

North American Clean Energy

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2017 ENERGY STORAGE Buyers Guide

Solar Thermal

A hot commodity

It's Time to Talk About Virtual Net Demand

Using GIS Technology to Find Optimal Sites for Utility-Scale Solar Generation

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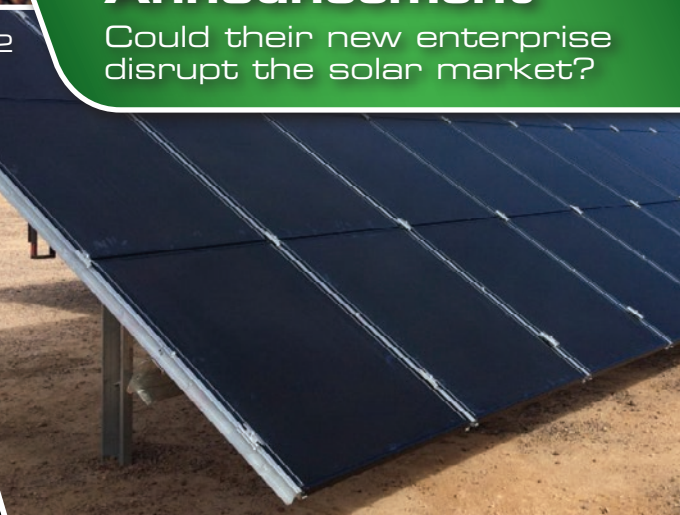
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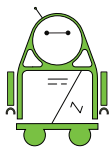
• OMCO's Big Announcement

Could their new enterprise
disrupt the solar market?

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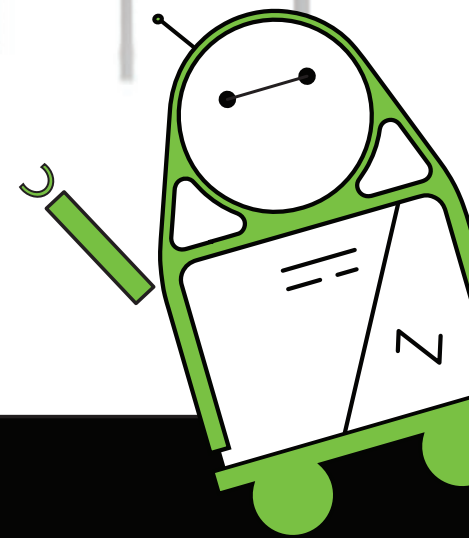
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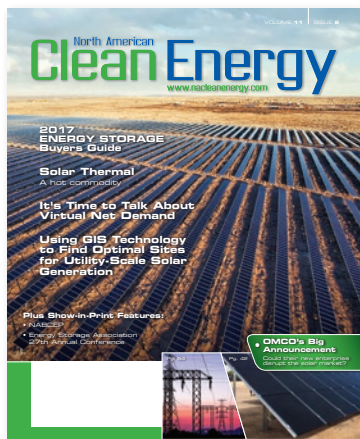
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With a strong commitment to renewable energy and the environment, the company is highly dedicated to innovative research and product enhancement to offer the industry's premier technology.





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On our cover...

Array Technologies, Inc. (ATI) and community solar developer SunShare commissioned the Jefferson County Community Solar Garden located near Arvada, Colorado. This 1.5MW solar garden will generate more than 2,500MWh of clean energy annually by utilizing ATI's DuraTrack HZ v3 single-axis solar tracking technology.

arraytechinc.com

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IN THIS ISSUE WE FEATURE OUR 2017 ENERGY STORAGE BUYERS GUIDE.

There is a race to discover the new super battery, due, in part, to the growing desire to trade fossil fuel burning automobiles for cleaner, greener, electric vehicles (EVs). With many major car manufacturers coming out with their own EV or plug-in hybrid versions, there is an urgent need for reliable, long-lasting, and affordable energy storage if these vehicles are to become mainstream.

Interestingly enough, EVs were in high demand more than 100 years ago. At the turn of the century, electric vehicles were preferred over their steam and gasoline counterparts. They were quiet, easy to drive, didn't require a long warm-up time or hand crank to start, and didn't produce an unpleasant smell. As electricity became more accessible, charging stations became widespread in urban areas and EVs became the vehicle of choice, that is, until Henry Ford started mass-producing his Model T.

The Model T had an electric starter which replaced the inconvenient hand crank, making it easier to drive, plus it was far less expensive than an EV. When cheap gas became more accessible, Americans were ready to get out and explore the country, and with electricity rare in rural areas, gasoline powered cars became more popular. The EV virtually disappeared by 1935.

Renewable energy, along with an increasingly environmentally conscience population have given the EV a second chance. This is making energy storage as a whole, a more important piece of the next generation energy puzzle.

Energy storage can be much more than a simple battery these days, and the applications are wide and varied. From batteries for small mobile devices, to batteries for large, utility-scale projects, the methods of storing energy must be designed to fit the application. Energy density, cost, and now more than ever, safety, are additional factors challenging this developing industry. For storage to be relevant in the world, there must be large amounts of capacity. There are many new exciting entrants into this industry with many more to come. As science and technology continue to grow, we've just now exposed the tip of the iceberg to what is possible.

If you happen to fly over Ontario, California, and you see a field of refrigerators, you'll have a bird's eye view of one of the most massive energy storage facilities in the world. These are all giant Tesla batteries positioned at the Mira Loma substation. Owned by Southern California Edison, these batteries are expected to cut a good chunk of fatty fossil fuels from SoCal's diet. Even industry experts can't help but marvel at the speed at which our resources are being transformed. The Los Angeles Times quoted Michael Picker, president of the California Public Utilities Commission, as saying...

"The innovation taking place occurs faster than we can regulate."

Bloomberg.com heralded the recent industry activity: Three massive battery storage plants—built by Tesla, AES Corp., and Altagas Ltd.—are all officially going live in southern California at about the same time. Any one of these projects would have been the largest battery storage facility ever built. Combined, they amount to 15 percent of the battery storage installed planet-wide last year. The Los Angeles Times caught up with Tesla's Chief Technology Officer J.B. Straubel, who added...

"...this is a revolution that's just getting started."

Enjoy the read,

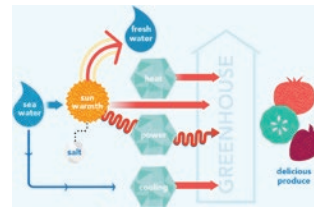
Meg and Jill



Zero-emissions, 100% V2G electric school bus

The Department of Energy announced they would be awarding \$15M to organizations in an effort to accelerate the adoption of advanced and alternative fuel vehicles. Blue Bird Corporation, a bus manufacturer located in Fort Valley, GA, was presented the largest amount at \$4.4M. One of the stipulations of the award is that the bus will be an affordable, 'low cost' electric bus solution. Additionally, Blue Bird is looking to implement technology, known as V2G, that will allow the bus to put electricity back into the grid – which may help bring much-needed funds to school districts. As a zero-emissions vehicle, this electric bus will be able to take away thousands of pounds of particulate matter from the air, making a positive impact on the environment, and the children these buses transport.

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Sundrop are showing the world it's possible to grow delicious, mouthwatering produce without needing fossil fuels, vast amounts of fresh water, or thousands of acres of cultivated farmland. In other words, they are breaking farming's dependence on finite resources. Sundrop technology doesn't exploit nature, it works in harmony with it. Sundrop uses the sun's energy to produce freshwater for irrigation. And they turn it into electricity to power their greenhouse to heat and cool their crops. The ventilation system also uses seawater to clean and sterilize the air, so it keeps bugs under control without the need for pesticides. A Sundrop hydroponic greenhouse turns seawater and sunlight into energy and water. Then, they use sustainably sourced carbon dioxide and nutrients to maximise the growth of their crops. Because they don't need soil, they're able to grow their produce on degraded land in arid areas previously considered too barren for agriculture.

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LED lighting transforms parking garage experience

American Airlines Center, in Dallas, selected Cree, Inc. lighting to provide a better lighting experience for fans as they enter and exit the world-class arena. Cree IG Series LED luminaires were chosen to replace the high-pressure sodium and metal halide light fixtures in its parking garages, establishing a welcome first impression with improved light quality that enhances visitors' sense of security, safety and comfort. The arena's switch to Cree LED parking garage lighting will generate an anticipated 66% reduction in energy consumption and \$1.26 million in total lifetime savings. American Airlines Center's parking facilities are illuminated by 782 Cree IG Series LED luminaires with WaveMax Technology. The IG Series addresses challenges particular to parking garages. WaveMax Technology offers an unparalleled lighting experience by distributing visually comfortable light with exceptional uniformity, high efficiency, precise control, and design appeal. The breakthrough waveguide technology banishes shadows by distributing light below the fixture and around the perimeter to create well-lit, welcoming space.

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NRG Energy Inc. and its subsidiary Reliant teamed up with the NFL to provide 100% Green-e certified renewable energy to NRG Stadium, site of Super Bowl LI, and the George R. Brown Convention Center, location of the NFL Experience and other NFL celebrations in Houston. For a period leading up to, during, and following the Big Game, for every megawatt hour of electricity used to power these events, NRG and Reliant will purchase and retire one Renewable Energy Certificate (REC) on behalf of Super Bowl LI. The RECs account for the electricity used at NRG Stadium and the George R. Brown Convention Center, supporting renewable energy and the over one hundred thousand fans visiting Houston to celebrate the Super Bowl.

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Using GIS Technology to Find Optimal Sites for Utility-Scale Solar Generation

by Nate Sylvester



FOR DEVELOPERS OF UTILITY-SCALE SOLAR ELECTRIC GENERATION, the race gets hotter every day to find ideal locations and meet booming demand for solar power.

By the end of 2016, close to 20,000 megawatts' worth of utility-scale solar photovoltaic projects had been deployed across the United States, according to the Solar Energy Industries Association (SEIA)¹. Another 20,000 megawatts have been contracted — 8,000 of which is in construction — and a whopping 34,000 megawatts more has been announced, according to SEIA. At peak solar output, that would be enough to power 55 million homes, which is half of the occupied housing in the U.S.

Solar developers today are much like treasure hunters of old. Both use maps marked with an “X” to find their treasure. Luckily, solar developers do not need to rely on drunken pirates to draw their treasure map. Today Geographic Information Systems (GIS) technology marks the spot for utility-scale solar treasure. Powerful GIS mapping tools can rapidly, efficiently, and effectively identify the most feasible locations for solar power and slash the time needed to bring projects online.

When developers look for the best locations for utility-scale solar, they need to consider various site characteristics to ensure that the project is viable, affordable, and can be built without any surprises. Developers are looking for sites that are:

- Large, relatively flat, non-forested upland
- Near existing utility substations and transmission lines that can receive the power generated by the proposed development, without a significant cost to upgrade
- Not within or adjacent to:
 - o Sensitive habitats
 - o 100-year-flood zones
 - o Conservation lands
 - o Or known cultural resource sites

Until recently, finding suitable locations for utility-scale solar development could take days, or even weeks. Specialists would have to pore over and cross-collate multiple types of maps to identify ideal locations. If any of those maps were out of date, developers risked unpleasant surprises about what they would be able to build, how quickly, and under what level of regulatory review.

Over the last few years, GIS technology and GIS databases have undergone a quantum leap in maturity and comprehensiveness. “Live map” services now get updated weekly, and even daily, as infrastructure, conditions on the ground, and land-use policies and restrictions change. For a developer looking for the best place to site several thousand PV panels and other expensive infrastructure, GIS specialists create interactive “webmaps” that reveal the best locations in just a matter of hours, rather than the days or weeks it could have taken years ago.



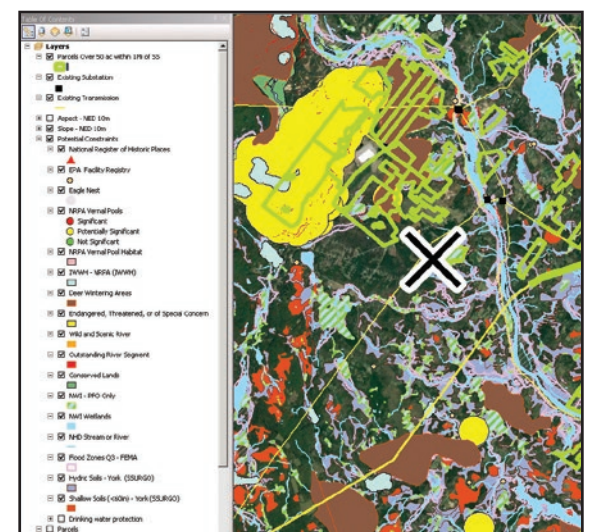
Many sources of information like the National Wetlands Inventory (NWI), National Hydrography Dataset (NHD), National Flood Hazard Layer (NFHL), Protected Lands of the U.S., the Environmental Protection Agency's Facility Registry Service (FRS), and many others are available as live map services, and easily added to an interactive webmap. When the datasets are updated, one can see those updates in real-time. Unlike working with printed maps in the past, these services allow access to the most reliable and current information.

In general, solar site prospecting is a smart process of elimination. After identifying the town, county, state or other area of interest, GIS Specialists can leverage technology to identify and eliminate all the areas that are defined as not suitable for development. A few examples include areas that are more than two miles away from existing utility infrastructure, wetlands, heavily forested or excessively hilly terrain, sensitive habitat areas, flood zones, and conserved lands.

As each new layer of information is applied to a map, more areas will be ruled out as unsuitable. What remains, and what ultimately gets revealed, are the areas that best meet the project developer's site criteria.

