ***gigawatt or 1,000 MW***
- ***kWh:*** ***kilowatt hour***
- ***BOS:*** ***balance of system*** *(all components except PV panels)*

AD INDEX

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UNITED IN SOLAR

I can name the 44 U.S. Presidents in order without hesitation. It doesn't impress as many people at dinner parties as I would hope, but it's a skill I will hopefully use to crush them later at Trivial Pursuit. Equally as impressive (in my eyes at least), I can quickly spout off a list of 44 mounting, racking or tracking companies. Just as Thomas Jefferson presided differently than Theodore Roosevelt (I could list details at your next party), Renusol and Sunmodo secure panels in different ways. Even in this flooded market, each solar mounting company has its own differentiating feature.

Welcome to the second installment of *Solar Builder*'s Mounting Guide. We have again tried to shine a light on a few exceptional companies while also providing an outlet for everyone to pitch their best products to our installer audience.

Now that we've somewhat mastered the art of mounting panels using the fewest number of parts, the industry is looking to install solar in uncharted areas. Landfills and brownfields will continue to be a growing installation market, and they require special mounting systems (see our story on page 18). Speaking of uncharted areas, South Carolina installed its first utility-scale solar farm this year, and you can see which mounting companies were chosen for this revolutionary project on page 26.

Each mounting company in this Mounting Guide brings a different expertise to the table. They're all leaders in their own way in the solar industry.

Which one will you choose?

Kelly Pickerel

Kelly Pickerel, Associate Editor

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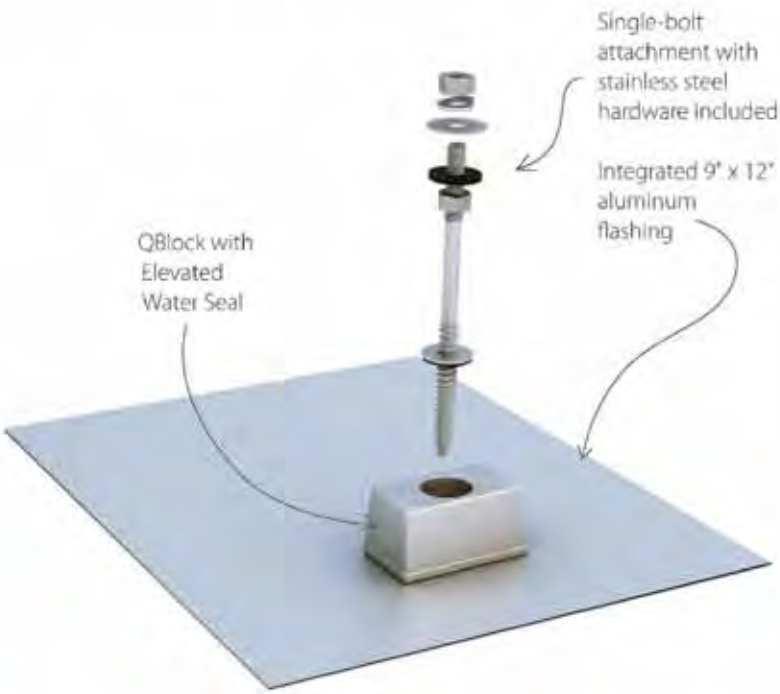

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SCHOOLED The National Solar Schools Consortium wants to bring solar to all U.S. schools, like *Solar Builder*'s 2013 Project of the Year winner Holston View Elementary in Bristol, Tenn.

NATIONAL SOLAR SCHOOLS CONSORTIUM AIMS TO BRING SOLAR TO EVERY SCHOOL IN AMERICA

Nonprofit organizations and solar companies from across the nation announced the launch of the National Solar Schools Consortium at the widely-attended National Science Teachers Association (NSTA) Conference in Boston in early April.

The goal of the Consortium is to act as a unified voice for the growing solar schools movement, promoting the use of solar energy on K-12 and post-secondary schools, consolidating and coordinating current and future solar curriculum and resource development and providing tools designed to help schools explore solar energy options both on campus and in the surrounding community.

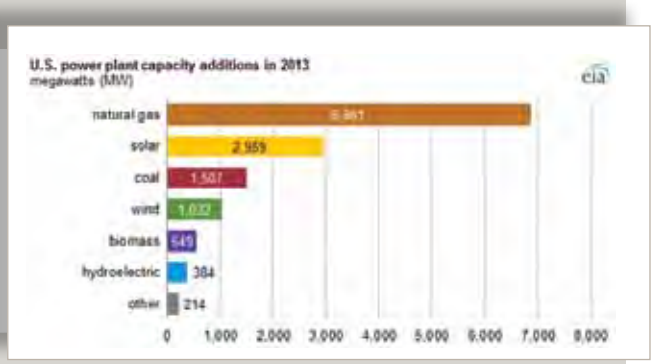
"It's estimated that thousands of schools across America have already installed solar panels, but tens of thousands of others are still tethered to fossil fuels," said Prof. Sharon Dannels, chair of the Educational Leadership Department at the GW Graduate School of Education and Human Development. "According to a recent study of California schools, an average-sized 313-kW solar system prevents the emission of an estimated 200 lbs of smog-forming pollution a year."

To kick off its efforts, Consortium representatives presented at several workshops at the NSTA Conference, held at the Boston Convention and Exhibition Center. During these presentations, teachers and other education professionals shared their needs for expanding access to solar energy and related educational resources for their schools. Interested stakeholders can also communicate these needs by completing a brief form on the Consortium website, *solarschools2020.org*.

"More and more schools across the country are discovering the benefits of going solar," said Rhone Resch, president and CEO of the Solar Energy Industries Association (SEIA). "Today, solar is the fastest-growing source of renewable energy in America, creating thousands of new jobs, pumping billions of dollars into the U.S. economy and helping to reduce pollution. For schools, solar can provide a curriculum where science, economics and the environment all intersect. SEIA is honored to be part of the National Solar Schools Consortium."

The Consortium comprises representatives of leading environmental, educational and solar-focused non-profit organizations, as well as for-profit solar businesses. Founding Consortium members include the Brian D. Robertson Memorial Solar Schools Fund, Community Power Network, Elephant Energy, the Foundation for Environmental Education, KidWind, Make It Right Solar, Mosaic, the National Energy Education Development (NEED) Project, the Natural Resources Defense Council, the Solar Energy Industries Association, The Solar Foundation, SolSolution, The Three Birds Foundation and Women in Solar.

UNITED STATES ADDS 2.2 GW OF PV IN 2013



According to the U.S. Energy Information Administration, natural gas-fired power plants accounted for just more than 50 percent of new utility-scale generating capacity added in 2013. Solar provided nearly 22 percent, a jump up from less than 6 percent in 2012. Coal provided 11 percent and wind nearly 8 percent. Almost half of all capacity added in 2013 was located in California. In total, a little more than 13,500 MW of new capacity was added in 2013, less than half the capacity added in 2012.

Solar PV added 2,193 MW of capacity in 2013, continuing the trend of the past few years of strong growth, helped in part by falling technology costs as well as aggressive state renewable portfolio standards (RPS) and continued federal investment tax credits. Nearly 75 percent of the capacity added was located in California, followed by roughly 10 percent in Arizona. (Note: These figures do not include distributed capacity under 1 MW. Distributed solar PV capacity additions also grew in 2013, with industry reports estimating nonutility additions of 1,900 MW. Most of this capacity was also located in California.)

After many years of little activity, the solar thermal industry completed several large-scale solar thermal plants in 2013 located in Arizona and California totaling 766 MW of capacity, more than doubling the total solar thermal capacity in the United States. A few more projects are expected to be completed in 2014-16; however, several other announced projects have since been cancelled or suspended because of a number of challenges such as environmental impacts on desert wildlife and water resources, cost-competitiveness and delays in transmission development.

TAKING OVER String inverters, like these manufactured by SolarEdge, are being used on more multi-megawatt installations.

STRING INVERTERS

INCREASINGLY BEING USED IN MEGAWATT-SCALE PV PROJECTS

PLUS OTHER GLOBAL INVERTER TRENDS

In a sign of their growing acceptance, string inverters are increasingly being considered in megawatt-scale PV systems, with more than 40 percent of inverter buyers regarding them as suitable for use in systems larger than 1 MW, according to a new report from IHS Technology.

In an IHS survey, more than 300 solar installers, distributors and engineering, procurement and construction (EPC) companies were asked about their preferences and opinions on PV inverters in order to help suppliers better understand the needs and requirements of their customers.

Of the more than 200 purchasers of PV string inverters that completed the survey, 80 percent indicated they might use string inverters in systems larger than 100 kW. All told, nearly half reported they would consider using the inverters in systems larger than 1 MW. This marks a huge increase from the previous year's survey when only 17 percent considered using string inverters in systems larger than 1 MW.

"The survey confirmed that the acceptance of string inverters in large systems has accelerated over the last year, mirroring the IHS forecast that these products will gain share in several key PV markets," said Cormac Gilligan,

senior PV market analyst at IHS. "The most common reasons given for solar purchasers preferring string inverters increasingly over central inverters in large systems were better system design flexibility, minimizing losses in the case of failure and lower lifetime system costs."

IHS predicts that low power, three-phase inverter shipments will increase by 14 percent a year on average for the next four years, with annual shipments of nearly 20 GW in 2017.

These findings can be found in the report, "IHS PV Inverter Customer Insight Survey," from the Power & Energy service of IHS.

The report also found that Chinese-made inverters are gaining increased acceptance in places such as the United States, Germany and the United Kingdom.

Chinese inverter suppliers appear to be overcoming the perception that their products are not of adequate quality. When buyers were asked the question, "Do you think Chinese inverters offer sufficient levels of quality?" half answered yes. This shows that the global level of acceptance for Chinese inverter suppliers has increased for a second consecutive year, Gilligan remarked.