As a developer, be sure to have a conversation with the GIS analyst that clearly defines what information is the most critical. For instance, one of the best ways to find the perfect site is to filter candidate locations first based on interconnection suitability — that is, where does the utility serving the area under study say it can most efficiently accommodate adding the output of a solar farm to the grid? Where are areas with transmission bottlenecks or other potential obstacles to plugging a project into the grid? And as thorough and as regularly updated as today's mapping databases are, there are still plenty of occasions when human intelligence and experience — a seasoned GIS analyst knowing about a land-use restriction or community sensitivity that may not show up on a map — can mean the difference between project success ... and controversy and delays.

Ultimately, beyond helping utility-scale solar developers find the “X” on the treasure map, what skilled GIS experts and GIS technology can do is to prevent unexpected surprises. When you know where the treasure is and there are no surprises, you are positioned to win the race to meet our country's unrelenting demand for more solar power.



Nate Sylvester, GISP is the National GIS Coordinator of TRC Solutions. He has over 12 years of experience managing GIS systems in the environmental consulting field and extensive experience working with clients to develop solutions for acquisition, management and analysis of geographic data for large projects. Nate is an expert in applying today's GIS technology to all phases of a project, from the early planning stages all the way through post-construction monitoring.

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¹“Utility-scale” refers to the size of projects and who buys the power: utilities or wholesale energy providers, not individual customers generating electricity from their rooftops or fields.

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Solar Thermal

A Hot Commodity by JT Max

When most people in America hear about solar energy, they think about solar electrical systems, the ones that use photovoltaic panels to convert sunlight into electricity. But there is another solar technology that has been around for much longer, and it's been popular on other continents for decades. That technology is solar-thermal. In America, however, despite being four times more efficient, this solar technology has been overshadowed by its electrical counterpart. Solar thermal technology was invented far earlier than PV because it's ideal for what the sun already does - heat things up.

Think about how, on a sunny day, a car steering wheel gets too hot to touch. That's the general concept of how solar thermal works. Solar "collectors" absorb sunlight, turning that light into heat. From there the heat can get used for any purpose, like showers, laundry, and space heating systems. While those are the most common applications, there are countless more. Think about the breweries, wineries, and textile companies that all use solar heated water. In fact, solar thermal technologies are undergoing a sort of renaissance, getting used in more creative and innovative ways. Think about dehumidification and desalination, and even refrigeration and water chilling. How is that all possible? Well, let's see.

The first idea you should understand is that solar thermal is not so much about producing hot water, but more about producing the heat itself. For desalination and dehumidification, you're using the heat to separate the water vapor from the rest of the fluid.

Take a grocery store for example. In order for the air to feel comfortable in a space where there are hundreds of machines simultaneously cooling off the air and heating it elsewhere, the humidity levels have to be carefully controlled. So dehumidifier systems are installed to remove the excess moisture from the air. The problem is that the moisture that accumulates in the dehumidifier somehow needs to be expelled to the outdoor air. Most commonly, natural gas is used in this case to boil off the accumulated water. This is where solar-thermal excels. Solar thermal systems provide that heat source and reduce the amount of natural gas that needs to be purchased and burned. Whole Foods Markets has been an early adopter of these systems. In this photo, you see an array of solar collectors being used to assist the dehumidifier on the roof of a Whole Foods in Hawaii. There is



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plenty of usable space on a grocery store roof, making dehumidification a perfect application for solar thermal.

Certain collectors are particularly good at dehumidifying because they are able to reach higher temperatures. These are called “evacuated tube” collectors. What’s special about evacuated tube collectors is that there is a gap between where the sunlight gets absorbed and the outside of the collector. This gap has no air in it; it is a vacuum (hence ‘evacuated’ tube). Since no heat is lost in a vacuum, none of the heat gets dissipated from the tubes. This means that evacuated tubes collectors retain more heat and can reach extremely high temperatures, which is quite useful for a dehumidifying system that has to boil off accumulated water.

As with dehumidification, desalination uses the evacuated tubes to turn liquid water into water vapor. But in desalination, the water vapor gets collected, not discarded. Water from a non-potable source (like the ocean) will get heated up by solar thermal collectors, and the resulting water vapor will get piped to where it can be re-condensed into liquid water. The resulting water can be used for things like drinking and irrigation. The beauty of this system is that, wherever the sun shines, unclean water can be turned into safe drinking water. As it happens, much of the developing world that lacks access to drinking water lives in sunny, equatorial areas: Sub-Saharan Africa, Central and South America, Southeast Asia and many island nations. In his book *Abundance*, Peter Diamandis argues that resource scarcity is not really about a scarcity of the resources themselves, but about the scarcity of technology to access those resources. For instance, the African country of Ghana has an abundant supply of sunshine, has easy access to saltwater in the Sea of Guinea, and has plenty of unsafe surface water. Solar thermal technology can give these people access to clean drinking water by harnessing resources already available.

Lastly, let’s talk about using solar thermal for refrigeration and air conditioning. These applications certainly seem the most counterintuitive of the ones mentioned so far. It doesn’t make immediate sense that you would want to add heat to a system that is trying to cool things off, but that is precisely what happens. More accurately, solar heat is used to help or replace the compressor. In order for the outdoor unit of an air conditioner to operate, the refrigerant must be at a high pressure. That is why outdoor units have compressor pumps. Unfortunately, the compressor requires huge amounts of electricity to do its job. Fortunately, solar thermal can help. As you may know, the pressure and temperature of a gas are directly proportional, so long as all other things are kept equal. A 2-liter bottle full of air has double the pressure when it is at double the temperature.


Likewise, when a solar thermal system adds heat to gaseous refrigerant on its way to the compressor, the pressure is proportionally increased. This dramatically reduces the amount of electricity the compressor has to consume, and reduces your power bill. The heat keeps you cool.

From small-scale home air conditioners to industrial scale chillers, or from safe drinking water in Ghana to efficient dehumidification systems at Whole Foods, solar thermal can be used to do it all. It may be the original solar technology, but it’s not your grandparent’s solar technology any more.



JT Max is the Director of Operations at Apricus, a leading designer and manufacturer of solar hot water and hydronic heating products.

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Optimizing Your PV Business and Passing on the Savings

by Lior Handelsman

Given the current state of the PV market, the installation business is becoming more competitive. As the dollar-per-watt cost of PV hardware drops, installers can find it increasingly difficult to stay profitable. For installers looking for ways to improve their competitiveness and bottom line, inverter selection may be the key.

Inverters are only about 10 percent of a PV system's cost, but they significantly influence soft costs including customer acquisition and Balance of System (BoS) costs. The inverter also has 100 percent control over secondary costs, such as monitoring and reporting. So, how can an inverter reduce these costs and help installers optimize their business?

Expanding Market Reach

The first area in which installers can become more competitive is market reach. By expanding their market reach to roofs that cannot support standard PV systems, installers access an entirely new group of potential system owners. Many roofs cannot optimally support PV due to the angle, multiple facets, or other factors. Certain inverter solutions, however, especially those with module-level MPPT, can help installers expand their market reach. This means that installers would have access to an entirely new market to which their competitors may not.

Sales

At the sales stage, there are two specific ways that installers can become more competitive. The first is through offering more competitive quotes. The second is by decreasing the average cost of customer acquisition. Installers can improve the competitiveness of their installation and system quotes by offering solutions that provide value. A technology that can provide more value is one that offers mismatch mitigation in order to increase the lifetime system production, thereby decreasing payback time.

Take, for example, a new and innovative inverter that offers 99 percent CEC efficiency. For the homeowner, this means more power is translated into useable energy for a decreased Levelized Cost of Energy (LCOE) of the system. This extra edge of 1 percent or more of improved efficiency can be enough to help an installer win the installation bid. If a larger percentage of bids are won, then the average acquisition cost is lowered.

To reduce average acquisition costs, installers can increase the average price of their sales by using technology that increases system size. By increasing the size of each individual sale (and thus increasing the revenue from each customer), installers can lessen the average cost of customer acquisition. Most standard inverter technology limits the system size either due to inherent technology confines or the roof design. Using technology that increases design flexibility means that more PV panels can be designed into the system. Standard inverters do not allow for parallel strings of unequal length or multiple orientations, different capacities, and layout in the same string. This means that roof design often dictates system capacity. However, with technology that maximizes design flexibility, installers can increase system size to better address the needs of the homeowner. Oversizing can also make a dramatic impact. The more an inverter allows for oversizing, the larger the system size can be. Some inverters today can enable up to 155 percent DC/AC oversizing. By increasing the system size, owners get more power and make more revenue, while the installer gains a competitive advantage and can increase the average profit per installation.

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System Design and Installation

From selecting system components to layout, the design stage can be a time consuming and complicated phase in the sales process. However, when a system maximizes design flexibility and eliminates many of the standard design constraints, the design stage becomes streamlined. While design software is important, it is the components that are key to shortening the design stage. Design simplicity allows installers to be significantly more efficient when designing PV systems. Additionally, products can be built and programmed to help enable faster installation and commissioning. For instance, some new inverters are small and light enough that they can be installed by only one person.

Safety

Another important element that can impact the profitability of both system and the installer is safety. Many new regulations are being issued, such as the integrated arc fault protection standard and integrated rapid shutdown for NEC 2014 and 2017 690.12. Even though they are important for improving system safety, these new standards can potentially increase the LCOE

of a system. However, they do not necessarily have to be a tradeoff. Some module-level power electronics offer embedded safety features that require no additional costs. This can further improve an installer's price quote while adding value to a system.

Even in areas without such regulations, homeowners might be reluctant to put up a PV system that lacks advanced safety features. If this is the case, a potential customer might be lost unless a safety solution is included.

Post-Sale Service

Finally, there is the service stage. This is both a particularly important and sometimes overlooked stage, potentially to the installer's detriment. After installation, homeowners still need service to keep their systems healthy and functioning at optimum levels. Labor-intensive maintenance can often be a challenge for installers to provide in a timely manner. This can lead to consumer complaints, bad reviews, and potential loss of future customers.

Installers can improve the service stage in a number of ways that will boost both their own and the system owner's bottom lines. The first is actually part of the system component selection process; by offering more reliable products with longer warranties, installers minimize future service calls. For instance, inverters that utilize film capacitors instead of electrolytic capacitors are designed to support enhanced product reliability.

Installers can also use module-level monitoring and remote troubleshooting platforms to make their service more time and cost efficient. As a result, homeowners are able to get up-to-date insight and track their investment.

The bottom line is that when installers select solutions that offer value throughout the entire supply chain, they can increase revenue and decrease expenses, while also improving the RoI for system owners.



Lior Handelsman, VP of Marketing and Product Strategy, founded SolarEdge in 2006 and currently serves as Vice President, Marketing and Product

Strategy where he is responsible for SolarEdge's marketing activities, product management and business development. Prior to founding SolarEdge, Mr. Handelsman spent 11 years at the Electronics Research Department ("ERD"), one of Israel's national labs, which is tasked with developing innovative and complex systems. At the ERD he held several positions including research and development power electronics engineer, head of the ERD's power electronics group and manager of several large-scale development projects and he was a branch head in his last position at the ERD. Mr. Handelsman holds a B.S. in Electrical Engineering (cum laude) and an MBA from the Technion, Israel's Institute of Technology in Haifa.

SolarEdge | www.solaredge.com



1500VDC disconnecting string combiner

Yaskawa - Solectria Solar recently launched the DISCOM 1500, the latest product in their suite of string combiners. With high quality and durability, the DISCOM 1500 allows for simplified installation and mounting flexibility, and also provides safety and protection features. The 1500VDC combiners are available in 8-24 fused positions and include a wide range of fuse values allowing up to 36 string inputs. The standard enclosure is powder coated steel (Type 4) with the fiberglass (Type 4X) enclosure option available upon request. The DISCOM 1500 includes connection plates for compression terminals (2 per output up to 600 kcmil or 1 per output up to 750 kcmil) and 90°C terminal rating.

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California Solar Program Catalyzes Business Opportunity for Native American Tribe

by Tim Willink

NATIVE AMERICAN TRIBES HAVE HARNESSSED solar power's potential to reduce energy costs and support environmental goals for years, but a new trend is emerging – tribes creating local economic growth by joining the fast-growing solar industry.

In Southern California, where solar installation is a thriving economic engine, the Mesa Grande Band of Mission Indians took advantage of a state low-income solar program to build a tribally owned solar company that will create opportunity for tribal members for years to come.

The Mesa Grande Band may be one of the first tribes to form their own solar businesses, but they won't be the last. Its experience offers other tribes lessons on turning short-term opportunity into long-term gain while expanding renewable energy on their reservations.

In 2014, two individual Mesa Grande members had rooftop solar installed on their homes through California's Single-family Affordable Solar Homes program (SASH). As often happens when one home in a community adds solar, other homes follow suit. In the case of Mesa Grande, the reservation leaders wanted to add more.

"The tribal chairman and I came back from a business trip, saw these homes with solar panels on the roofs, and asked the homeowners about it," said Mesa Grande Band Vice Chairman Curtis La Chusa. "We figured that's a really good plan – renewable energy fits our environmental respect as a tribe."

It was also a boon for a tribe facing 80 percent unemployment and sky-high energy rates. "The gas and electric cost of living up here is

enormous," said Chairman Virgil Oyos, Jr. "If people run their air conditioning 24/7, which a lot of people do, they're looking at a \$700-\$800 bill. Now [with solar] they're paying pennies comparatively."

Tribal leaders worked with SASH program administrator GRID Alternatives to sign up other households for the program. With additional solar installations came workforce training opportunities for tribal members, learning to install on homes in their own community. For the participants, this sparked a new venture – a tribally owned energy company.

In 2015, the tribe secured a \$165,000 community development grant from the Department of the Interior, using some of the funding to lay groundwork for the business, and started recruiting founding members.

Candace McElroy, a stay-at-home mom with two kids, was one of them. "I got an email from Curtis saying we have an opportunity to start a company to help our mother earth, help our people, and help people on other reservations. As soon as I heard we were going to help our people I said, 'I'm ready to jump in.'"

She joined a core team of 10 people from Mesa Grande and other tribes in the area, and began volunteering on SASH installations both on and off the reservation.

Within a year, they gained enough experience to strike out on their own, and Tekamuk Energy was born. Tekamuk means "protected place in the sun" in the Mesa Grande language and refers to the tribe's homeland village – fitting for a company harnessing solar to bring financial relief and economic opportunity to the community.

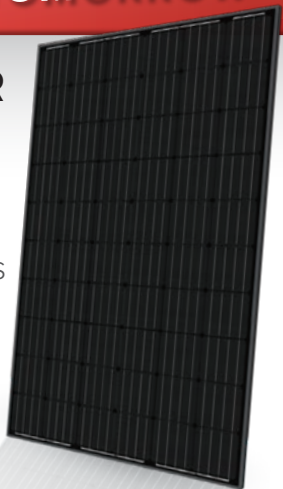
"A spark was ignited by these volunteers. They could see something greater than just learning the trade and getting a job," said La Chusa. "They saw they could create a company that would last many years and provide opportunities to not only Mesa Grande but for other communities. They kept that spark and grew it into a fire."

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Tribal leaders helped Tekamuk partner with a local solar company to gain additional training and work experience. It may seem unconventional for one solar company to share its expertise and hardware to help a potential competitor grow, but the company's owner, a former community college instructor, saw the bigger picture.

"We knew if we could actually get Tekamuk and its team to become a self-sustaining solar electric installation and support team, there could be years of continued employment and training," said owner Ross Hider, who is also a C10 electrician. "Tribal members would be building careers to provide for them and their families long-term, and Tekamuk could support the backcountry where distributed power is most practical and most needed."

Hider developed a six-month/80-hour training curriculum for the ten initial Tekamuk employees, providing enough classroom hours to take the NABCEP Entry Level Solar PV Installation exam, helping secure required certifications, and training them on NEC code. Meanwhile, he hired the crew from Tekamuk to work on a variety of jobs, and helped them get some jobs of their own.

"We have been working business-to-business with different installers," said Hider, who estimates they've done 15-20 installation and troubleshooting jobs so far. This year, the company will recruit ten new employee to start their training, while the original ten move into more specialized and supervisory roles.

With the early success of Tekamuk and the community's enthusiasm for solar power, Mesa Grande is looking toward 100 percent participation. By 2019, Mesa Grande wants to supply all 175 tribal members living on the reservation with renewable energy, including some who have never had electricity before. With solar already on 13 of the reservation's 50 homes, that goal is within reach.

In September 2016, the tribe teamed up with neighboring San Pasqual and La Jolla tribes to secure a U.S. Department of Energy cost-share grant. This collaboration will leverage SASH and other funding to bring at least 170 kW capacity grid-tied rooftop solar projects for two community buildings and 40 low-income single-family tribal homes—five in Mesa Grande. Tekamuk will install a portion of these projects as a SASH program subcontractor a status it won with help from Hider in late 2016.

Mesa Grande officials hope Tekamuk, the tribe's broader renewable energy goals, and its collaboration with other tribes will encourage Native Americans everywhere to embrace solar as an opportunity. "We've taken this thing and

built on it to create an economic opportunity for folks in their home," said La Chusa. "Hopefully this will be a start for tribes around the nation to work together in bringing clean energy to their reservations."

Tim Willink is Director of Tribal Programs for GRID Alternatives, America's largest nonprofit solar installer, whose mission is to make solar power and job training accessible to underserved communities. GRID has partnered with 40 Native American tribes across the country since 2010, helping them achieve their renewable energy goals. Learn more at www.gridalternatives.org/tribal

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The Gateway to Optimized Solar Generation

by Dr. Roberto Aiello

In Q3 2016, the U.S. installed 4,143 megawatts of solar photovoltaic (PV) generation, bringing the total installed capacity of PV generation to 35.8 gigawatts – enough to power 6.5 million American homes. This is according to GTM Research and the Solar Energy Industries Association's (SEIA) Q4 2016 U.S. Solar Market Insight report, which predicts that the industry is poised to nearly double year-over-year.

The solar industry is experiencing unprecedented growth. As the industry heats up, technology is trying to keep up. Today, technologies measure solar production, track energy usage and predict demand – but they do so in silos. To harness the full potential of solar generation and limit waste, advanced monitoring technologies with edge computing power are needed to control distributed devices, monitor the health of PV installations and give operators visibility into performance and generation output. Intelligent dynamic systems are needed to balance on-premise generation with demand. If the two aren't correlated, excess

capacity is simply put onto the grid, which isn't the best use for the consumer and can lead to grid reliability issues.

What's needed is a solution that collects data from and communicates with generation assets, the on-premise utility meter, and in-home appliances; is aware of weather forecasts; and knows the local utility's rate structures. The solution could analyze the data for PV performance, and learn how to optimize PV generation by understanding weather influences, utilities pricing structure at the give time, and premise usage patterns. Then it could use machine-learning algorithms to redirect generation accordingly.

Known as a "gateway", this technology greatly increases PV efficiency. The gateway is a standalone device that talks to the inverter, collecting a wide range of data that reveals the health and efficiency of the solar panel to ensure that generation is optimized. It can also act as an intermediary between on-premise solar generation, electricity demand and electricity storage, as well as the electric grid.

The universally accepted gateways can capture power, current, voltage, frequency, temperature and more. They tell operators how the panels are functioning and if they are working to full capacity. A gateway provides information to operators so they can quickly and easily identify issues with the solar system and dispatch the appropriate technician with the right equipment to repair the problem. For example, if it appears that something is interfering with the panels or limiting their production (the PV panels may require cleaning or a tree branch to be removed) having this information will help minimize field visits, ensure proper maintenance, and optimize costs.

Gateways also offer revenue-grade metrology for solar leasing companies to accurately measure and monitor PV generation. The system captures key inverter data that enables an operator to remotely diagnose inverter issues and ensure the distributed assets are performing to their optimal limit.

With embedded machine learning, gateways also dynamically direct the flow of electricity between generation, demand, and on premise storage. Leveraging customer usage patterns, weather and utility pricing structures, the application on

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the gateway determines if PV generation meets current demand or if access energy can charge an energy storage unit. It also calculates if current demand is met by PV generation, storage or from the grid. Monitoring and directing premise electricity from various generation sources is enabling a new level of energy optimization within the home.

By correlating on-premise generation with demand, consumers can optimize their energy usage with no manual interaction. Imagine a hot summer evening when the demand for electricity is approaching the grid capacity. The utility would push hourly or day-ahead price information to the application running on the gateway, indicating a higher price of energy in a given period of the evening. The application running in the gateway would calculate and optimize the energy based on the price signal either by pre-cooling the house, charging an EV, or feeding the energy to the grid. As opposed to a traditional demand response program, the consumer would not need to suffer through hot temperatures, yet would still receive comfort and financial savings while reducing the exposure of disruption on the grid.

As the solar industry continues to heat up, gateways will play an important role in ensuring that these assets are optimized. Performance monitoring brings greater efficiencies and operational precision to PV installations.

Dr. Roberto Aiello is the managing director of the Itron Idea Labs and responsible for new business innovation at Itron, including Internet of Things. His previous experience includes managing wireless research at Interval Research, Paul Allen's technology incubator and technology transfer at Disney Research. He is an advisor to Google Advanced Technology and Projects (ATAP) and is a Lean Startup expert who serves as a mentor at the Cleantech Open and Startup Weekend. Dr. Aiello also founded two venture-funded, wireless semiconductor companies and one web/mobile startup. Dr. Aiello worked as a physicist at Stanford Linear Accelerator Center and Superconducting Super Collider.

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Should Trump Support Clean Energy? Artificial Intelligence Has the Answer

by Attila Toth

TRUMP IS ENAMORED WITH BIG OIL. He has infamously called climate change a hoax invented by the Chinese. And yes, he has promised to bring back America's long-gone coal jobs. How will the tremendous progress our nation has made on clean energy, particularly solar power, survive under this President?

Most people believe that clean energy is a politically divisive issue, where Democrats earnestly support renewable energy adoption as a path to reducing greenhouse gas emissions, and Republicans reject solar subsidies preferring to frack instead, right? Wrong.

After an especially divisive election, it may come as a breath of fresh air to learn that clean energy knows no party. A recently published study produced a surprising conclusion. The study pulled the addresses of 1.5 million Democratic and Republican party donors in the top 20 solar states. An Artificial Intelligence-based image recognition model used satellite images to analyze the roofs to determine which donors had adopted rooftop solar.

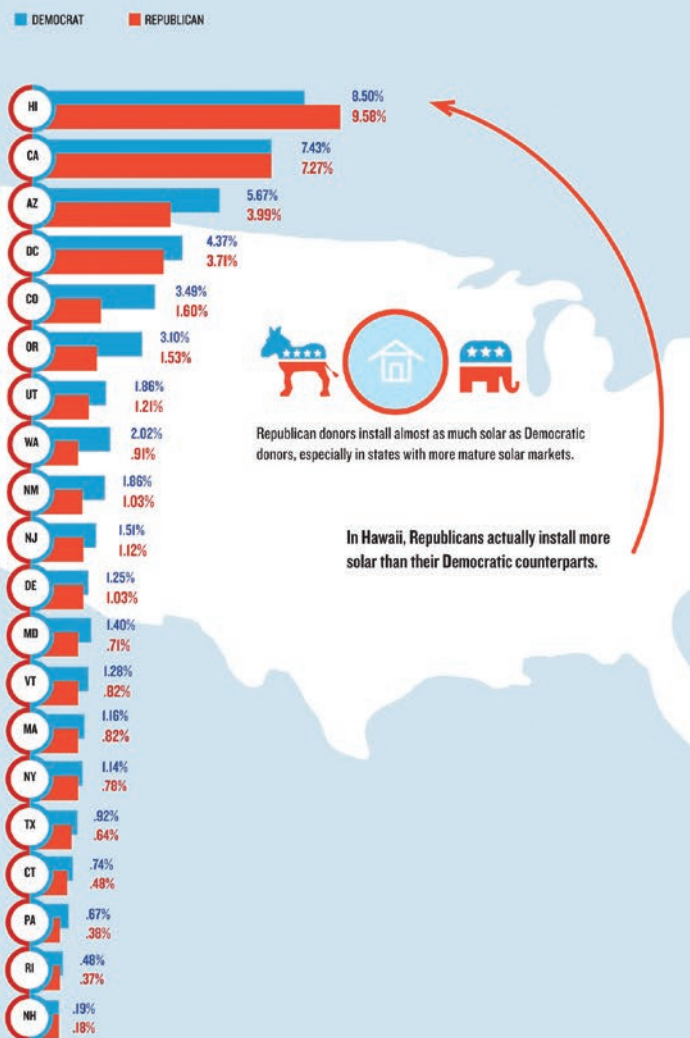
The result? 3.06 percent of Democratic donors and 2.24 percent of Republican donors across these states have installed rooftop solar. The margin is quite narrow between the two camps. When you look at the numbers within individual states, the numbers get even more interesting; in Hawaii for example, Republicans install more solar than Democrats.



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If you look at the news, clean energy often seems like a partisan issue, but rooftops tell a different story. We used artificial intelligence to analyze 1.5 million rooftops of Democratic and Republican donors across 20 states to see how they compared. The results speak for themselves.

SOLAR INSTALLATION RATES FOR DEMOCRATIC VS REPUBLICAN DONORS BY STATE





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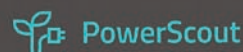


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SOLAR ECONOMICS MAKE MORE SENSE THAN EVER

If you live in one of the above states, it's worth noting that there's a reason so many people are going solar. It's because unlike other home improvements, solar starts paying for itself the minute the panels are turned on.

Find out if solar makes sense for your household by calling 650-999-9900 or visiting PowerScout.com



*Sources: PowerScout analysis; satellite imagery using a convolutional neural network (CNN). Election contribution data from the Stanford Database on Ideology, Money in Politics, and Elections (DIME, 2012), 2012 survey of solar homeowners.

It seems that, in well-established solar markets like California and Hawaii, party affiliation does not matter when it comes to adopting solar - it's all about the savings. Money talks, and in California, Republicans and Democrats appear to be speaking the same language.

In states like Oregon and Colorado, with more nascent solar markets, Democrats take the lead over Republicans on solar installs. While the early solar pioneers might be environmentally or politically motivated, as soon as costs fall and markets mature, adoption comes down to hard economics.

So why is this study unique and how was it done?

This study was unique in that it was the very first to examine solar adoption at the household level rather than by ZIP code or utility service territory. This was only possible by using innovative technology and lots of cool data.

It all started with the publicly available list of donors to the Democratic and Republican parties, as well as candidates with addresses in the top 20 solar states. Focusing on the physical addresses of political donors, as opposed to county level voting patterns, dramatically improved the quality of the analysis, and established a positive connection between each home and its resident's political affiliation. The amount of money someone forks out for a political campaign is the strongest indicator of his political leaning. Listed addresses for donors can include work addresses, PO Boxes and apartments, but in order to focus on locations most likely used for rooftop solar, addresses were filtered for donors in single family homes. What remained were 1.5 million homes across 20 states, as shown in the chart. The final count was 1 million Democratic donors and 500,000 Republican donors.