The biggest increase was recorded in the United Kingdom, where nearly 60 percent of inverter buyers consider Chinese inverters to be acceptable quality, compared to 40 percent in the United States.

More entities are also using or buying microinverters in 2013, according to the survey, with 42 percent now utilizing such products.

The United States continued to show the highest levels of microinverter usage with a small increase over the previous year, while larger gains came from the European markets. In the United Kingdom, for instance, over half of purchasers now use or buy microinverters.

"Following several years of intense marketing and training for installers, microinverters have now progressed from being a 'niche' product, to gaining wide acceptance in the PV market," said Gilligan. "Major suppliers, such as SMA and Power-One, have also released microinverters, helping them to gain acceptance and traction in key markets."

news

USA TO DODGE SOLAR SHORTAGE EVEN AMID NEW ANTIDUMPING FINES ON CHINESE MODULES

A long-running battle in the global PV market between the United States and China over antidumping and subsidy charges could expand into higher solar costs, with wide-ranging ramifications for the United States if punitive tariffs are levied on Taiwanese cells.

However, enough tariff-free capacity should still be available in 2014 to ensure there are no shortages in the United States this year, even if solar modules are expected to feel an impact on pricing, according to new analysis from IHS Technology.

In ongoing investigations expected to culminate later in the year, the U.S. International Trade Commission is determining if further penalties should be imposed on solar modules containing cells manufactured in Taiwan. Having already punished China in 2012 with antidumping and countervailing duties, the United States is now seeking to close a loophole in which Chinese module manufacturers circumvented the large fines — ranging from 34 to 250 percent — by using third-party suppliers of PV cells located in Taiwan.

If the final ruling, expected in October, determines there is cause to impose penalties also on Taiwanese-sourced PV components, the price of solar cells and panels would almost certainly rise in the United States. This, in turn, is prompting fears that an increase in pricing might cause PV panel shortages in the U.S. market and disrupt the growth of PV installations.

But the prospect of a shortage here

at home is unlikely, at least for this year, IHS has deemed after a careful study of possible aggravating factors as well as feasible sources for market relief.

In all, an estimated 57.8 GW of production capacity representing crystalline solar cells and thin-film solar modules is available globally in 2014, 11.2 GW of which are located outside of China and Taiwan. Those 11.2 GW of capacity are not covered under the present U.S. inquiries, and when added to 6.1 GW of global thin-film capacities, the overall available supply of tariff-free solar capacities would amount to 17.3 GW.

At such levels, enough volume remains to support the entire breadth of U.S. solar installations for 2014, projected to reach 6.5 GW. This means the United States need not fear the possibility of a shortage this year, IHS believes.

MODULE PRICES TO RISE

The lowest module prices currently available in the U.S. market (all of them Chinese modules containing Taiwanese cells) are in the range of $0.62 to $0.65 per watt. Non-Chinese suppliers offer products at prices higher than $0.70. Depending on the final outcome of the trade case, PV module prices could rise to somewhere between $0.75 and $0.80.

For the Chinese, preserving the U.S. market — the third largest in the world after China and Japan — will be integral.

Chinese companies are now increasing their shipment volumes to the United States to build up module stocks not yet affected by tariffs, prior to the final decision in October. Such a move will allow them a buffer of a few months, noted IHS.

TOP 10 SOLAR MODULE SUPPLIERS IDENTIFIED

Six of the Top 10 solar module suppliers for the U.S. market in 2013 have their headquarters or the bulk of their manufacturing operations in China. These companies, all currently relying on solar cells from Taiwan to serve the U.S. market and sidestep the stiff fines, held a combined market share last year of 42 percent, based on total merchant shipments.

The No. 1 spot, however, belonged to U.S. thin-film manufacturer First Solar, ahead of runner-up Yingli Green Energy, third-ranked Trina Solar and No. 4 Canadian Solar. SunPower, the other leading U.S. manufacturer, was ranked fifth.

Rounding out the rest of the Top 10 were ReneSola, Suntech, SolarWorld, ET Solar and Hyundai.

MOUNTING GUIDE 2014

Welcome to the second installment of *Solar Builder*'s Mounting Guide. We hope our stories on unique projects, installation tips and a product showcase help you find the best mounting system for your next project.

We start off this issue with a look into those mounting companies separating themselves from the crowd. With more than 50 mounting-specific manufacturers in the industry, it can be easy to get lost in the shuffle. Embracing social media and designing for a mobile era only ensures a company's longevity. Check out *Solar Builder*'s picks for the best mounting manufacturers on YouTube, Twitter and those inventing apps.

YouTube VIDEO STARS

Search for an installation video or product review of any common solar mounting company and you'll be flooded with amateur videos from average citizens and installers not affiliated with mounting companies. Sometimes these informal and pure reviews are the best way to know if a system works, but there are many good YouTube channels from the manufacturers themselves. Most feature installation videos either in animation or real-life applications. If you really have questions about a system, videos straight from the experts might be more beneficial than Jim Bob working in his backyard. Here are our picks of some of the elite solar mounting YouTubers active in the last year.

IronRidge

17,743 views | 8 total videos | 4 new videos since Jan. 2013

IronRidge has a good mix of animated overviews and actual step-by-step installation videos. Have questions about how to install the roof-mount system on tilt legs? That's covered in a video that gives exclusive tips like how to torque rails and keep track of loose bolts. IronRidge released the FlashFoot in early 2014, and a YouTube video explanation was a perfect way to introduce the new product to the solar community.

Quick Mount PV

18,542 views | 43 total videos | 25 new videos since Jan. 2013

It's safe to say that installing solar on shingled or tiled roofs is a little more complicated than a basic flat-roof project. Quick Mount PV makes the installation process a no-brainer with its YouTube channel (and all videos are also nicely organized on the Quick Mount PV website). From quick tips showing how to cut tile to in-house demonstrations on how to find rafters, these videos really are helpful to the novice solar installer or those double-checking their work.

Solar FlexRack

10,719 views | 16 total videos | 8 new videos since Jan. 2013

Solar FlexRack has a unique pre-assembled, unfolding design to its ground-mount system, but that means nothing until you see it in action. The company has a number of videos showing installations in a variety of conditions, and most are in real-time, proving how quickly mounts can be installed. Step-by-step videos provide a little extra help to installers who may have questions about how that unfolding contraption actually works.

GameChange Racking

811 views | 13 total videos | 13 new videos since Jan. 2013

Seeing a real-time installation of a ground-mount is occasionally beneficial, but who really wants to spend 20 minutes watching a guy secure bolts? GameChange Racking knows our attention spans are dwindling, so the company speeds up its install videos to fit in less than four minutes. GameChange also shows transparency, letting viewers see its systems go through wind-load testing. We could watch videos of huge 120-mph fans all day.

**Views and video totals accurate as of April 21, 2014.*

BIG Tweeters

Besides the best breaking solar construction news from *Solar Builder* (@solar_builder), Twitter is full of solar companies tackling issues and relaying the latest industry information. Solar companies have really embraced social media, and it makes a big difference as customers get younger and more tech-savvy. Whether installers or manufacturers actively participate in online conversations could sway decisions about project and product selection. Here are some of *Solar Builder*'s favorite fellow conversationalists.

TWEETS 1,255 | FOLLOWING 146 | FOLLOWERS 5,399 | following

Tweets

Applied Energy Technologies (AET) @AETenergy
A great mix of industry news and actual product installations. Join in with the company's hashtag challenge: #LayMoreRackThanAET.

Ecolibrium Solar @EcolibriumSolar
Very conversational account, asking questions while promoting unknown elements of its products.

SolarDock @solardock
Promotes necessary tips, like remembering about fire safety on rooftops and gives suggestions on how to better design arrays.

AllEarth Renewables @allearthrenew
Spreads the good news about solar outside of just its own Northeast home. Want to know the latest local and state bills concerning solar? This account has the info.

Unique Apps

A new age is upon us, one run by smart gadgets and advanced technology. Most of these devices and their applications can make our lives better and easier, as long as we keep the Candy Crushing and Snapchatting to a minimum. It seems like every company or product has a mobile app these days, but surprisingly only a few solar mounting companies have developed tools to make solar installations easier. Here are the ones that do more than just list systems and ways to purchase.

Solar Builder

Available on iOS devices

We wouldn't be a good magazine without a shameless plug of our own app in this category. The *Solar Builder* app is an extension of this fantastic print publication and our website. Bonus videos and expanded graphics are peppered throughout our interactive pages, and archived copies stay on your device for easy viewing at a later date. Now instead of carrying your favorite article in your wallet for years to come (you do that, right?), you can pull it up whenever you want, without the crease marks or coffee stains.

RBI Solar Shading Calculator

Available on iOS devices

RBI Solar's shading calculator helps installers calculate row spacing in the field so they have a better idea how far apart rows need to be in different areas. Users pick their location on a map so approximate sun angles can be considered. Then after submitting the array's tilt angle and module length, the app calculates the post-to-post distance, the inter-row spacing and the distance from the front of the first panel to the front of the second. RBI Solar's shading calculator takes a lot of the guesswork out of project planning.

Unirac Toolbelt

Available on iOS and Android devices

The Unirac Toolbelt is like a full set of tools any solar installer would benefit from having on hand. Users have many cool functions right in one device, like a True South Compass, a U-clinometer (which helps determine the pitch and angle of any surface) and the Theodolite (which uses your device's camera to determine roof angle, height, altitude, latitude, longitude and azimuth, all at ground-level). The Toolbelt app also makes working with Unirac products even easier, with direct access to technical support and configurators to map out a new project, module-by-module.

FILLING UNUSED LAND WITH SOLAR

The landfill and brownfield market is growing for solar installations, and SunLink has worked out a system that will last. By **Kelly Pickerel**

Massachusetts isn't that big. It's the seventh smallest state in the union, and the only states it beats are its surrounding New England friends. But it's the 14th state by way of population — more than 6.5 million people call the Bay State home. The state's population density is third in the nation with 840 people per square mile. That's a lot of people on top of each other; space is tight.