Satellite images for these 1.5 million homes were pulled and processed with a machine-learning model called a convolutional neural network (CNN). A more in- depth explanation of convolutional neural networks won't fit here, but it may help to think of a CNN as a computerized version of the part of the human brain that helps us see.

This model was trained with hundreds of thousands of labeled images of homes with and without solar panels, until the model was able to distinguish between the two types. It was then able to process thousands of images at a time to determine which homes had solar and which did not.

So when President Trump and Secretary of Energy Perry work to craft policies to guide America's energy future, they may want to keep in mind that Republicans and Democrats alike vote for renewable energy. The numbers clearly show that the two parties agree on at least one thing (and that ain't coal).



Attila Toth is Founder & CEO of PowerScout, in the San Francisco Bay Area. PowerScout is a data-driven online marketplace for products and services in sustainable smart home improvement. The company leverages large amounts of data to present customers with tailored advanced energy solutions that combine photovoltaic solar, electric vehicle charging, electric storage and energy efficient large appliances. Prior to founding PowerScout, Attila was SVP of Worldwide Sales at C3 IoT, General Manager of the Commercial and Government Business at SunEdison and Management Consultant with McKinsey & Co. advising clients in the energy and technology sectors.

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2017's MVP: U.S. Commercial Solar

by Graham Smith

The United States solar industry grew impressively in 2016. A confluence of market conditions, including lower solar system costs and attractive incentives such as the Investment Tax Credit (ITC), helped drive the residential solar sector to unprecedented levels of growth in Q3 of 2016. In just one year, there was nearly 200 percent growth in the residential sector with more than four new gigawatts (GW) of capacity installed nationally. But as we look ahead to 2017, the growth of residential solar is expected to stagnate, due in part to push back from electric utility influencers concerned about remaining equitable and profitable. However, another segment of the market, commercial solar, is well poised to support the growth of the broader solar market even as residential growth slows.

Net metering, a system in which utilities are required to pay solar customers a state-determined rate for excess energy produced, has taken an important role in the solar business model across the United States. According to the U.S. Energy Information Administration, over 2,100 megawatts in generation capacity was added through net-metered solar in 2015, enabling the industry's fourth consecutive year of booming annual growth at above 50 percent. Net metering clearly drives the growth of solar, but many utilities argue that structuring a system to compensate solar users for excess power sent to the grid is not in the best interest of non-solar energy customers.

In 2016, 44 utilities in 25 states proposed a rate structure fee hike of at least 10 percent, and filed a total of 117 policy actions to change rates. With debates ongoing in Nevada and Florida, and net metering decisions expected soon in

Massachusetts and New Hampshire, 2017 is likely to be a more challenging year for residential solar. The general utility pushback against distributed renewable energy led Bloomberg New Energy Finance to predict that the residential sector will experience 0.3 percent growth in 2017 – a marked difference from the 21 percent growth it saw in 2016.

But while we confront the growing pains facing the residential sector, the commercial solar sector is entering a period of growth. Corporations are leading the charge, with almost half of Fortune 500 companies and 60 percent of Fortune 100 companies having set aggressive sustainability goals. Large players like Target, Walmart, and Apple have installed nearly 1,100 megawatts (MW) of solar capacity as of October 2016, and the small- to mid-sized commercial solar market represents tremendous additional untapped potential. Over half of rooftop solar potential consists of “small buildings” that are not residential households. Wiser Capital estimates that the mid-sized commercial market potential in the Northeast United States alone represents a \$67.5 billion opportunity.

What about the aforementioned net metering debates? Commercial entities interact with net metering in a way that is different from residential. Most use energy at the time of generation during business hours. With less excess energy being directed back to the grid than residential users, corporations are generally far less affected by net metering policy outcomes. In addition, commercial properties have more available roof space and higher electricity bills than other sectors, making them excellent candidates for solar. With strong corporate interest, a limited dependence on state incentives, and plentiful available infrastructure, the growth of the commercial sector depends primarily on increasing access to capital for the sector.

The commercial solar market in the United States has been underfunded since inception. With a diverse customer base ranging from small local businesses to large corporations like Target, the due diligence required for a project to be funded often results in prohibitively high transaction costs. The result is a market that lacks standardization and is often underserved by financiers and developers alike. Clean energy entrepreneur Jigar Shah recently referred to United States small commercial solar as the “disrespected asset class.”

The future remains bright. California, arguably the nation's leader in solar, can provide a good indicator for what's to come in the rest of the country this year. In 2016, California's commercial solar sector installed roughly double the 114 MW that it did the year before. This growth was driven in large part by a continued commitment to solar by corporate buyers, as well as greater access to various financing options for developers. Emerging innovative financing solutions, that reduce transaction costs and time to secure funding, will be the catalyst for growth of the commercial sector in 2017. While there are plenty of unknowns around the state of the solar industry at the start of the year, the building blocks are in place for commercial solar to drive the industry forward.

Graham Smith is the CEO of Open Energy Group, a technology driven investment platform that provides accredited investors with attractive, steady returns from the generation of renewable energy.

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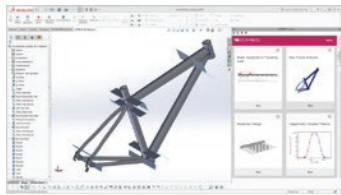
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Build simulation apps that integrate with CAD

COMSOL, Inc. has announced an update to its LiveLink for SOLIDWORKS product. As an add-on to the COMSOL Multiphysics software, LiveLink for SOLIDWORKS allows a CAD model to be synchronized between the two software packages. Simulation specialists and analysts can now build apps with the Application Builder to let users, such as design engineers, to analyze and modify a geometry from SOLIDWORKS software right from the tailor made interface of the app. With this update of LiveLink for SOLIDWORKS, a new Bike Frame Analyzer app has been added to the Application Libraries in order to show the new capabilities. This app leverages LiveLink for SOLIDWORKS to interactively update the geometry while computing the stress distribution in the frame that is subject to various loads and constraints. Using this app, you can easily test different configurations of a bike frame for different parameters such as, dimensions, materials, and loads. The app computes the stress distribution and the deformation of the frame, based on the structural dimensions, materials, and loads/constraints of the bike frame.

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State of Solar Under the Trump Administration

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NOW THAT WE HAVE A NEW PRESIDENT, WHAT CAN BE EXPECTED TO HAPPEN WITH the renewable energy industry in the United States and, more specifically, with PV Solar? Unfortunately, it's too early to get an idea of what side of the renewable energy future President Trump will take. In many of his comments pre-election, as well as those post-election, he stated he does not believe in global warming and that he wants to enhance coal and oil production while reducing EPA regulations for fossil fuels.

If Trump were really concerned about job growth, and took into account the massive growth of jobs in renewables (solar alone created over 209,000 jobs since 2010), he would fully support the success of these industries. While the number of employment opportunities is impressive, more importantly, these are good paying jobs. So, let's look at some of the facts, and where we hope to see the growth of solar PV. After President Trump's inauguration on Friday, January 20th, the energy URL changed to "An America First Energy Plan."

Boosting Domestic Energy Production

Trump has said that he believes boosting domestic energy production is in the United States National Security interest. Considering the value of solar PV and other renewables, it makes sense for the present administration to align with this stance. Whatever program we end up with, it's vital to consider the impact on the global environment.

Trump shares many Americans' belief that we should commit to achieving energy independence from OPEC. This heightens the value of a focus on renewable energy. Since Trump loves to watch the polls, hopefully he will look at the polls that show that renewable energy jobs are higher paying jobs and that over 80% of Americas' believe that solar is a great source of energy while reducing energy costs to the home and business.

Job Creation and National Security

The United States Military also views solar as a boost to national security for global installations, including the front lines of the current war in the Middle East. In fact, one of the United States military bases in Israel has invested in a 5MW solar project due to go online early 2017. It's a perfect example of advocating solar to both reduce energy costs and increase national security. Another example is the decision by the military, in 2015, to establish solar energy training programs in an effort to equip soldiers with the necessary skills to land lucrative solar jobs upon their release from military service.

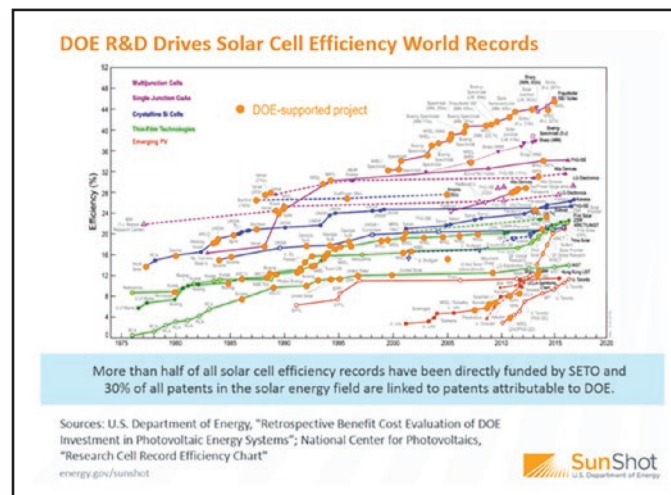
A brighter future depends on policies that stimulate our economy, ensure our security, and protect our lives. Any White House Administration with policies that fail to help companies and consumers lower energy costs while gaining energy independence, will also fail to secure a future where the United States is in control of its own energy resources.

The world has watched China become the largest supplier of solar PV modules. The science for this actually started with NASA, and grew from revenues coming through the oil companies, the US Coast Guard, the US railroads and our space program. If the US policy early on had supported PV manufacturing on US soil, chances are that we would have added countless manufacturing jobs and grown our own economy.

Even taking into account the loss of manufacturing jobs in other sectors, the solar PV industry had an approximate 34 percent year-on-year growth rate in 2016, exceeding the 32 percent year-on-year growth rate a year earlier. In 2017, producing global capacity reaching 77 gigawatts (GW) in 2016 and 79 GW. Had these been US jobs, we potentially would have added thousands if not a million or more high paying manufacturing jobs.

Solar is Cost Competitive with Fossil Fuels

Falling prices have helped the solar industry be cost competitive with fossil fuels. Although the solar market will continue to look good over the long term, major policy changes can impact ups and downs in growth, and will either help or hinder job creation and costs. In the past, the involvement of the DOE in solar cell efficiency has outperformed all other innovation (either from private investment or manufacturers trying to edge out their rivals for market share).

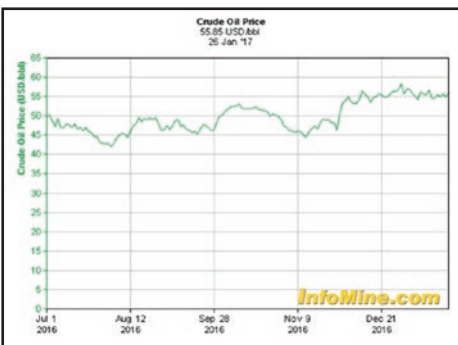


No Clear Message Towards Policy

During and after the election, Trump has spoken without clarity about the United States efforts to combat climate change, but he has shown a willingness to embrace renewables as a domestically produced energy source and jobs driver. After months of speculation about how a President Trump would act toward clean energy, the administration has signaled its intent to erase President Barack Obama's clean energy policies. There was a climate action plan under Obama, now there is no mention of it. The previous energy policy can be viewed at <https://energy.gov/eere/solarpoweringamerica/solar-energy-united-states>

Trump's pick to lead the Department of Energy, former Texas Governor Rick Perry, has some supporters saying they believe innovation will be the hallmark of his tenure. Previously, Perry stated that energy storage and solar power are some of the methods for energy innovation developing energy independence. At his confirmation hearing, Perry appeared to support clean energy programs via research through DOE programs.

Another important signal to watch when considering post-election pricing of energy is the steady increase of the price of gas. At my local gas station, it has increase by 28 cents a gallon. Although that's still relatively inexpensive, the last thing any of us wants is a progressive rise in gas prices.



The growth of solar depends on all of us. We need to keep voicing our opinion and work harder to get that next project sold and started. This started as a grassroots effort, and in many ways it still is. We all create an image of the value that solar brings to our customers, and they look to us to help them reduce their costs and their carbon footprint in the world.

Robert Benedict is Vice President of Sales Americas for Recom Solar, the second largest PV manufacturing company in Europe.

Recom Solar | www.recom-solar.com



Modular mounting system

Sollega Inc. announces the FastRack FR510-SIM (String Inverter Mount) universal one-piece modular mounting system for all string inverters. Specifically designed to mount string inverters on commercial low-pitch roofs. Features include: same FR-510 used to mount modules; aluminum rail provides flexible installation; efficient to ship, stage, and install; multiple Inverters can be mounted with combined rail; fully ballasted with mechanical attachment options; one tool, all top mount installation; and full engineering services provided.

Sollega, Inc. | www.sollega.com

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Crown Battery's proven array of Renewable Energy Deep Cycle Batteries. Unlike some deep cycle battery manufacturers who lump a few of their industrial products into a group and call it their RE line, Crown Battery evaluated the marketplace needs and re-engineered an entire line of 2-, 6- and 12-volt batteries to fit contemporary solar and wind power systems.



- ▶ The most complete, dedicated array of RE batteries with unmatched application flexibility and ease of handling
- ▶ Battery capacity ratings that range from 120 to 3690 ampere-hours (100 Hour Rate) and unmatched application flexibility
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You've researched the renewable energy equipment you've bought. Now it's easy to select the storage batteries you need. Crown Batteries. Once you compare all the other renewable energy batteries in the world today, you'll find there's really no comparison. It's truly the best batteries for your solar system.

Contact us for more information: 419.334.7181
www.crownbattery.com
sales@crownbattery.com



ADS integration automates CAISO energy bidding process

Trimark's T1-S SCADA now includes the option to accept, schedule, and execute California ISO (CAISO) Automated Dispatch System (ADS) commands. This functionality allows utility-scale PV resources to participate in the real-time energy market by responding to 5-minute dispatch commands. Trimark's T1-S SCADA integrates with the CAISO ADS application to automate acceptance and execution of secure CAISO instructions including startup, shut down, transition, curtail, and ancillary service requests. CAISO's ADS system facilitates secure, real-time dispatch instructions to power generation resources that participate in the real-time energy market. ADS sends unambiguous dispatch instructions to generation resources, tracks the real-time operational profile, records the transaction, and documents whether the instruction was approved or rejected.

Under normal conditions, CAISO dispatches an ADS instruction (e.g. startup, shut down, transition) every five minutes. CAISO can also dispatch energy instructions (e.g. Max) on a 10 minute, 15 minute, or hourly interval. ADS commands are also used to communicate ancillary service awards. When the T1-S SCADA ADS module receives a command, CAISO allows 90 seconds for the resource to start the action. During this time, T1-S SCADA authenticates the command, reviews the instruction against pre-defined acceptance criteria, and documents the transaction. If the command meets the acceptance criteria, and the resource can deliver the power characteristic required, T1-S SCADA will automatically coordinate adjustments across all plant devices (e.g. inverters, energy storage, capacitor banks) to meet the instruction. Upon acceptance, CAISO expects the resource to smoothly ramp changes over two minutes to reach the new target. All dispatches and resulting control actions are recorded with time stamps and retained for reporting and auditing.

Trimark Associates | www.trimarkassoc.com

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NIST re-assembling the Million Pound Deadweight Testing Machine

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Portable solar powered battery packs

Larson Electronics has released a new series of portable battery packs powered with lithium-ion batteries that offer multiple charging capabilities. These battery packs are powered by lithium ion batteries with a Samsung ICR18650-3.7V-2600mAh cell. These units are designed for off-grid use in remote locations with solar panel compatibility (Escape 30, Boulder 15, Nomad 27, and Nomad 13). These solar units are available with rated outputs of 300W, 2,000W, and 500W. The units come with AC and PV charging options and can be charged by a wall charger, a car charger, and solar charger. A digital panel displays the status of the battery in real-time. The battery pack supports 120/240VAC output voltages and frequencies. A Type G AC output socket/charging cable is supported by this unit. This product can be charged using solar panels (PV) with a max input voltage of 150Vdc and MPPT input voltage of 18~50V DC. The portable battery pack weighs 26.4lbs and measures 15.9" x 8.4" x 10.2".

Larson Electronics
www.larsonelectronics.com

WHEN IT CAME TO SECURELY ATTACHING
5.38 MW OF SOLAR PANELS TO THEIR ROOF,
TOYS "R" US DIDN'T PLAY AROUND.



American made S-5-PV kits and clamps are the industry standard in metal roof mounting hardware. That's why the biggest names in business rely on our solar mounting solutions. They know that it's only secure, if it's S-5! secure.

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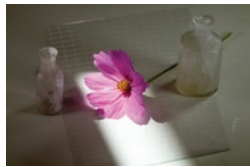




Solar pipe rack fittings

Hollaender Manufacturing has introduced a new family of Speed-Rail solar pipe rack fittings which allow installers of Unirac ULA large array pipe rack kits to use standard 2" IPS Sch. 40 pipe as cross braces in place of the current Unirac supplied square braces. The new fittings allow installers to use the same pipe for cross bracing as is used for other pipe components. Hollaender's Speed-Rail slip-on pipe fittings are used with aluminum or galvanized steel, strong and lightweight, and come in a wide variety of fixed and adjustable configurations, including the tees and flanges most commonly used in solar panel installations. All Speed-Rail fittings are made of 535.0 aluminum-magnesium and are backed by a 10-year warranty against corrosion, will not rust, and can be used with galvanized steel or other metals without concern for galvanic corrosion.

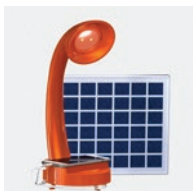
Hollaender Manufacturing
www.hollaender.com



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SolarWindow Technologies applies its electricity-generating coatings onto flexible glass only 0.1 mm thick. It is flexible enough to bend without breaking or cracking. SolarWindow's coatings are suitable for curved and non-flat surfaces in automotive, aircraft, and military applications.

SolarWindow Technologies | www.solarwindow.com



Solar-powered, rechargeable lamp system

Elevate Technologies Corp introduces the IntelliEnergy Lamp lighting and energy solution for no-power applications. A solution for utility, recreational, and/or emergency lighting situations, the solar-powered IntelliEnergy Lamp works as a flashlight, a table lamp, and a relocatable wall-mounted fixture delivering illumination and serving as a smart power source for charging USB devices. With power processing, rechargeable LFP batteries, 5W solar panel, long lasting LEDs, and durable materials throughout, the IntelliEnergy Lamp will reliably light any space and keep cell phones, tablets, cameras, and other USB devices powered for daily use. The lamp's microprocessors auto-sense battery type as well as solar panel size and power, and applies the correct charge sequence for fast, efficient, and safe, optimized charging. The IntelliEnergy Lamp never over-charges or over-depletes batteries. Built in timer and charge status LEDs provide an extra level of convenience.

Elevate Technologies Corp.
www.nopowerlighting.com

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Racking, Mounting, and Solar Trackers

Along with quality panels, it's important to ensure a solid base and a supportive structure for a successful solar installation. The following highlights a variety of mounting and racking solutions available, along with their key features, to help solar designers and installers find the best option for their project.

SEE AD ON PAGE 35



DPW | SOLAR MOUNTING SOLUTIONS



DPW Solar

Product: POWER DISK

Application: Roof-mount

Angle: Flush

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/

Approvals: UL 2703

Warranty: 10-year manufacturer's warranty

Key Features:

- Rail-less roof mounting system;
- Base attaches anywhere on the roof;
- Compatible with most framed PV modules;
- Spin the disk for easy vertical adjustments;
- Integrated grounding.

www.dpwsolar.com

SEE AD ON PAGE 13



Structural Solar LLC

Product: Canopy and Ground Mount Structures

Application: All parking areas and ground mounts

Angle: up to 45°

Material: Galvanized and aluminum structures

Pre- or Post-assembly: From supply only to fully installed

Certifications/ Approvals: AISC

Warranty: Structures durable for 40-years

Key Features:

- Structural design;
- Manufacturing;
- Construction.

www.structuralsolar.com

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ISA Corporation

Product: WSS Elevated Racking

Application: Commercial roofs, existing parking structures

Angle: 0° to 40°

Material: High strength aluminum and stainless steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: PE certified in many states

Warranty: 15-year warranty with extension options

Key Features:

- Fully kitted for quick assembly, pre-assembly available;
- Elevated arrays to reduce shade potential and maximize roof usage;
- Each mounting post supports 6-12 modules to reduce roof penetrations;
- Customized designs available to conform to space requirements;
- 3D layout of racking on proposed roof provided with quote.

www.isa-corporation.com





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- Commercial and residential solutions
- Flat roof pitch roof and ground mount

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Everest Solar Systems, LLC

Product: CrossRail Shared Rail

Application: Sloped roof

Angle: Flush to roof slope

Material: Aluminum and stainless steel

Pre- or Post-assembly: Pre- and post-assembly

Certifications/Approvals: UL Listed

Warranty: 12-year warranty

www.everest-solarsystems.com



Sollega, Inc.

Product: Sollega String Inverter Mount
Application: Roof-mount, ground-mount
Angle: 20°
Material: Ultramid (glass reinforced nylon) and aluminum
Pre- or Post-assembly: Pre-assembly
Certifications/Approvals: PE Stamp
Warranty: 25-year warranty
www.sollega.com



PV Racking

Product: Clamp-Free Solar Mounting Systems
Application: Roof-mount, ground-mount
Angle: 9° to 45°
Material: Aluminum and galvanized steel
Pre- or Post-assembly: Post-assembly
Certifications/Approvals: UL 2703
Warranty: 15-year warranty
www.pvracking.com



DCE Solar

Product: Contour
Application: Ground-mount
Angle: 5° to 35°
Material: Galvanized steel structural members, stainless steel hardware
Pre- or Post-assembly: Pre-assembly of C-beams to angle braces
Certifications/Approvals: UL 2703
Warranty: Up to 25-year warranty available
www.dcesolar.com



SnapNrack

Product: SnapNrack Array Skirt
Application: Roof-mount
Material: 6000 Series Aluminum, stainless steel hardware, and rubber

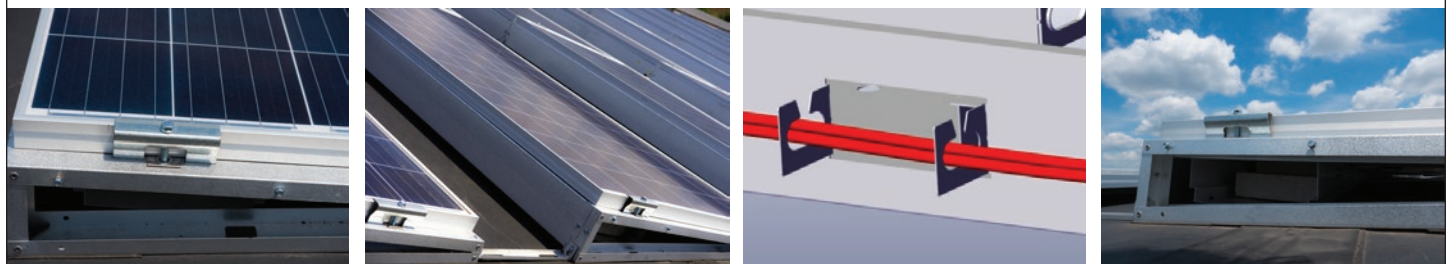
Pre- or Post-assembly: Pre- and post-assembly
Warranty: 20-year warranty
www.snapnrack.com



- ✓ Higher Net Profits
- ✓ Integrated Wire Management
- ✓ Code Compliant

Why Installers Love Our Racks

HIGHER NET PROFITS INTEGRATED WIRING CODE COMPLIANT CUSTOM DESIGNS MADE IN THE USA



It's fair to say installers love SMS racks. Why? Because they arrive pre-assembled with all the hardware pre-inserted. SMS racks are code compliant and can be custom designed to meet customer requirements. Installers don't even need to provide extra parts for wiring as SMS racks incorporate THRU-IT™, our patented integrated wire management system. Most of all they love that they can be off the roof in half the time and on to their next job, which translates into higher net profits. Call us at 845-565-6363 and find out how you can love our racks too.

- Average 50% faster to install than any other rack
- Rack arrives direct from factory with **all** hardware pre-inserted
- Integrated wire management system
- Ballast protected from environment and contained per code
- Low profile design equals less ballast blocks
- Single tool installation
- EPDM rubber strips are pre-applied - shipped direct
- Available in Galvanized Steel/Aluminum/Painted (powder coated)
- 20 Year Warranty (25 years available), Made in NYS USA
- Preferred rack by solar installers



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 NY 12550
 USA

Phone: 845-565-6363
 Fax: 845-565-3709
 Ron Bibbo - Sales: 908-442-5803
 Email: info@mountsfor solar.com

MOUNTSFORSOLAR.COM

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TRA Snow & Sun

Product: Shadow Power Awning System

Application: Commercial, residential fixed side wall

Angle: Side vertical walls

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: 100% IBC compliant; meets or exceeds tile roofing best practices

Warranty: 25-year manufacturer's warranty

Key Features:

- Simple, easy-to-install mounting system for mounting solar panels to any vertical structure;
- Available in landscape and portrait;
- Fewer parts equals lower cost;
- Proves shade to windows, sidewalks, or structure below;
- Keeps the solar panels cool and efficient with constant airflow beneath the panels.

www.trasnowandsun.com

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RBI Solar

Product: Next Generation Ground-Mount

Application: Ground-mount, commercial, utility-scale

Angle: 5° to 40°

Material: Galvanized steel

Pre- or Post-assembly: Pre-assembly available

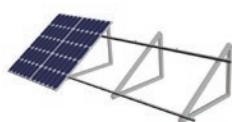
Certifications/Approvals: UL 2703

Warranty: 20-year warranty

Key Features:

- Foundation solutions available for all soil types;
- Proprietary on-site testing;
- Professional engineers licensed in all 50 states;
- Accommodates slopes up to 30% with topographic site map;
- National installation capabilities.

www.rbisolar.com



SunModo Corp.

Product: EZ Awning System

Application: Solar awning

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Warranty: 20-year structural warranty, 5-year finish warranty

www.sunmodo.com



Solarland USA Corporation

Product: SLB-0114

Application: SOP mount

Angle: 0° to 90° tilt angle

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Warranty: 5-year warranty

www.solarlandusa.com



We engineer, manufacture, and install every megawatt we sell, so we designed our new fixed tilt racks with the installer in mind, us.

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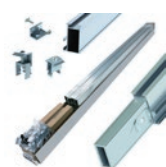


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SFlex, Inc.