Now consider that Massachusetts has 594 inactive or closed landfills and 23 still actively filling with waste. That's a lot of uninhabitable land in a state that seems pretty crammed. Parks, shopping malls and golf courses have been built on old landfills, but there are often settlement issues or reports of methane gas escaping when not properly monitored. The better and safer option for these brownfields? Solar installations.

Massachusetts knows this. The state has installed more than a dozen in the last few years — Washington Gas Energy Systems built six, Gehrlicher owns a few, Clean Focus recently announced 19.5 MW of new projects, and Borrego Solar has used its PPA experience to construct solar on capped landfills, too. In 2012, Borrego worked with mounting system manufacturer SunLink on

two projects in the towns of Ludlow and Easton.

Constructing solar on capped landfills requires a certain expertise and knowledge of the many installation issues that can arise — differential settlement, weight limits and increased expenses, to name a few. But SunLink has the experience, says Yury Reznikov, vice president of product and strategy.

"We're warranting these products for 15 to 20 years, so we've learned a lot about how to install them, how to make sure the landfill caps survive for the next 15 to 20 years," he says. "We believe our solution is one of the few that is going to be out there for the long term."

LIGHTWEIGHTS

When you see a capped landfill, it often just looks like a large, grassy field; you wouldn't know there's a mound of trash hiding underneath. Although the ground looks fairly normal, a traditional penetrating ground-mount solar installation won't work, says Joe Harrison, senior project developer at Borrego Solar.

As landfills fill up with trash, areas are compacted and covered with layers of soil and sand. Generally since the late 1980s, landfills in the Northeast have been capped with a geomembrane lining. About 2 ft of soil is then spread on top of the cap and grass is grown. Vegetation is monitored annually to ensure root systems don't damage the cap.

Two feet of soil is nowhere near deep enough for a penetrating system, and since nothing can puncture a landfill cap, ballasted is the way to go when installing solar at landfills. But even weight is a concern on top of that geomembrane film.

"Our ballast blocks are around 1,500 lbs a piece, so it doesn't create an issue for the cap, but the challenge is moving them around and getting them in place," Harrison says. "We have a staging area during construction off of the cap, then only tracked equipment is moving around on the landfill. When you have a [machine] pick up a ballast block and start driving around, the point load on all four tires is too great for the landfill and cap. You have to use tracked equipment to spread out that weight."

SunLink is a big proponent of pre-panelization — the act of assembling systems off-site to speed installation and cut down on unnecessary weight loads on unstable ground. Its two ground-mount systems — the Ballasted Ground Mount System (GMS) and the Large-Scale GMS (a penetrating system) — can both be assembled and installed quickly. The ballasted system situates panels one-by-one in portrait orientation while the penetrating system uses four panels on top of each other in landscape orientation. The Ballasted GMS works well on landfill caps, but it was not chosen for the Ludlow or Easton landfill projects. Instead, Borrego and SunLink decided a reformatted version of the Large-Scale GMS would be more efficient for the scale of the landfill projects.

"If you have the right crew, the right equipment, the right project, we believe that the four-in-landscape [orientation] is more cost-effective in terms of installation," Reznikov says. "Borrego thought, because they know how to build these projects, they were going to be better off with the four-in-landscape product."

UNDERGROUND MOVEMENT

The Ludlow project was a 2.6-MW installation, while the landfill in Easton received a 1.9-MW solar installation. Usually projects of that size are installed in long, continuous rows of panels. But differential settling of things underneath landfill caps prevents long rows from happening.

"If you think about things in landfills, things decompose at different rates so it's not a steady settling that occurs," Harrison says. "You might have a bunch of material in one section that decomposes quickly, and you get an indentation in the landfill. Eighty percent of the settling occurs in the first 10 years, so we won't install on a landfill that is less than 10 years old."

Since settling still happens after the 10-year mark, solar modules are best situated into tables, usually four panels high by five panels wide using SunLink's system, to accommodate possible movement. The tables are secured to two posts and ballasted a few inches apart so there's enough space that the racks won't hit each other when differential settlement does occur.

"We do offer enough adjustably in the system to provide for differential settlement, but with the lifetime of a system at 20 years, we can't predict everything," Reznikov says. "We want to make sure if there is an unexpected amount of differential settlement, a two-post, non-continuous system gives a little more flexibility."

MAXIMIZING PROFIT

There are a lot of added expenses to a landfill-based solar system, including concrete costs for ballast blocks, transportation costs for getting ballast blocks to sites and wiring costs for securing and protecting wire above ground since it can't be trenched underground. Finding any way to save a few dollars elsewhere on a system is really beneficial, Harrison says.

"It's already more expensive to construct on landfills, so it really makes sense to maximize the system size as much as you can," he says. "Maybe you tighten up the row spacing, maybe you use a more efficient module — we're really focused on driving down the cost of solar.

"SunLink is a good partner," he continues. "We really work together with them to drive down the cost and come up with the best solution. The SunLink system has a better coverage ratio, and we can fit more PV on the site."

SunLink is committed to meeting its customers' needs.

"We're there to support our customers with whatever they need," Reznikov says. "We're here to help our customers solve problems. We pride ourselves on going the extra mile to get a project to a successful state. We have the engineering chops to answer the need."

Since these two Massachusetts projects in 2012, SunLink has continued to partner on landfill installations. Reznikov says the company is working on around 20 MW of landfill projects in 2014.

"We've seen the market expand quite a bit," he says. "Before it was a couple hundred-kilowatt jobs. [Then] with Borrego we saw almost 4 MW, and we're seeing that expand more and more. When we look at landfills or brownfields, that's just land folks can't necessarily use. It's a perfect place for solar. It's something that we believe is going to keep growing. Given the number of landfills out there in the U.S., developers are focusing on that. They're growing, and we're growing with them. We're big believers in the landfill space."

Kelly Pickerel is editor of *Solar Builder*.
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ARE SOLAR TRACKERS RIGHT FOR YOUR NEXT PROJECT?

Tracking systems are simpler and more efficient than ever.

By Jay Johnson

The utility-scale solar market is one of the largest areas of opportunity in North America, underscored by the fact that it more than doubled in size between 2012 and 2013 alone. With analysts projecting this growth trajectory to continue through at least 2016, the sector continues to draw the attention of investors. At the same time, the costs and capabilities of balance of system (BOS) components continue to improve, providing developers and installers with an expanded arsenal to help stakeholders get immediate and long-lasting returns from their solar assets.

One structural BOS component growing in popularity is solar trackers, which are motorized structures that orient photovoltaic (PV) panels toward the sun throughout the day to maximize the capture of sunlight. When properly utilized, trackers have been shown to significantly boost the production of utility-scale PV plants and accelerate ROI for system owners.

Let's take a look at the potential benefits of horizontal, single-axis solar trackers (the most commonly implemented tracker design) and examine the considerations installers face throughout the tracker selection and construction processes.

WHY SOLAR TRACKERS?

Solar trackers enable large-scale PV installations to better capture solar irradiance as the sun moves across the sky. Output gains will vary, depending on both project site and tracker technology, with higher-performing models achieving as much as a 25-percent performance increase.

Furthermore, utilities across the United States are increasingly implementing time-of-use (TOU) rate structures, where electricity prices rise during periods of peak demand — typically in the late afternoon hours. As we can see from Figure 1 (a case study from a PV system located in Chowchilla, Calif.) on the next page, the tracker-equipped project will capture increased sunlight during peak use hours, corresponding to stronger rates of return. Additionally, as electricity rates increase and TOU rates land in project financing contracts, the monetary benefits of trackers are only getting stronger.

When irradiance is important and/or in combination with a power purchase agreement (PPA), trackers are usually a no-brainer solution.

WHAT MAKES A QUALITY TRACKER?

Much like any PV system component, different tracker products will offer a variety of features and benefits. Installers should be prepared to do their homework to find a tracker that offers the ideal combination of affordability, performance and reliability. Poor tracker selection can be a major pain point for installers — low-quality products can lead to time-intensive work and cut into profits.

A key indicator of tracker bankability will come from third-party validation. Certification bodies like the Underwriters Laboratories (UL) and the International Organization for Standardization (ISO) regularly perform a number of tests related to product safety, performance and durability in extreme environments. The highest quality trackers will meet or exceed evaluation criteria in areas ranging from accelerated aging to wind resistance and will be fully compli-

ant with safety-focused manufacturing codes. UL recently launched its 3703 certification standards specifically for the tracker market.

Strong product warranties also speak volumes to a tracker provider's commitment to its customers. If a PV system is expected to return dividends for a minimum of 25 years, its trackers should be held to those same standards of longevity.

SYSTEM DESIGN AND INSTALLATION

It should come as no surprise that numerous factors must be taken into account when designing a tracker-equipped PV system. As with any ground-mount project, site assessment begins with an evaluation of land size, cost, topography and weather patterns. When adding trackers to the mix, additional considerations include potential gains in energy capture, levelized cost of energy (LCOE) and projected payback time. An essential design aspect is ground cover ratio (GCR), which is the ratio between the PV modules' area and the total ground area. An increase in GCR corresponds to a linear negative impact to system output. This is because the higher the GCR, the smaller the distance between the tables, thus increasing panel-on-panel shading. Unlike fixed-tilt systems, trackers with integrated backtracking program can position tables to avoid shading the adjacent panels.

In terms of installation, advanced trackers are far less cumbersome and complex than their predecessors. Today's system integrators can benefit from trackers based on modular designs to significantly decrease the amount of time, tools and manpower required at a jobsite.

CASE STUDY

With a smart tracker system design in place, PV plant developers

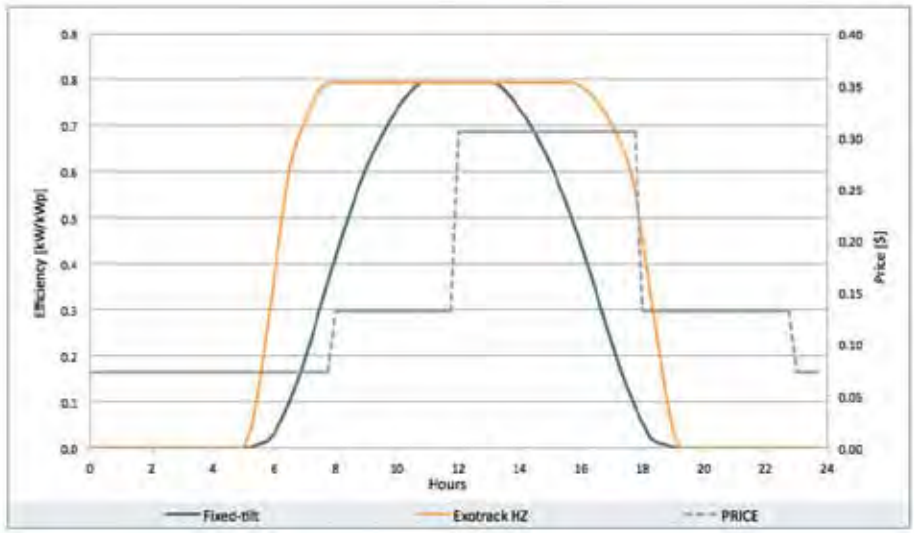

FIGURE 1 Energy yields during average June day in comparison to TOU prices.

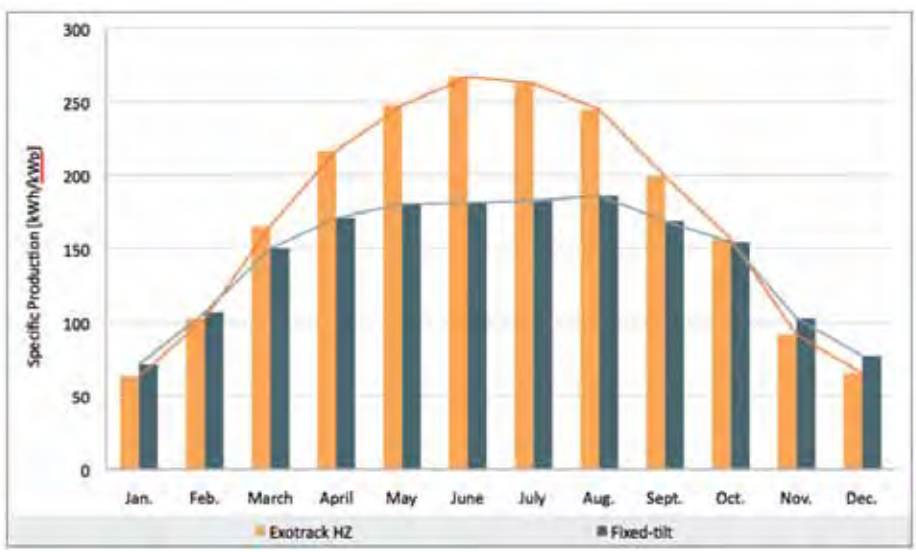

FIGURE 2 Yield increases 20.16% with trackers.

and investors can immediately see financial benefits. Figure 2 is an example of the annual performance of the PV plant in Chowchilla, with and without tracker technology. While fixed-tilt systems might offer a minor performance advantage in the winter months, tracker-equipped plants will achieve significant gains throughout the summer, in this case yielding an average production increase of 20.16 percent.

As we can see here, the increased output offered during summer months will more than offset production loss during the winter.

Solar tracker technologies have come a long way in recent years. Today's solutions offer the simplicity and reliability PV plant stakeholders need, at the price points they want. With the right tracker technology — accompanied by an optimized plant and smart tracker implementation — installers can offer their customers a safe, long-term solar investment opportunity.

Jay Johnson is vice president of business development for Exosun Inc., a developer and supplier of solar tracking systems, including the Exotrack HZ.

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BREAKING GROUND

A major first for South Carolina turns to trusted names for support.

By **Kelly Pickerel**

South Carolina is in the heart of solar country. Its neighbor North Carolina is ranked 10th in the nation for solar jobs (3,100 total) and can power nearly 40,000 homes with solar energy. Georgia to the west has 146 solar companies. In the south, Florida (you know, the Sunshine State) powers more than 20,000 homes with installed solar power.

So why then does South Carolina rank 29th for solar jobs (1,000 total), can only power 400 homes with solar and has a measly 33 solar companies? Some blame the state's strong support of nuclear power. In fact, South Carolina's V.C. Summer Nuclear Station is in the midst of a multibillion-dollar expansion, receiving new reactors (two of only four new nuclear reactors being built in the United States in 30 years). Nuclear power supplied more than 57 percent of the state's electricity generation in 2013 (according to the U.S. Energy Information Administration), so solar isn't especially attractive right now.

But big players are starting to make that change in South Carolina. This January, a revolutionary solar project was commissioned in Walterboro. Santee Cooper, the state-owned electric utility, built a 3-MW solar farm on an old cotton field as a test bed for understanding how solar fits in with the grid and how to go about building more. Schletter and Array Technologies Inc. were the lucky manufacturers chosen to jump-start South Carolina's solar construction.

COLLETON SOLAR FARM

is unique not only for being the first utility-scale solar farm in the state, but it was also built in nine weeks — astounding in itself even for an experienced group of solar installers. Alder Energy Systems, based in Charleston, S.C., won the bid to develop the 3-MW solar farm, installing 1.8 MW with Schletter's FS System and 1.2 MW with Array Technologies' DuraTrack HZ single-axis tracker. Donald Zimmerman, principal/owner of Alder Energy Systems, says commercial operation began on Dec. 20, 2013, 67 days after initial construction.

"There were a number of Doubting Thomases that didn't believe we could get it done," he says. "Contracts weren't even signed until the first week of October. It took a lot of trust of all the participants that we were going to get this done. We didn't have time to validate, double check, wait for the ink to dry. That [trust] was one of the reasons we were able to get it done."

The project had to be completed quickly to ensure all appropriate tax breaks were used.

"We had to get it done by the end of the year because bonus depreciation was going away," Zimmerman says. "The economics of the project really required that tax credit."

Zimmerman says the project was able to be completed quickly because there was a well thought-out and well-planned design from the get-go. Alder Energy had procured all major equipment prior to winning the RFP from TIG Sun Energy, a subsidiary of Intertech Group, so there wasn't an equipment hold-up to get things started. Having a good group of South Carolina-based contractors — those from Alder Energy, Gregory Electric and Sunstore Solar — helped things move smoothly, especially when installing both a fixed-rack and tracking system.

"We only had something like three-and-a-half weeks between order and driving our first pile for the fixed system," Zimmerman says. "The Array Technologies tracker was another week or two behind that. [The installation schedule] was all based on availability of equipment and materials."

SINCE SANTE COOPER

was taking a chance on this project in a state where solar is in its infancy, the utility chose to do a mix of

Photos courtesy Santee Cooper and Alder Energy Systems

fixed and tracking for research purposes.

"This was originally set up with Sante Cooper to provide insight into what solar will do to their network and how to best plan for putting more solar into their network," Zimmerman says. "They looked at it as a research tool. We have 455 string monitors, all five inverters are identical, they're strung identically, they're all the same panels. Everything is identical except the racking systems — 40 percent is tracking, 60 percent is fixed."

Alder Energy chose to work with Schletter, Array Technologies, SMA America inverters and Canadian Solar modules because, as Zimmerman says, they're the best of the best.

"We decided essentially right from the get-go on this project to use only Tier 1 manufacturers, guys that were leaders in the industry," he says. "Being it was our first one, it was the proven chosen to make. Let's face it, there's a reason they're leaders in the industry."

Kyle Petty, senior account manager with Schletter, says it was extremely gratifying to be considered the best for this project when the market is full of quality products. He hopes to work with Alder Energy and in South Carolina in the future.

"This project was an excellent step for solar in the state of South Carolina," Petty says. "I am already hearing rumors of similar size projects in the works. With individuals like Don pushing for more solar in the state, I am expecting to see more and more action as the years progress."

Zimmerman says he likes how Schletter handles everything and makes sure the project is the best it can be.

"They sent out a soils crew with a couple test piles. They drove them in, they pulled on them and yanked on them and got all the appropriate engineering parameters necessary to provide a fully-engineered system for that site," he says. "It was essentially one phone call, one responsible party for that whole process. That was really a key selling point. If I get these guys on the job, I know they'll get the job done, and they'll get it done right. I don't have to coordinate my soils guy with my structural engineer. It can all be done under one umbrella."

Array Technologies equally impressed Zimmerman, sending a field representative in the first couple days of construction to walk the crew through the installation process.

"This was the first time Gregory Electric and Alder Energy worked with our DuraTrack HZ single-axis tracker, but they put such a great team together and were such exceptional planners that they basically had it all figured out during the early stages of the tracker installation," says Edgar Pedrego, project manager with Array Technologies Inc.

"It is important to us that the hard work Array Technologies Inc. has put in over the years is validated by solar industry leaders that choose our product due to its reputation for reliability, longevity, ease of installation and the high level of customer support that comes with it."

Mostly, the project went off without a hitch. The weather was great and everything got done in record time. The only hiccup was working with the old cotton farm's loose soil conditions.

"The first 2 ft of soil was so loose it didn't have any holding power," Zimmerman says. "We ended up going with 12 ft of pile embedment which is a lot deeper than most people. We did have problems securing a pile driver with enough length/height in order to drive these piles. We didn't really have a good backup to the pile driver."

OVERALL, EVERYONE — including Sante Cooper — was impressed with the project.