Product: S:FLEX 12-Kit

Application: Pitched roof racking solution

Angle: 0° to 45°

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: IBC 2009, IBC 2012, UL 1703, UL 2703

Warranty: 10-year warranty

www.sflex.com



RoofClamp RC & RCT

Product: Mounting Clamp

Application: Standing seam metal roof

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: Tested up to 2,400lbs with 600lbs allowable loading when properly installed

Warranty: Lifetime warranty

www.roofclamp.com



Magna Structural Systems

Product: Fixed tilt racking

Application: Utility-scale ground-mount

Angle: Fully customizable

Material: Galvanized HSLA steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: ASCE 7-10, OBC 12, UL 2703 compliant (grounding and bonding), ISO compliant

Warranty: 25-year warranty

www.magna.com

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Ecolibrium Solar

Product: EcoX Rail-less Racking System

Application: Roof-mount

Angle: 0° to 90°, flush mount, parallel to roof angle

Material: Aluminum with stainless hardware

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703 (grounding and bonding, mechanical loading, fire for Type I and II modules), ICC waterproofing

Warranty: 15-year warranty

Key Features:

- Up to 30% fewer roof penetrations and streamlined logistics for quick and easy installation;
- Skirt or skirt-free options for a beautiful finish on composition, tile, and metal roofs;
- Ecolibrium Solar offers residential and commercial racking with fast installation and comprehensive customer support.

www.ecolibriumsolar.com

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Magerack Corporation

Product: MageMount Rail-less Solar Mounting System

Application: Roof-mount

Material: Aluminum alloy and stainless steel

Angle: Pitched

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703, Class 'A' Fire Rating

Warranty: 25-year warranty

Key Features:

- As strong as rail-based system;
- Roof attachment span is up to 6ft for landscape module layout and up to 4ft for portrait module layout;
- 30% fewer roof penetrations compared with rail-based mounting system;
- Installs like a rail-based mounting system with familiar and fewer components;
- All mounting components, including roof attachments, are self-bonded and grounded with one grounding lug;
- Includes roof attachments for all roof types.

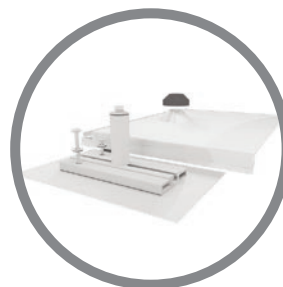
www.magerack.com



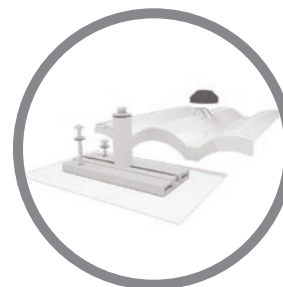
Tile Replacement Mount
Fast & Simple | Versatile | 100% Watertight



Say Yes To Tile



Flat Tile Mount



W Tile Mount



S Tile Mount

Say no to messy tile grinding or cutting.
Install solar *faster*.

Works with W-shaped curved tile, S-shaped curved tile and flat tile roofs.

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SEE AD ON PAGE 28



AP Alternatives

Product: Advanced Modular

Application: Fixed-tilt, ground-mount, commercial and utility-scale

Angle: Customizable from 2° to 45°

Material: Galvanized steel

Pre- or Post-assembly: Both pre-assembled and field-built options

Certifications/Approvals: UL 2703, PE stamped in every state

Warranty: 25-year warranty

Key Features:

- Pre-panelized option takes man hours out of the field and into a private wage QA/QC controlled manufacturing environment;
- Continuous table design seamlessly rolls with the topography, easily able to accommodate over 20% slopes;
- Shallow helical anchor foundations allow for extreme flexibility, even in adverse soil conditions;
- Compatible with all major crystalline and thin film module types;
- All hardware is manufactured in the USA.

www.apalternatives.com

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SolarRoofHook

Product: Low Profile QuickBOLT

Application: Roof-mount for asphalt shingle roofs

Material: Aluminum and stainless steel backed EPDM

Angle: 90°

Pre- or Post-assembly: No assembly required

Certifications/Approvals: Tensile, lateral, and water testing performed by Terrapin Test Labs

Warranty: 20-year warranty

Key Features:

- An extension of the QuickBOLT line, this is a flashing-free, leak-proof solar mounting solution for asphalt shingle roofs;
- The Low Profile QuickBOLT includes an L-Foot which sits flat on the leak-proof stainless steel backed EPDM washer without having to make any adjustments;
- The Low Profile QuickBOLT can be installed in less than 60 seconds;
- Mount the fixed-height Low Profile QuickBOLT and secure the L-Foot for a ready-to-go, level array, requiring no adjustments;
- All spec sheets, test results, and installation instructions can be found online.

www.solarroofhook.com



SolarDock

Product: SolarDock

Application: Flat-roof and ground-mount installations

Angle: Up to 35°

Material: Aluminum with stainless steel hardware

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: TUV Rheinland Certified; tested and passed proposed UL2703 standard; wind tunnel tested up to 150 mph

Warranty: 25-year warranty

www.solardock.com



TerraSmart

Product: TF2

Application: Ground-mount

Material: ASTM A 1011 Cold Rolled Steel, Hot Dip Galvanized to ASTM A 653 (G90 min) ASTM A 500 Hollow Structural Steel, Hot Dip Galvanized to ASTM A 123 (3.0 mils min), 316 Stainless Steel for all Module Mounting Hardware, Carbon Steel Alloy, Mechanically Galvanized to ASTM F2833 for all Structural Hardware

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703, Edition 1, CPP Wind Tunnel Tested. NEC Compliant, Load capacity up to 170mph Wind Speed and 100 PSF Ground Snow Load, Tilt angle 5° to 40°, Slopes: East or West Facing: up to 30%, North or South Facing: up to 36%

Warranty: 20-year warranty

www.terrasmart.com

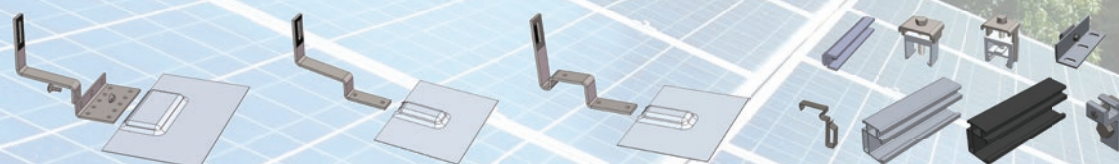
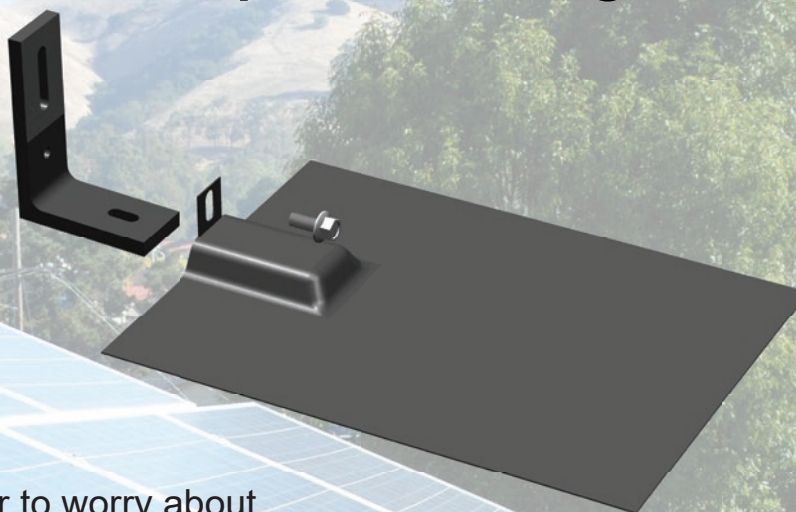


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Lowest Cost
Unbeatable price

Most Reliable
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No hole on flashing surface
Absolute waterproofing

Easiest to Install
Simple design
Intuitive to install
No tiny rubber seal and washer to worry about



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Advanced Racking Solutions

Advanced Racking

Product: TRP - Total Roof Platform

Application: Roof-mount

Angle: 0° to 10°

Material: Aluminum and stainless steel

Pre- or Post-assembly: High degree of pre-assembly

Certifications/Approvals: UL1703, UL2703 Bonding Grounding

Warranty: 10-year warranty with 20-year warranty available

Key Features:

- Simplifies the ordering, installation, and management of PV racking hardware;
- Fits all types of roof tops; shingle, metal, and flat, making racking hardware simple;
- Design fully supports the module, no corner clamping, and uses the same rail, splice bar, and clamps for each roof type;
- Roof connection kits work seamlessly with the TRP platform, providing efficiencies in hardware recycling, inventory storage, racking hardware installation;
- Advanced Racking focuses on the US market. hb solar Canada focuses on the Canadian market.

www.advancedracking.com

SEE AD ON PAGE 29

Quick Mount PV®

RESPECT THE ROOF



Quick Mount PV

Product: Tile Replacement Mount

Application: Roof

Angle: Sloped roofs

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: 100% IBC compliant; meets or exceeds tile roofing best practices

Warranty: 20-year warranty

Key Features:

- Versatile: Works with Flat, S-shaped, and W-shaped tiles;
- Flexible: Works with all standard rail-based racking systems;
- Simple and clean: No time-consuming, messy tile grinding or cutting;
- Double flashed: Flashed at both the deck and tile levels for code compliance;
- Waterproof: Features patented QBlock Elevated Water Seal Technology.

www.quickmountpv.com



Zomeworks

Product: FXL-260 (up to 4kW)

Application: Pole-mount rack

Angle: 0° to 45°

Material: Welded steel, aluminum

Pre- or Post-assembly: Post-assembly

Warranty: 10-year warranty, materials and workmanship

www.zomeworks.com



OMG Roofing Products

Product: OMG PowerGrip and PowerGrip Plus

Application: Roof-mount

Material: Galvalume plate with membrane specific to the roof

Warranty: Through roof system manufacturer where applicable

www.omgroofing.com

5-Panel Ballast Ground Mount System

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Galvanized components • Sets up in minutes
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Powers Super Purlin
U.S. Patent No. 8857133

Gator Clamp
TÜV Approved Grounding
\$1.50/ea
Patent Pending

Powers Systems
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Reduced Installation Time
Less Labor - Less Material

For more information: Steve Jones • 615.415.0082 • steve@powerssolarframes.com

Visit our website to see our Solar Carport Systems • www.PowersSolarFrames.com

SEE AD ON PAGE 34



TerraGen Solar

Product: TGR flat roof mounting system

Application: Any type of flat roof

Angle: 0° to 35°

Material: Aluminum and steel

Pre- or Post-assembly: Pre-fabrication completed

Certifications/

Approvals: Tested to UL 2703 standards, Wind tunnel tested in accordance with ASCE 7 Standard, National Building Code of Canada (NBCC) 2005 [2010], International Building Code (IBC) 2006 [2012], Ontario Building Code (OBC) 2006 [2012]

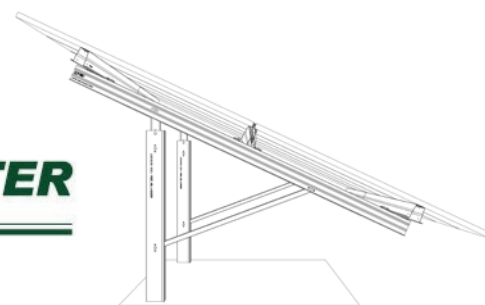
Warranty: 10-year warranty

Key Features:

- TerraGen's TGR mounting system was designed to minimize the installation time. Each system is fabricated on a project specific basis, enabling pre-assembly of many system components prior to shipping to site;
- Reduced installation cost and time;
- The TGR mounting system does not use the module frame for the structural integrity of the mounting system. The system is designed to minimize the amount of material needed, while ensuring module warranty is not voided;
- The TRG system is able to accommodate any tilt angle and any inter-row spacing;
- By utilizing north-south and east-west rails, the TGR system is typically under 3 psf for a 10° system. Save on ballast and labour costs with the minimal ballast requirements of the TGR system.

www.terragensolar.ca

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Schletter Group

Product: G-Max Fixed-Tilt Ground-Mount

Application: Ground-mount for utility-scale and commercial projects

Angle: 10° to 35°

Material: Galvanized steel

Pre- or Post-assembly: Pre-assembled with only 4 components to be installed in the field

Certifications/Approvals: UL 2703 pending

Warranty: 20-year standard warranty

Key Features:

- Modules can be installed either from top-down or bottom-up creating a safer installation with reduced ladder or scaffolding requirements;
- As much as 20% reduction of piles creates an overall reduction in manufacturing times, improved shipping costs, simplified site deployment, and faster installation time;
- Combined purlin design eliminates fourth purlin in portrait resulting in a 25% reduction in material and handling;
- G-Max includes visual quality assurance measures designed into the system including part identification numbers and embedment depth call-out.

www.schletter.us



Fabrack Solar, Inc.

Product: Four Season Variable Racking

Application: Ground-mount

Angle: 30°, 45°, 60°

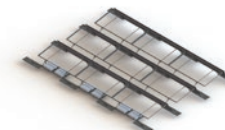
Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: Fully engineered

Warranty: 25-year warranty

www.fabracksolar.com



Polar Racking

Product: PRG: Flat roof ballasted mounting system

Application: Rooftop

Angle: 5°, 10°, 15°

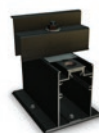
Material: Aluminized steel

Pre- or Post-assembly: Minimal roof assembly

Certifications/Approvals: UL 2703, Class A fire tested for type 1 and 2 modules

Warranty: 10-year warranty backed by a third-party insurance company

www.polarracking.com



Roof Tech, Inc.