"We had tremendous compliments," Zimmerman says. "When the SMA tech came out to commission the inverters, he told us a little story: 'Going out to South Carolina and these guys have never done one of these before, so expect a bunch of yahoos.' But when he got here, he said this was one of the easiest commissionings he's done. There were no problems. Everything was just right. He was very impressed.

"I felt good about that," he continues. "It was our first one, and the experts said us yahoos did OK."

Hopefully it's a sign of good things to come. Sante Cooper plans to be very open about the research availability of the farm. All the collected data from the Colleton solar farm will be made available to all public utility companies. Another local utility, South Carolina Electric & Gas (SCE&G), has already made plans for a 2-MW solar farm at the Lake Murray dam outside of Columbia.

"Surrounding states are really hot with solar right now, and there is no reason why South Carolina can't catch up. The sun is not going anywhere," Pedrego says. "Once everyone is on board — meaning regulatory committees, utilities, etc. — the solar market will grow naturally on its own."

"In the state, power companies are beginning to embrace solar. I see more [projects] coming," Zimmerman says. "It's a sign of great things to come in South Carolina, and it's great to be a big part of it."

Kelly Pickerel is editor of *Solar Builder*.

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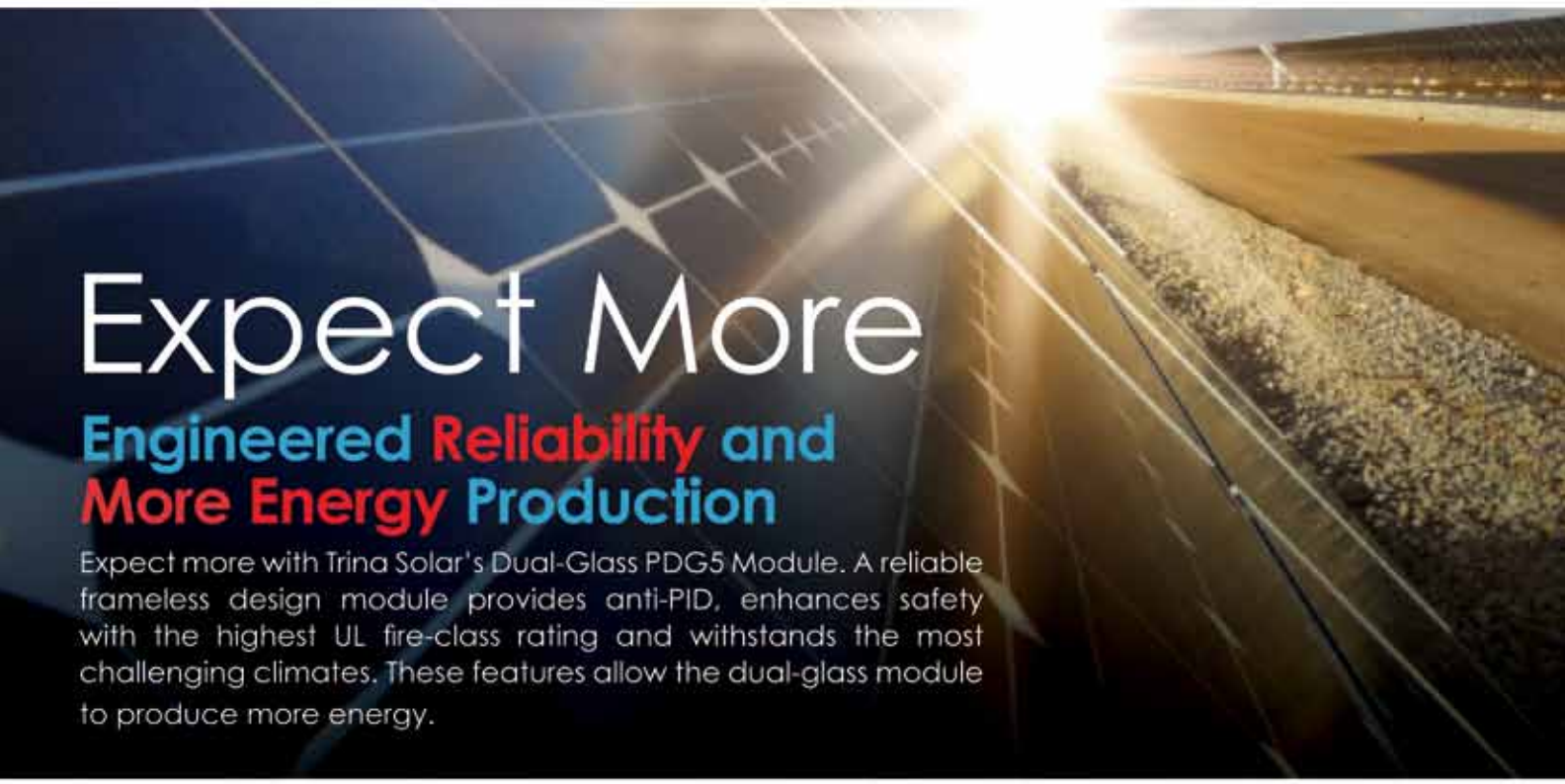

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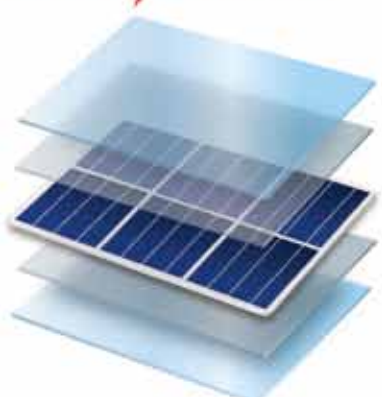

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Q&A FRAMELESS MODULES AND HOW TO MOUNT THEM

Frameless modules are becoming more than just an aesthetics-pleaser on residential roofs. There are many benefits to them — better fire protection, better moisture barrier, no grounding needed — but there are also many installation aspects that take some getting used to. How are they mounted? What about wire management? What are the extra costs? *Solar Builder* hopes this crash course helps answer some of the basics.

JING TIAN, PRODUCT MANAGER AT TRINA SOLAR

Trina Solar manufactures the PDG5, a 60-cell dual glass module. It comes in at around 255 W, has a 15.2% module efficiency and is UL certified. Trina offers a 30-year warranty on the product.

WHAT IS A DUAL GLASS/FRAMELESS MODULE?

A traditional module is a silicon sandwich. There's glass with a silicon cell in middle, and the backsheet is typically polymeric with a frame around to ensure the mechanical integrity of the product.

With a dual glass module, we replaced the backsheet with another sheet of glass, so it's a glass sandwich without a frame. The cells are encapsulated in glass.

WHAT ARE THE ADVANTAGES OF A FRAMELESS MODULE?

Glass is much less flammable than polymeric materials. From a fire safety perspective, that's why we passed as a Class A fire-rated module. One of the common concerns with a silicon module is a microcrack. Having a glass panel, front and back, gives better mechanical protection during transportation and installation. There's also no grounding for the frame because there is no metal for the modules.

WHAT TYPE OF CUSTOMER WANTS A FRAMELESS MODULE?

These modules target any customer. There's an industry adoption curve for people to get used to dealing with a dual glass panel [like] handling of the module, the installation process. What really appeals right now to early adopters is aesthetics, fire safety and high wind load. Because there's better mechanical integrity, it provides better resistance to wind loads.

ARE SPECIAL PARTS NEEDED TO INSTALL FRAMELESS MODULES?

Trina developed our own clamps that mate with most commercial rails. For ground-mounting, [we're] continuing with a C-clamp-type of solution. But we have been working with mechanical BOS companies, from ground-mount to roof-mount, to work with their existing solutions to work with our modules. We're working with partners to make it easier for installation.

JOHN WILLIAMSON, ENGINEERING MANAGER FOR ARRAY TECHNOLOGIES INC.

Array Technologies Inc. (ATI) manufactures fixed-mounting and tracking systems. The company recently developed a new design for both its DuraTrack HZ tracker and DuraRack fixed rack to accommodate frameless modules.

DID ARRAY NEED TO REDESIGN ITS SYSTEMS FOR FRAMELESS MODULES?

Array designed a custom tracker structure, including a brand-new racking system designed especially for frameless modules. The racking system was extremely rigid to prevent module damage. However, it included a well-thought out assembly system that allowed rapid deployment and installation on-site and minimized materials as much as possible using custom-designed rails and clips to keep structural costs down, and assembly tools to reduce installation time on-site.

HOW DOES SECURING FRAMELESS MODULES DIFFER FROM TRADITIONAL MODULES?

Though the backbone of the tracker structure remains the same, ATI uses a completely different system for racking both kinds of modules. Framed modules don't require special supports and custom designed clips for attachment to a structure. Frameless modules require special clips to support them at specific locations. To install these at the lowest possible price point, custom racks must be designed for the individual frameless module to support them properly.

CAN INSTALLERS ADAPT TO INSTALLING FRAMELESS MODULES PRETTY QUICKLY?

Workers can be trained in less than a day on how to properly install frameless modules. There are different instructions and tools needed. We have full documentation that we provide our customers for install, as well as an excellent project management team who will train customers on best practices and installation techniques.

WHY INCORPORATE FRAMELESS MODULES INTO YOUR SYSTEMS?

We incorporated frameless modules due to the demand of our customers. As a leading ground-mount solutions provider, it is our policy to work with customers to find the most effective configuration of our tracker to bring lowest LCOE, fastest installation and the most reliable product possible. If that requires designing new racking systems or other subcomponents for large projects, we will happily take on the engineering challenge.

WHAT IS YOUR OUTLOOK ON FRAMELESS MODULES IN THE INDUSTRY?

Frameless modules are becoming somewhat popular because they are cheaper than framed modules by themselves. However, removing the frames requires the racking company to support the frames in special ways with more expense, often requiring special clips that are expensive to manufacture and install. I think in certain cases projects can be less expensive than framed modules, but it often requires a development partnership between the module company and racking company to get there. If cost simply shifts from the modules to the racking, it doesn't save the customer any money and can slow down a typical project.