Product: E Mount Air

Application: Asphalt pitched roofs

Angle: 1:12 to 12:12

Material: Anodized aluminum

Certifications/Approvals: UL2703, ASTM 2140, ICC ESR-3575

Warranty: 10-year warranty

www.roof-tech.us



ILSCO

Product: Copper Flex Braid

Application: Grounding and bonding

Material: Electro-tin plated pure copper

Pre- or Post-assembly: Pre- and post-assembly

Certifications/Approvals: UL 467 Listed

Warranty: One-year manufacturer's warranty

www.ilsco.com

CSS RACKING THE PROBLEM SOLVER FOR COMMERCIAL ROOFS



- Best Solution for Weak Roofs
- Anchors to Strong Building Girders
- Maximizes Roof Area for Solar
- Elevates Solar to Clear AC Units
- Tilts up for Roof Work



www.isa-corporation.com

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Solar Mounting Solutions

Product: SMS Low Profile Ballasted Racking System

Application: Roof-mount for ballasted flat-roofs

Angle: 5°, 10°, and 15° standard, other angles available

Material: Galvanized steel, aluminum/SS, hardware pre-installed

Pre- or Post-assembly: Components pre-assembled, all hardware pre-inserted

Certifications/Approvals: UL 2703, UL 467 grounding and bonding, CPP in progress

Warranty: 20-year warranty, 25-year available

Key Features:

- Ballast blocks are completely covered by panels and protected from the elements;
- All stainless steel hardware is pre-inserted at the factory for fast and easy installation;
- All EPDM rubber is pre-applied at the factory for fast and easy installation;
- Only one hex nut driver is required for complete assembly;
- Factory pre-installed grounding and bonding clips.

www.mountsfor solar.com

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MT Solar, LLC

Product: Top of Pole Mounts **Key Features:**

Application: Ground-mount

Angle: 5° to 90°

Material: Steel

Pre- or Post-assembly: Post-assembly

Warranty: 10-year warranty

- Typical lead time is 10 days or less for orders under 20 mounts;
- The entire mount, from the frame to the solar modules, can be installed on the ground. Once assembled, it can be lifted to the top with the chain hoist;
- With the simple hand crank tilt mechanism, a homeowner can easily adjust the tilt from 5° to 90° while standing comfortably on the ground;
- All mounts are made with standard parts, which allows Dealers and Distributors to stock them in their warehouses or change the design halfway through the order;
- Fits 1 to 20 60-cell modules or 1 to 15 72-cell modules on a single pole. Any configuration of 4 or 5 high in landscape over multi-poles.

www.mtsolar.us



Silverback Solar

Product: 60 Series

Application: Roof-mount

Angle: 3° to 75°

Material: Galvanized and stainless steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 1703

Warranty: 20-year warranty

www.silverbacksolar.com



AceClamp

Product: AceClamp A-2 Solar Kit

Application: Roof, SSMR

Angle: Various

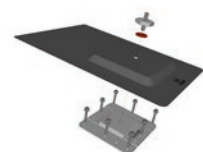
Material: Stainless steel, aluminum, brass

Pre- or Post-assembly: Pre-assembled

Certifications/Approvals: FM approved, UL listed

Warranty: 20-year warranty on manufacturer's defects

www.aceclamp.com



Zilla Corporation

Product: Double Stud XL Flashing

Application: Roof-mount

Angle: Flush mount on composition/ asphalt shingle roofs

Material: Galvanized steel base plate and aluminum flashing

Pre- or Post-assembly: Post-assembly using standard tools and hardware

Certifications/Approvals: Passed AC 286 evaluation standards using the methodology of UL 441

Warranty: 10-year limited warranty

www.zillarac.com

INTRODUCING THE SOLAR CONNECTIONS KIT

Solar Panel Mounting System For Standing Seam Roofs

- ⚙ Easy Installation
- ⚙ Tested to the UL 2703 Standard
- ⚙ Fully Grounded and Bonded



SOLARCONNECTIONS.COM
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 800-815-SOLAR

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Solar Connections International

Product: Solar Connection Kit

Application: Roof-mount

Angle: Varies; perpendicular to roof

Material: Aluminum with some stainless steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 1703, UL 2703

Key Features:

- UL 1703 and UL 2703 Listed;
- Fully grounded and bonded;
- Universal design works with most solar panels;
- Knurled pattern on top bolt for extra grip;
- Integrated cable management for a clean installation.

www.solarconnections.com

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Arctech Solar

Product: Fixed-tilt, ground-mount

Application: Ground-mount

Angle: 10° to 45° field adjustable

Material: Galvanized steel, stainless steel hardware

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 2703 Certified by ETL

Warranty: 10-year warranty with optional extensions

Key Features:

- Very low part count;
- Able to mount to nearly any foundation required;
- Available in Landscape or Portrait;
- Field adjustable tilt angle;
- Field adjustable for wind and snow loads.

www.arctechsolar.com

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GROUNDING MID & END CLAMPS WORK WITH NEW WIRE MANAGEMENT SYSTEM

- Adjustable to fit various modules
- One tool installation
- Sold pre-assembled



EcoFasten Solar

Product: Rock-it System 2.0

Application: Roof-mount for composition shingle or tile

Angle: Fixed

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703 First Edition, System Class A Fire Rating

Warranty: 10-year limited product warranty

www.ecofastensolar.com



Unirac, Inc.

Product: ROOFMOUNT | RMDT (Dual Tilt)

Application: Ballasted flat-roof

Angle: 8° dual tilt

Material: Galvanized G235 steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 2703

Warranty: 20-year limited product warranty

www.unirac.com



KB Racking

Product: EkonoRack

Application: Flat roof

Angle: 5°, 10°, 12°, 15°

Material: Aluminum, stainless steel fasteners

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: ETL Certified to UL Standard 2703

Warranty: 10-year standard product warranty

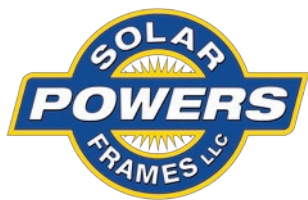
www.kbracking.com

TGR Flat Roof Mounting System

- ✓ Lower total cost
- ✓ Lowest global loading
- ✓ Any tilt angle, any interrow spacing

Request pricing or learn more:
1 855 988 3772
www.terragensolar.ca

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Powers Solar Frames

Product: Posted ground-mounts, ballast ground-mounts

Application: 5-high posted ground-mounts, 5-high ballast ground-mounts

Angle: 0° to 30°

Material: Galvanized steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: Gator Clamp provides Bonding



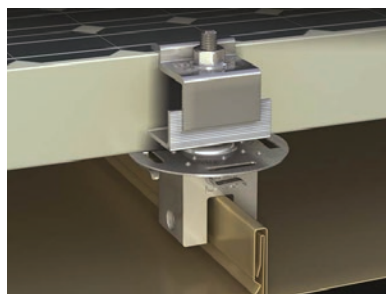
Warranty: 20-year limited warranty

Key Features:

- All systems feature Powers Solar Frames' patented Super Purlin Panels;
- Secure to purlin using patented Gator Clamp;
- Speed of installation saves install time and labor costs;
- Cost efficient.

www.powersolarframes.com

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S-5!

Product: S-5 PV Kit

Application: Roof-mount, standing seam, and exposed fasten (trapezoidal and corrugated)

Angle: Flush to roof

Material: Aluminum 6061 T

Pre- or Post-assembly: Either pre- or post-assembly

Certifications/Approvals: UL 2703 listed for bonding and mounting, ETL 1703



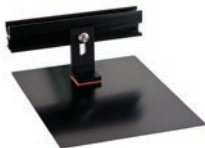
Warranty: 25-year manufacturer's warranty against manufacturer defect

Key Features:

- Works with all S-5 clamps and S-5 brackets;
- Unprecedented holding strength with S-5 clamps;
- Costs less than .08 cents for mounting hardware;
- Direct attach solution, no rails or racks necessary.

www.s-5.com

SolaRack



Product: SolaRack Composition L-Foot Kit

Application: Roof-mount

Material: Aluminum L-foot, lag, and rail attachment bolt

Pre- or Post-assembly: Pre-assembly

Warranty: 15-year limited warranty

Certifications/Approvals: UL 1703 Fire Class Rating A Type 1 & 2

www.solarackusa.com

SunWize Power & Battery



Product: Large Format Side of Pole Mounts

Application: Side-of-pole mount

Angle: 15° to 60°

Material: Aluminum with stainless steel hardware

Pre- or Post-assembly: Post-assembly

Warranty: 1-year warranty

Certifications/Approvals: Certified up to 140MPH Wind Speeds per IBC 2012, ASCE 7-10, Zones B & C

www.sunwize.com



SunRise Solar America, Inc.

Product: Drop On Solar Arrays

Application: Residential rooftop

Angle: Any roof angle

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: Patented

Warranty: 20-year standard warranty

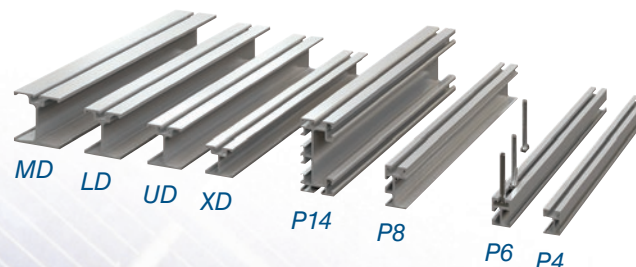
www.droponsolar.com

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Patent Pending



A Cost Saving Rail Solution for Every Application



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KINETIC Solar Racking and Mounting

Product: K-Flash

Application: Pitched-roof, ground-mount, and flat roof

Angle: Flush-mount up to 40°

Material: Anodized, extruded aluminum

Pre- or Post-assembly: Some pre-assembly required

Certifications/Approvals: Fully engineered, LCAB, UL 467, CSA-C22.2 No.41

Warranty: 20-year warranty

Key Features:

- Easy-to-use, quick-to-install;
- Knowledgeable staff;
- 100% watertight flashing;
- Low per-watt price;
- Widely available.

www.kineticsolar.com



Pegasus Solar

Product: LightSpeed Mounting System

Application: Residential composite or tile roofs

Angle: Up to 45°

Material: Aluminum mounting hardware, powder coated skirts

Pre- or Post-assembly: Pre-assembled factory components, field installation, web design tool

Certifications/Approvals: UL Sub 2703, ASCE 7-05, ASCE 7-10, and AC286 Rain Test standard with and without Sealant

Warranty: 10-year warranty

www.pegassussolar.com



Spice Solar

Product: Spice Built-In Racking

Application: Roof

Material: Galvanized steel, aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL-1703, UL-2703, FSEC, LADWP, CA Fire Codes, System Fire Class Rating A, Type 1 & 2 Modules

Warranty: 10-year warranty

www.spicesolar.com



Solar Speed Rack

Product: Solar GroundMount

Application: Ground-mount, utility-scale, commercial, and residential

Angle: 0° to 35°

Material: High strength steel, stainless steel, and anodized aluminum

Pre- or post-assembly: Nearly all components are pre-assembled, and/or kitted for rapid install

Certifications/Approvals: UL 467, PE Certified

Warranty: 10-year warranty

www.solarspeedrack.com

Cable Management that works with your racking system

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www.obous.com

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SINGLE AND MULTI POLE MOUNTS
Fits Any Size Solar Module

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EASE OF INSTALLATION
- Build it on the ground
- No Cranes or Heavy Equipment Necessary

www.MTSOLAR.us 844-MT-SOLAR (687-6527)

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Gamechange Solar

Type of Tracker: Single-axis

Drive System: Linear actuator

Modules per Row: Up to 90 modules

Module Mount: Bolts, nuts, star washers, or star washers and river washers

Slope Tolerance: N/S slopes of 5%, E/W slopes of 13%

Tracking Range: 90° to 120°

Standard Configuration: 1 up in portrait

Certifications: UL 2703, CPP wind tunnel, Black&Veatch Bankability

Key Features:

- Secure monitoring and control tracker array in real-time via an encrypted cloud portal; SCADA solution available;
- Real time tilt and battery level information, remote control for each tracker's tilt through Cloud VPN or proprietary network;
- Stow windspeed varies with time of day, averages 70+ mph. Typical stow time under 2 minutes with Smart Stow Technology;
- Each linear actuator has an integrated solar panel and battery providing integrated backup power of up to 5 days;
- High intrinsic damping eliminates costly dampers, and reduces material cost.

www.gamechangesolar.com/tracker

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OMCO Solar

Product: OMCO Field-Fast Racking System

Application: Ground-mount, utility-scale

Angle: As specified

Material: Galvanized and aluminum steel

Pre- or Post-assembly: Pre- and post-assembly

Certifications/Approvals: UL 2703

Warranty: 20-year warranty

Key Features:

- Proprietary design reduces installation costs and ensures proper construction;
- Simple and fast assembly;
- Easy module install;
- Turn-key system install capabilities.

www.omcoracking.com



Exosun

Type of Tracker: Horizontal single-axis

Drive System: Rotative drive, multi-row system

Tracker Length: From 65' to 98' (20m to 30m) depending on DC configuration

Tracker Height: Average 3.2' (1.5m)

Pile Count: 0.1 pile per module (450 piles per MW with a 310V module)

Modules per Row: From 20 to 30 depending on DC configuration

Module Mount: Unique double support, no need of additional rails. self grounding module clamp

Slope Tolerance: 10% in all directions, between each table and each row

Tracking Range: 50°

Standard Configuration: 3 standards: csi modules 1000V: tracker 30 rows of +/- 20 modules each; csi modules 1500V: tracker 20 rows of +/- 30 modules each; First Solar four 1500V tracker 20 rows

Preventative Maintenance Required: Restricted to minimum, only 530 key elements for 100MW installed. No sensors or batteries, only industrial long-lasting solutions

Tracker Power Consumption: 500 including stand-by mode

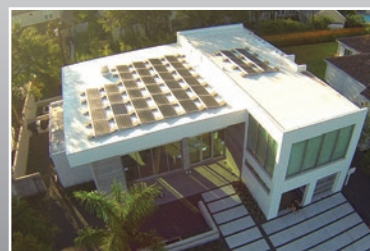
Certifications: Eurocodes, asce, SANS, UL

www.exosun.net

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EcoX Rail-less Racking
Unsurpassed installation ease on pitched shingle, metal and tile rooftops.