10 TIPS

FOR INSTALLING FLASHED SOLAR ROOF-MOUNTS

By **Jeff Spies**, senior director of business development for Quick Mount PV

1. LOCATING RAFTERS

Rafter-finding techniques include attic rafter mapping, rubber mallet roof tapping, drilling two to three holes through the sheathing to locate the edge of the rafter or using sophisticated stud finders like the Bosch D-tect 150.

2. CENTERING ATTACHMENT POINT

Take care to center your lag bolt in the middle-third of the rafter. This ensures the fastener has the structural capacities listed by the American Wood Council charts.

3. PILOTING HOLES

Drilling pilot holes is critically important when using 5/16- or 3/8-in. lag bolts in a 2x rafter. This is true even with the newer generation of self-drilling fasteners (like those from GRK). While these specialty fasteners can be installed in wider lumber without pilot holes, failure to drill pilot holes in the outer chord of 2x4 or 2x6 rafters will likely result in split rafters.

4. REMOVE SHINGLE NAILS

Always remove the nails on composite shingles to allow the upper edge of flashing to be 1/2-in. above the butt edge of the third course shingles. Failure to remove nails will prevent the flashing from being positioned up under the butt edge of the third course of shingles and thus become a leak risk, especially when the flashing is positioned under a butt joint between two adjacent sections of shingles.

Failure to remove nails is the most frequent mistake when installing flashing. Removing nails allows the flashing to extend up under the third course of shingles for code-compliant, reliable waterproofing.

5. ACCEPTABLE WORKING TEMPERATURE

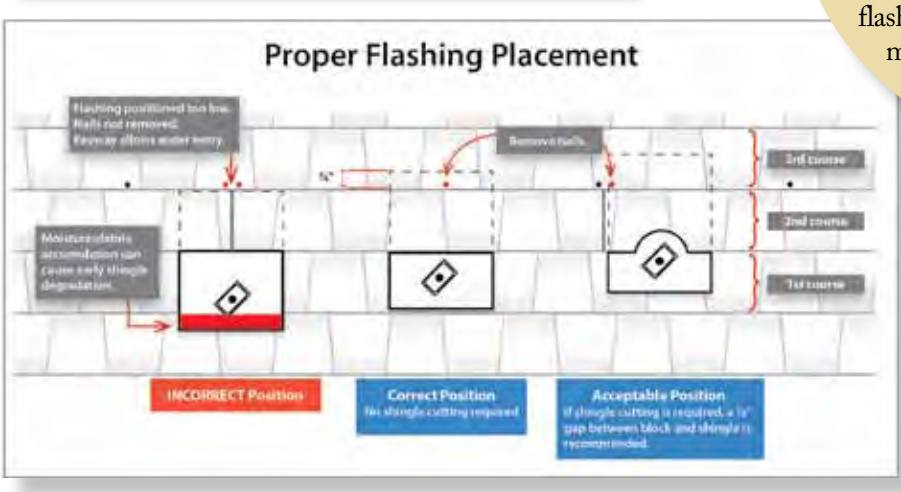
Shingle temperatures should be between 45° and 85° F to avoid damaging the shingles. When installing on asphalt shingles above 85° F, care must be taken to avoid compression deflection of the flashing from over-torquing the lag bolt. Special roofing shoes or protective mats can be used to minimize the risk of bruising on warm or cold days.

7. FLASHING MATERIAL

Flashings should be made from an NRCA-compliant metal (aluminum, stainless steel, lead or galvanized steel). The TRI requires curved tile flashing be made from malleable metal. SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) considers galvanized steel to be suitable only for 15 years of service life, and any breach of the zinc coating will cause corrosion and rust staining. For this reason, galvanized is inadvisable in coastal and industrial environments as well as any installation with more than 15 years of expected life.

6. FLASHING WIDTH

Asphalt shingle flashings should be at least 9 in. wide to comply with roofing industry best practices. This assures at least 4 in. of coverage from the edge of the hole to the edge of the flashing. More width provides additional protection from wind-driven rain making 12-in. wide flashing very popular. Tile flashings typically are 18 in. or wider to meet Tile Roofing Institute (TRI) guidelines.



This diagram shows the acceptable position for flashed roof-mounts. Most mounts will require at least one nail be removed.

8. SEAL DESIGN MATTERS

Select flashed mounts with a robust seal. Seals that are elevated above the waterline will provide longer life than seals at the waterline, especially in freezing climates. Please note that sealant is a helpful addition to a properly installed flashing; however, when used alone, sealant is not an alternative to metal flashing required by building codes.

This flashed Quick Hook uses a three-course sealing system that is approved by the TRI guidelines. Mastic applied to fiber mesh provides long-term waterproofing of the top and sides of the base flashing to the rolled roof underlayment.

9. INSTALL BASE FLASHING ON ALL TILE ROOF MOUNTS

This frequently disregarded code requirement will cause premature leaks on tile roof installations within five to 10 years. All major tile manufacturers abide by TRI's guidelines which mandate flashing at both tile and underlayment levels. All tile standoffs need a "base flashing" that is bibbed or three-coursed to the underlayment. Then the "tile-level flashing" is installed either on top or just below the tile. Tile hooks also require base flashing, but tile-level flashing is not required since the tile is not penetrated.

The Tile Roofing Institute guidelines require a base flashing be used at the underlayment level. The TRI guidelines are code-required for most tile roofs. Underlayment bibbing is one of two accepted methods for waterproofing the base flashing.

10. THE BENEFITS OF RE-ROOFING UNDER THE ARRAY BEFORE SOLAR INSTALLATION

Most arrays are installed on roofs with less than 10 years of remaining life. It is strongly advised that the installer replace the shingles or tile underlayment under the field of the array before installing solar. Replacing the roof under an average-sized array prior to PV installation will add $1,000 to $1,500 to the initial installation cost. Homeowners who ignore this advice will pay an additional $3,000 to $5,000 to remove and reinstall an average-sized system for the inevitable roof replacement. Simply stated, unless your roof is relatively new, re-roofing prior to PV installation is the most effective strategy to getting the best financial performance from a solar investment.

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Which title group best describes your primary job title? (choose only one)

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B ☐ Manager, General Manager, Project Manager, Coordinator, Administrator, Treasurer, Financial Manager
C ☐ Superintendent, Supervisor, Foreman, Inspector
D ☐ System Designer/Engineer
E ☐ System Integrator/Installer
F ☐ Estimator, Consultant
G ☐ Architect/Builder
H ☐ Operator, Field Personnel, Technician
I ☐ Other; Specify _____

What markets do you serve?
(check all that apply)

A ☐ Residential
B ☐ Industrial/Commercial
C ☐ Utility
D ☐ Other; Specify _____

Define your level of purchasing authority
(choose only one)

A ☐ Purchase products/services
B ☐ Authorize the purchase of products/services
C ☐ Specify products/services for purchase
D ☐ Recommend products/services for purchase
E ☐ All of the above
F ☐ None of the above

What is your company's anticipated annual renewable power construction related revenue or expenditures?
(choose only one)

A ☐ More than $50 million
B ☐ $25,000,001 - $50 million
C ☐ $10,000,001 - $25 million
D ☐ $5,000,001 - $10 million
E ☐ $1,000,001 - $5 million
F ☐ $500,001 - $1 million
G ☐ $250,000 - $500,000
H ☐ Less than $250,000

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- **BUSINESS GROWTH AND MARKETING** – Discover tools and trends to improve residential and commercial solar development, social media, and innovative marketing for your business.
- **FINANCE AND DEVELOPMENT** – Access information and solutions for securitization success, community solar, distributed generation, and energy storage.

Schedule-at-a-Glance

MONDAY, JUNE 23

8:00 a.m. – 3:30 p.m.	Seminars and Workshops*
4:00 p.m. – 5:00 p.m.	General Session
5:00 p.m. – 7:00 p.m.	Show Floor Opening and Happy Hour

TUESDAY, JUNE 24

9:00 a.m. – 5:00 p.m.	Educational Sessions
10:00 a.m. – 6:00 p.m.	Exhibit Hall Open
12:00 p.m. – 1:30 p.m.	Networking Lunch
4:30 p.m. – 5:30 p.m.	Poster Reception
5:30 p.m. – 6:30 p.m.	Networking Reception

WEDNESDAY, JUNE 25

9:00 a.m. – 3:00 p.m.	Educational Sessions
10:00 a.m. – 4:00 p.m.	Exhibit Hall Open
11:45 a.m. – 1:00 p.m.	Networking Lunch

Preliminary schedule is subject to change. All events are located at Boston Convention and Exhibition Center unless otherwise specified.

Full session descriptions and details:
www.pvamericaexpo.com/conference-program/

**Separate registration required.*

WHO'S EXHIBITING AT PVA

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Advanced Racking Solutions metal roof mounting systems

Advanced Racking Solutions Inc. designs and delivers innovative mounting systems for all types of metal roofs. The VICERACK clamped, non-penetrating system attaches to the standing seam on metal roofs and was developed in conjunction with engineers at S-5!. The VICERAIL system for screwed-down metal roofs attaches to the purlin with proper weather sealing. All Advanced Racking Solutions mounting systems are wind tunnel tested. Proprietary system design will not increase wind loading on the building.

VICERACK and VICERAIL can be installed on the north pitch offering greater roof coverage and reduced roof loading — less than 2 psf. Aisles and walkways create access to all modules in the array. Available in a variety of tilts with site-specific layouts provided for each project, including landscape or portrait module orientation. *advancedracking.com*

AET RAYPORT ECO solar mounting solutions

Designed for cost-driven projects, AET's all new RAYPORT ECO solar mounting solutions include all the features installers look for in a cost-competitive package: industry-leading installation, high shipping density (lower freight bill), compatible with all panels, layout/loading analysis included, galvanized for corrosion resistance, lightweight for easy handling on the jobsite and turnkey installation services.

Save time and money with AET's turnkey installation services available for all AET RAYPORT ECO solar mounting solutions. From the initial phases of design and engineering to manufacturing and installation, AET's turnkey installation services offer a single point of contact for solar projects. *AETenergy.com*

AP Alternatives

AP Alternatives' core focus is providing the highest quality solar racking and installation services for commercial and utility scale systems. AP's modular solar racking is manufactured and assembled in a quality controlled environment ensuring each system meets strict quality standards. The pre-assembled and prepanelized racking allows for rapid installation times and reduced on-site labor. With more than 25 years of manufacturing knowledge and a proven track record of successful installations, simply send AP Alternatives your modules and let the experts do the rest. *apalternatives.com*

Array Technologies DuraRack

A perfect blend of industry leading technology and cost-saving elements, Array Technologies Inc.'s DuraRack fixed-tilt mounting system has proven itself as the premiere fixed-tilt system of the future. Several of DuraRack's leading product features include the lowest number of posts per module, an all-bolted coupler solution that eliminates the need for field welding, customizable tilt angles between 10° and 40°, the industry's fastest install rates and availability in portrait or landscape module configurations. With more than 53 MW installed at five different sites in just less than six months, DuraRack is ramping up to become a leading solution for fixed-tilt ground-mount sites across the solar industry. *Photo credit: AMEC, arraytechinc.com*

PRODUCT SHOWCASE

Daetwyler Clean Energy

With Daetwyler Clean Energy's (DCE) experienced engineering and global fabrication facilities, the premier solar racking hardware manufacturer provides economical solar racking hardware direct to installers and project developers for small- to utility-scale installations. Each of DCE's solar solutions is designed specifically to achieve maximum output while optimizing economics. The Eco-Top and Secure-Top rooftop mounting systems feature modular designs with minimal parts which makes system design and installation fast and easy. The Modu-Rack ground-mount systems are available in several configurations to address any soil condition. The Modu-Rack SA is DCE's single point anchoring system, and the Modu-Rack DB is a driven beam system. And, the Cap-Rack systems are designed to address conditions encountered with landfill sites. *daetwylerce.com*

DPW Solar Power Rail pre-assembled module clamps

DPW Solar expands the Power Rail family with the addition of pre-assembled PV module clamps. Designed with the solar installer in mind, the new clamps feature the patented RAD lock-in-place fastener and require no additional field assembly. Simply twist the clamp assembly into any Power Rail channel and slide up the PV module. No loose parts and quick quarter-turn insertion reduce overall assembly times and lower costs on projects. Available with a factory-assembled integrated ground disk, the clamps also feature stainless steel construction for higher strength and reliability in harsh environments. Pre-assembled clamps are now available for mid- and end-clamping of most framed PV solar modules. *dpwsolar.com*

Eaton B-Line mounting systems

Eaton's B-Line business offers a market-leading Fixed Tilt Ground Mount and Ballasted Flat Roof racking systems for commercial and utility-scale solar projects. The Ground Mount system is configured to match each project site, featuring pre-assembled components, optimized adjustment process and an innovative module mounting process. The result is a simple, fast and structurally reliable solution. The ARISTA rooftop racking system couples a simple, pre-assembled product with an elevated racking system, helping improve system performance while allowing better access to the roof. The solar team from Eaton's B-Line business is available to provide assistance for all solar projects from the design stage to on-site training and support. *cooperindustries.com*

EcoFasten GreenFasten

EcoFasten Solar was founded by a former roofer with decades of experience to bridge the gap between the people who design solar arrays and the people who install them. Utilizing a patented watertight bushing and backed by IAPMO Certification, the GreenFasten solar roof-mount system is the strongest, most straightforward solar attachment point in the industry. Compatible with a variety of EcoFasten Solar compression brackets, GreenFasten delivers a mounting solution for virtually all new or existing composition shingle roofs. Utilizing lag bolts to secure this system to a roof means durability you can trust. All EcoFasten products are made with pride in Vermont using recycled materials. *ecofastensolar.com*

Ecolibrium Solar EcoFoot2+

The EcoFoot2+ is engineered to yield all the benefits of the EcoFoot2, plus the added benefit of a universal pre-assembled clamp, a lower part count and innovations that reduce the heat buildup on the racking system. There are only four parts: base, deflector, high tower clamp assembly and low tower clamp assembly. The reduced part count plus pre-assembled clamps increase install speed and lowers the end cost. Additionally, the new clamping mechanism improves module compatibility, spacing flexibility and reduces attachment requirements. Ecolibrium Solar continues to seek the equilibrium between what is economically competitive, ecologically conscious and where innovation can be used to insure integrity. *ecolibriumsolar.com*

GameChange Racking Pour-in-Place Ballasted Ground System

This innovative new ground system from GameChange Racking utilizes self-leveling technology which substantially reduces install time. The Pour-in-Place forms are placed and supported, the concrete is poured and panels are mounted. Ballast/concrete is added only after leveling is completed. This makes installation much faster than precast systems since it is easier to adjust light systems than heavy ones.

The simplicity of the process ensures Pour-in-Place can be installed 68% quicker than any precast system. The large ballast footprint reduces landfill cap loading. It's available in both one- and two-panels-up portrait and comes with an integrated tray for easy wire management. Pour-in-Place is wind tunnel tested, rated for 120 mph wind speed and meets IBC and ASME standards for structural loading. *gamechangeracking.com*

Hollaender Speed-Rail fittings

Hollaender offers Speed-Rail fittings designed specifically for installation of solar racking systems in areas that experience extreme wind. New fittings include a tee and elbow for use with 2-in. IPS pipe. On a Speed-Rail fitting, the component that produces pipe holding power is a single integrated proprietary internal/external reverse-knurl cup-point set screw that securely attaches the fittings to the pipe and provides tremendous resistance to loosening and pullout. The new fittings are designed with two set screws, producing a substantial increase in pullout resistance. Testing on the 2-in. IPS fitting shows the addition of the second set screw increases pullout capacity from 3,900 to 8,200 lbs on galvanized pipe, an increase of 110%. *solar.hollaender.com*

IronRidge Roof Mount

IronRidge Roof Mount is a rail-based solar mounting system for residential and commercial rooftops. The unique curved profile of the XRS Rail enables it to achieve a 12-ft span between attachments. This reduces the number of roof penetrations and attachment points per installation, reducing cost and liability. Additionally, IronRidge Roof Mount is certified for Integrated Grounding (UL 2703). The Grounding Mid Clamps bond solar modules directly to the rails, eliminating the need for separate module grounding hardware.

Base installation is also simplified by IronRidge FlashFoot, an all-in-one roof attachment for shingle roofs. FlashFoot integrates a standoff, flashing and L-foot into a single assembly, reducing base installation procedures by up to 40%. *ironridge.com*

KB Racking EkonoRack 2.0

The KB Racking product development team has taken the intuitive design of EkonoRack and redefined it to meet customer demands. The affordable, flat roof mounting system now features pre-assembled roof protection mats, 20% less aluminum and a sleeker design. The ETL-certified system consists of three major components and has been praised for its simplicity by installers across the United States and Canada. With EkonoRack 2.0, rapid installation and long-lasting durability are now available at a lower price and in more locations. *kbracking.com*

Legrand Cablofil FAS Rack

The Cablofil FAS Rack PV mounting system from Legrand is a line of supports for ground-mounted PV arrays. The FAS Rack system is designed for fast installation with minimal on-site labor requirements. Prefabricated components eliminate time-consuming and expensive "stick built" installations. The system has been engineered to be installed by two-person crews without special tools or large equipment. Designed to ASCE 705 requirements, FAS Rack is engineered and tested to withstand extreme wind and snow loads. Array tables are joined by a slotted splice that allows for thermal expansion and contraction. This feature maintains the system's UL 2703 rating and eliminates the need to run bonding jumpers or ground each individual table. *legrand.us*

Mounting Systems Inc. Alpha+ and Tau+ on-roof systems

Alpha+ and Tau+ are new pitched roof racking systems that employ Mounting Systems' all-new Clickstone technology. The Clickstone works on a simple principle: Click into the rail, position, tighten, done. Alpha+ can be mounted on various pitched surfaces while Tau+ is specifically for trapezoidal sheet metal roofs. The Clickstone's symmetrical design lets the installer insert the Clickstone into the rail more easily, adjust it more accurately and secure it more quickly. This and new economical rails result in exceptionally fast assembly and easy system installation. Newly designed planning software (Quick Configurator) also speeds project planning and permitting. *mounting-systems.us*

PV Racking Power Carport

The PV Racking Power Carport is a 60-panel solar carport designed to provide coverage for four vehicles. The three-post carport is engineered to withstand 130 mph wind loads and 35 psf ground snow loads. The bolt-together design makes on-site installation very simple; no welding required. The carport will come equipped with PV Racking slide-in rails, making module installation much quicker than standard clamp based systems. Complete kits are available with modules and inverters. Carport and racking installation services available in the mid-Atlantic region. *pvracking.us*

Quick Mount PV E-Mount

E-Mount uses the patented QBlock Elevated Water Seal technology to provide superior waterproofing on composition/asphalt shingle roofs. Priced at a modest premium over commodity roof-mounts, E-Mount makes it possible to deliver Quick Mount PV quality even on price-sensitive jobs. All stainless steel hardware included for fast, single bolt installation. E-Mount comes with a 10-year limited product warranty. *quickmountpv.com*

Quickscrews Stone Coat Steel Roof-Mounting Series

Quickscrews International now has five different hooks developed for the Stone Coat Steel style of metal roofs. These products have become the No. 1 style for mounting on metal roofs that have the appearance of tile. The parts are mounted under the steel sheet and slip through the overlap, leaving a sturdy mounting base for a wide range of racking systems. The two newest hooks are able to cover wider areas in cases that require it. Quickscrews also added an adjustment capability to compensate for surprises that cannot be seen until the metal sheets are removed. *quickscrews.com*

RBI Solar Carport Solutions

RBI Solar has included a wide range of solar carport solutions to its product selection including single slope, double slope, inverted slope and full coverage designs. RBI Solar focuses on creating durable, functional and cost-effective custom solutions for each project. RBI Solar's capabilities also extend into the installation portion of projects. Multiple crews and a fleet of post-driving machines allow RBI Solar to meet the demands of shorter construction schedules. Leveraging more than eight decades of experience in the commercial design-build specialty structures market, RBI Solar works with clients to identify the most economical, low maintenance and robust solar mounting structures. RBI Solar mounting systems are highly engineered and backed by a 20-year product warranty. *rbisolar.com*

Renusol MS system

Renusol MS is a simple, compact and cost-effective pitched roof solution developed specifically for mounting PV modules to trapezoidal sheet metal roofs. Uniquely, the system attaches directly to the sheet metal, eliminating the need for long rails and attachments to purlins or rafters. Made of stainless steel and aluminum, it consists of a clamp base for quick installation, self-piercing and self-tapping screws with hardened tips that eliminate rooftop drilling and pre-assembled, adjustable mid- and end-clamps for securing the PV panel EPDM gaskets under all clamp bases. The system has been third-party tested for waterproof assurance. The Renusol MS system is compatible with all widely used sheet metal roofs 26-gauge or thicker with flat trapezoidal peaks at least 3/4-in. width. *renusolamerica.com*

PRODUCT SHOWCASE

Schletter Fix-EZ Ballasted Flat Roof System

Fast and easy to install, Schletter's Fix-EZ ballasted rooftop mounting system is now ETL-listed. The Fix-EZ allows for module tilt ranges from 5° to 15°, depending on the length and orientation of the system. The system is designed with multifunctional components and includes integrated ballast blocks, which act as ballast weight in addition to serving as the system's support mechanism. Module mounting rails support modules and perform as the system's windbreak with Schletter's ETL-listed Rapid2+ modules clamps for bonding/grounding the modules to the rails. The ETL-listed Fix-EZ is now available for flat roof projects in every state. *schletter.us*

S:FLEX LEICHTmount

S:FLEX Inc. provides a complete range of rooftop and ground-mount solar structures with in-house custom design expertise. LEICHTmount is a highly flexible flat roof low-ballast system. Designed for hassle-free installations, it can be installed as a non-penetrating system or as an anchored system with minimal strategic attachment points. The combination of variable row spacing, tilt angles between 0° and 35° and extendable base rails allow for individually customized projects. Arriving on site with pre-assembled parts guarantees a simple time-saving install. In addition, it is adjustable to conform to unforeseen design changes or unknown obstructions on the roof. The patented technology of LEICHTmount provides absolute stability by using precisely calculated weight distribution. *Photo credit: S:FLEX, sflex.com*

SolarDock

Invented in 2003, SolarDock was designed to meet the needs of commercial property owners and tenants for racking that would protect their building while providing a strong ROI. SolarDock is engineered to: Protect the roof — SolarDock makes no penetrations, even at high angles, and has no metal parts that touch the roof, eliminating the chance of roof leaks and damage; Protect the solar panels — SolarDock's full-frame support protects the panel from micro-fractures created by wind uplift forces while enclosed sides and back protect the wiring from damage caused by weather, animals and birds; and Protect the bottom line — SolarDock saves money throughout the life of the system, with reduced installation costs, little or no operations costs,and increased power generation. *solardock.com*

Solar FlexRack Tracker

The Solar FlexRack Tracker offers a distributive drive system allowing this single-axis tracker to be installed on sites not usually considered for conventional trackers. Solar FlexRack's design and flexibility creates maximum ground coverage ratio, accommodating two- or three-high landscape panel orientations. The Solar FlexRack Tracker has gone through extensive third-party testing and validation including wind tunnel testing, full bankability study and full life-cycle testing. The intelligent design allows for a quick and easy installation with no field welding or special equipment required. The SFR tracker's movements are provided by a maintenance-free actuator, and nylon bearings are also used that require no lubrication. *solarflexrack.com*

Sollega FastRack FR5°

Sollega's FastRack FR5° one-piece mounting system was recently installed on a multi-roof array of 820 kW at the Westin Hotel located on the Caribbean Island of St. Maarten. The FR5° utilizes HDPE plastic with UV inhibitor and coated fasteners for superior corrosion resistance. The arrays were ballasted and anchored utilizing Sollega's heat-weld solution to a fully adhered TPO roof requiring no holes to be drilled in the roof. *sollega.com*

SunLink Precision-Modular RMS

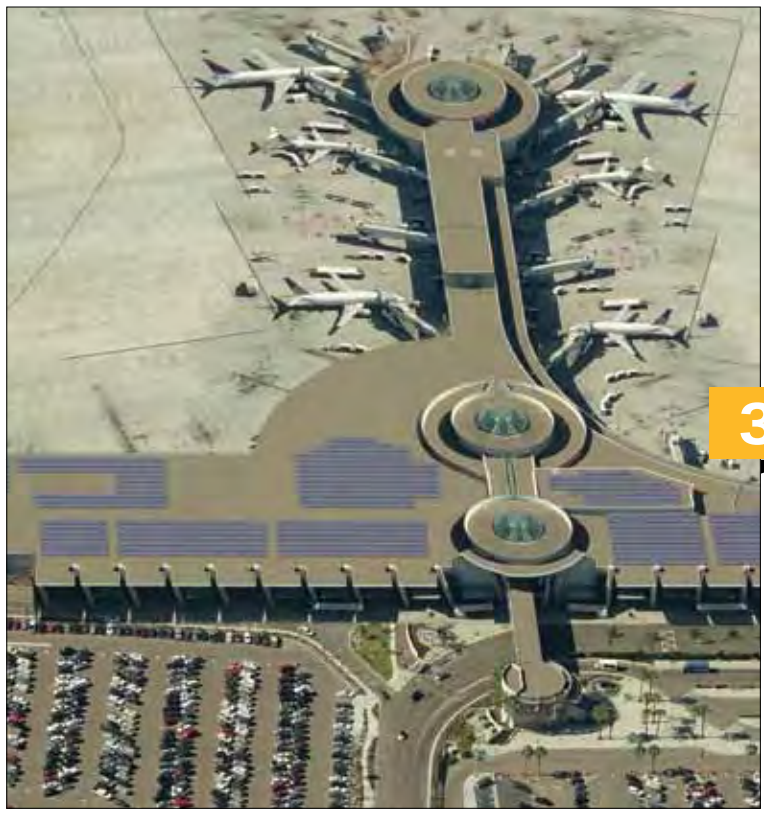
Precision-Modular RMS is the newest addition to SunLink's quality engineered Precision RMS roof-mount racking family. Precision-Modular RMS is constructed of aluminum and features roof-friendly rubber feet that prevent any metal from touching the roof surface. The system is also fully connected north/south and east/west to better distribute loads and does not rely on the module frame as a structural element. The system is assembled, laid out and installed module-by-module to maximize layout flexibility, dramatically reduce costs through standard inventory and facilitate last minute on-roof changes. The building block design is so lightweight and easy to install that it can be assembled by one person. Precision-Modular RMS is available for 60- and 72-cell modules and 5° and 10° tilt. *sunlink.com*

SunModo

SunModo Corp. was formed with the mission of driving down the total cost of solar systems through product innovation and system integration. Its patented flashing mount product has been used to install more than 10,000 solar projects. Moreover, SunModo continues to improve its existing products and develop new products. The new SunBeam system is one of those innovations with the following key features: robust, versatile and advanced engineering that's designed for multiple configurations; spanning over obstacles to take full advantage of roof space to maximum the system size, offering increased ROI; lightweight for structural loads, and strong for high costal winds; and made of all-aluminum to resist costal salt air corrosion. *sunmodo.com*

Zilla Store

The new Zilla Store is now open for business, making it easier for solar professionals to select and purchase Zilla products, reducing time delays on installations. The Zilla Store allows users to order the newest line of Zilla products including Zilla Flashings, Zilla Rac Pacs and other popular Zilla products. The new PVC Electrical Flashings is the newest iteration of the best-selling Zilla Electrical Flashing which is designed for a water-tight seal to protect solar installations' electrical components and the roofs on which they are installed. The new Zilla Rac Pac offers racking and attachment components for two modules included in one easy package. *zillarac.com*



1 In early April, Hanwha Q CELLS completed a 10.86-MW project at the Reilly Tar & Chemical Superfund site in Indianapolis, the first utility-scale solar project constructed on an active EPA Superfund site. The project uses Q CELLS Q.PRO L polycrystalline modules installed on Solar FlexRack mounting systems.

2 OnForce Solar installed a 402-kW rooftop solar power system for Price Master Corp. at its corporate office and warehouse distribution center in Queens, N.Y. The system was made possible through an award from NYSERDA as well as a property tax abatement from New York City.

3 Borrego Solar Systems Inc. will develop at 3.3-MW solar system with panels on the roof of the newly expanded Terminal 2 West at San Diego International Airport (SDIA) and in a section of the Terminal 2 short-term parking lot adjacent to the terminal. Borrego Solar will break ground on the project in mid-2014 with an expected completion date by the end of the year.

The system will generate an estimated 5.3 million kWh of electricity in its first year of operation — enough power to offset a projected 10 to 13 percent of the energy needs for Terminals 1 and 2 at SDIA. Borrego Solar will build and finance the system through a 20-year PPA, which will save the San Diego County Regional Airport Authority a projected $3 million to $8 million over the contract period.

This project at San Diego International Airport will mark Borrego Solar's third airport installation, following projects currently under construction at airport facilities in Massachusetts and New Jersey.

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