EcoFoot2+ Ballasted Racking
Impressive install time of 13.5 modules per installer-hour* on flat rooftops.



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Scorpius Trackers



Scorpius Trackers, Pvt., Ltd.

Type of Tracker: Horizontal Single-axis, Tilted Single-axis, Dual-axis

Drive System: Linear actuators (array), gear motor drive (row)

Tracker Length: 206' (63m) (N/S row length)

Tracker Height: Up to 6' (1.8m)

Pile Count: Between 225 to 450, depending on configuration

Modules per Row: Up to 126

Module Mount: Clamps or bolts and washers

Slope Tolerance: E/W 14%, N/S 5%, row tracker

Tracking Range: +/-60° in E/W

Standard Configuration: 2 or 1 up in portrait, 2 or 4 in landscape

Preventative Maintenance Required: Not required

Tracker Power Consumption: self-powered

Certifications: Wind tunnel, Independent Engineers Certification

Key Features:

- No cabling or power and communication;
- Completely wireless;
- Few connections, few posts, fast install time;
- Bearings have zero maintenance for 50+ years;
- Predictive maintenance intelligent stow;
- Advanced processor, GPS based real time tracking.

www.scorpiustrackers.com

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shoals TRACKER

Shoals Technologies Group

Type of Tracker: Single-axis horizontal, ganged configuration with linkage

Drive System: Electromechanical; electric motor and linear screw jack

Tracker Length: Row length is always 2 strings long. Actual dimension varies with location and voltage of project. A typical 1500V is 24 rows with each row 197' (60m)

Tracker Height: 5' (1.5m)

Pile Count: 1 pile per 6 modules

Modules per Row: Always 2 strings; 1000V project, 36, 38, or 40; 1500V, 56, 58, or 60

Module Mount: Rolled formed rail/clamp

Slope Tolerance: E/W (along linkage) +/- 10°, N/S 5%

Tracking Range: +/- 45°

Standard Configuration: Linear actuator in the center of tracker block, 2 strings per row. For 1500V, up to 24 rows, for 1000V, up to 32 rows

Preventative Maintenance Required: Lubrication of screw jack every 3 years. Check torque marks on bolts

Tracker Power Consumption: 0.5

Certifications: UL 2703, UL3703, Black and Veatch due-diligence, PE stamp

Key Features:

- Designed to install quickly with less hardware;
- Steel is all post hot-dipped galvanized;
- High quality industrial motors and gears eliminate downtime and maximize energy harvest for all PV technologies: crystalline, CIGS, and CdTe;
- Shoals BLA covers from the back of the glass to the inverter.

www.shoals.com




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AllEarth Renewables

Type of Tracker: Dual-axis

Drive System: Hydraulic

Tracker Length: 12' to 15' (3.65m to 4.57m)

Tracker Height: 18' to 21' (5.48m to 6.4m)

Pile Count: 1

Modules per Row: 4

Module Mount: Rail and clamp

Slope Tolerance: 0° to 60°, +/- 10°

Tracking Range: 360°

Standard Configuration: 60 or 73 cell modules, 24/20 panels

Preventative Maintenance Required: Once per tracker per year

Tracker Power Consumption: 100kWh per tracker per year

www.allearthrenewables.com



SunLink Corporation

Type of Tracker: Single-axis
Drive System: Distributed electric motor and slew drive
Tracker Length: 304' (93m) (90 module row)
Tracker Height: Project specific
Pile Count: 11 piles per 90 module row
Modules per Row: Up to 90

Module Mount: Module rails, module clamps
Slope Tolerance: 10% constant grade and 2% change in grade N-S, any practical E-W
Tracking Range: 120°
Standard Configuration: 1 high in portrait

Preventative Maintenance Required: Annual visual inspection. Grease slew drive every 5 years. Tracker performance monitored by Vertex.
Tracker Power Consumption: Self-powered
Certifications: ETL Listed to 2703 (grounding and bonding)
www.sunlink.com



GP Joule

Type of Tracker: PHLEGON Single-axis tracker
Drive System: Direct current linear electrical actuator
Tracker Length: 27.5' (8.38m) per bloc
Tracker Height: ~11' (3.35m) at max tilt
Pile Count: ~275 piles/MW dc
Modules per Row: up to 84 x 72 cell modules per row
Module Mount: Direct bolt
Slope Tolerance: +/- 7° N/S
Tracking Range: -45° to +45°
Standard Configuration: 3x4 landscape
Preventative Maintenance Required: None required
Tracker Power Consumption: 2-3MWh/yr/ MWdc
Certifications: CE, CSA, UL Listed
www.gp-joule.com



NEXTracker

Type of Tracker: Single-axis tracker
Drive System: Decentralized, self-powered (no drive system)
Tracker Length: Up to 311' (95m)
Tracker Height: 48" above flood clearance
Pile Count: 0.13 piles/module
Modules per Row: up to 93 modules
Module Mount: Rail and clamp mountings available
Slope Tolerance: 15%
Tracking Range: 120°
Standard Configuration: Modules in single portrait orientation
Preventative Maintenance Required: Annual visual inspection
Tracker Power Consumption: 0kwh/MW - self-powered tracker
Certifications: UL 2703 & 3703, II suppliers ISO 9001 certified
www.nextracker.com

safeTrack Horizon

The cost-effective horizontal tracking solution for every challenge



Less leveling work

Flexibly adapts to terrain on slopes with inclines of up to 20° in all directions thanks to a new drive system, making expensive grading unnecessary

Lower O&M costs

Low-maintenance components and a construction which enables easy, automated cleaning, reducing operating costs



High ground cover ratio

The ground cover ratio of the safeTrack Horizon is the highest of all comparable systems, enabling the installation of up to 33% more capacity on the same area

Ready for glass-glass modules

The fully synchronous drive technology prevents tracker twisting, allowing for the use of glass-glass modules



German engineered tracking systems made by

TRACKING & MOUNTING SYSTEMS

www.ideematec.de

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Krinner Solar LLC

Type of Tracker: Krinner Tracking System

Drive System: Linked system with screw jack, single drive also available

Tracker Length: Up to 325' (99m); standard linked 204' (62m); standard single drive 270' (82.5m)

Tracker Height: Center pivot axis 4.26' (1.3m)

Pile Count: 400 to 500 piles per MW, depending on wind and soil conditions

Modules per Row: Up to 96 (for 1500V strings); standard linked 60 modules; standard single drive 80 modules

Module Mount: Standard one row vertical (in portrait); 2 or 3 in landscape possible

Slope Tolerance: Rigid pivot axis N/S 6° / 10%; E/W 10° / 17%; pivot axis with universal joint (hinged system) N/S 15° / 26% per joint

Tracking Range: -50° to + 50° for linked system (central drive); -60° to + 60° for single drive

Standard Configuration: Central drive: 60 to 84 modules (72 cells) in portrait; single drive: 80 to 96 modules (72 cells) in portrait

Preventative Maintenance Required: Central drive: no maintenance, only the screw jack once per year; single drive: no maintenance, only the oil-level in the slew gear must be checked (through oil level windows)

Tracker Power Consumption: Central drive: 300kWh/MW and year (average); single drive: standard self-powered > 0 consumption

Certifications: Designed according to standards DIN; EN ISO; UL, TÜV certifications

Key Features:

- Tracker system for all terrain types;
- Maximum flexibility for plant design;
- Maximum reliability and durability;
- Extremely minimized maintenance;
- Maximum cost savings for installation and civil work;
- Central drive and single drive design.

www.krinner-solar.com

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Ideematec

Type of Tracker: Single-axis, horizontal tracking system

Drive System: Single row electrical drive unit (AC and DC)

Tracker Length: 500' (150m)

Tracker Height (top of posts): 13.2' (4m)

Pile Count: 16 modules/foundation

Modules per Row: 2 modules in portrait or 4 modules in landscape

Module Mount: Rivets

Slope Tolerance: 36% N/W/S/E

Tracking Range: Up to 58°

Standard Configuration: 2 modules in portrait on 28-32 rows per table; 5 tables per tracker

Preventative Maintenance Required: Recommended but not required

Tracker Power Consumption: 1800kwh / MWp per year

Certifications: UL, CE, TUV

Key Features:

- High peak power results in low cable costs;
- High terrain tolerance results in lowest grading costs;
- Suitable for 1500V and 1000V solutions resulting in high layout flexibility;
- No modules twisting due to patented synchronized drive units. Also fits frameless modules;
- Low amount of foundations results in fast onsite installation.

www.ideematec.com

As of January 2017
Arctech Solar's cumulative installed capacity
has reached

10GW

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Arctech Solar Holding Co., Ltd.

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End-to-end tracking solution : hardware, tracker controller & structure designs.

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India's largest 10 deg TILT, Auto E-W tracking plant

- Awarded 'Solar Trackers Company of the Year' for 2015 and 2016 at the Global Solar EPC Summit.
- Several MW class installations currently under operation in **India, USA, Africa, Middle East, Japan.**
- **Global** product & design **patents.**
- Proven tracker technology that **enhances energy generation by upto 25%.**
- **In-house facilities** and instrumentation that enable **research, validation & testing.**
- **Project pipeline of over 500 MW** for FY 2016-17.

About Scorpius Trackers
Scorpius offers the best in Tracking Technology, from maintenance-free bearings for the lifetime of the plant, to electronics and actuators that are self-powered. Truly, world-class bankable technology at very competitive upfront CAPEX and minimal O&M costs.

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Scorpius Trackers Pvt Ltd
397/6-7, Senapati Bapat Road
Pune - 411016, Maharashtra, India
T: +91 20 2565 9413
E: info@scorpiustrackers.com

ScorpiusTrackers
www.scorpiustrackers.com



DEGERenergie

Type of Tracker: Single-axis DEGERtracker S100-PF-DR with MLD technology

Drive System: Maintenance-free screw drive

Tracker Length: 78' (24m)

Tracker Height: 7' (2.15m)

Pile Count: 5

Modules per Row: 44

Module Mount: Rails and clamp

Slope Tolerance: +/- 1° to the most energetic position with MLD technology

Tracking Range: +/- 50°

Preventative Maintenance Required: None required

Tracker Power Consumption: 435kWh/ MW-year (87 systems/MWp)

Certifications: CE, UL

www.deger.biz

SEE AD ON PAGE 7



Array Technologies

- Type of Tracker:** Horizontal single-axis
- Drive System:** Flexibly linked rotating driveline
- Tracker Length:** Variable, average 296' (90m)
- Tracker Height:** Variable, minimum post height is 42"
- Pile Count:** Variable, average 7 modules per pile
- Modules per Row:** Up to 93 modules
- Module Mount:** Single-bolt module clamp
- Slope Tolerance:** 40° cone flexibility along driveline, 15% grade along the N/S module row
- Tracking Range:** +/- 52°
- Standard Configuration:** 90 modules per row, 28 rows per module block
- Preventative Maintenance Required:** None
- Tracker Power Consumption:** 405kWh/MW-year
- Certifications:** UL 3703, CE

- Key Features:**
- (R)evolutionary tracking system designed to lower lifetime costs and deliver measurable value to solar power plant owners;
 - Flexibly linked row design, with each industrial-grade motor driving up to 800kW, effectively reduces the number of potential failure points to a minimum and allows quality sourcing of key components for long-term reliability;
 - Ease of installation and significant upfront cost savings through ATI's single-bolt module clamp, material kitting, pre-assembled components, and relaxed installation tolerances;
 - Zero scheduled maintenance for 30 years. The DuraTrack HZ v3 drivetrain is lubricated and sealed for life. ATI designs for the full site-specific wind load at full tilt angle without relying on active wind stow or UPS. v3 features a passive wind management system which mechanically responds to loads on a row-per-row basis, improving tracker performance.

arraytechinc.com

SEE AD ON PAGE 3



Soltec America, LLC

- Type of Tracker:** Horizontal single-axis
- Drive System:** Sealed slewing drive, DC motor
- Tracker Length:** 151.6' (46m)
- Tracker Height:** 5.11' (1.55m)
- Pile Count:** 7 piles per 90 modules
- Modules per Row:** 90
- Module Mount:** Omega rails with rivets or bolts and nuts
- Slope Tolerance:** N/S 17%; E/W unlimited
- Tracking Range:** 120° +
- Standard Configuration:** 2 x 45
- Preventative Maintenance Required:** Yes
- Tracker Power Consumption:** 216kwh/MW-year
- Certifications:** UL 3703, IEC 62817
- Key Features:**
 - Cost effectiveness enabler;
 - Yield enabler;
 - Land-use enabler;
 - Factory serviced product.

www.soltec.com



Grupo Clavijo ETL, S.L.

- Type of Tracker:** Single-axis one-row
- Drive System:** Slew drive
- Tracker Length:** 295' (88.9m)
- Tracker Height:** 4.9' (1.49m)
- Pile Count:** 9
- Modules per Row:** 90
- Module Mount:** Rails, clamp, rivet
- Slope Tolerance:** 10%
- Tracking Range:** +/- 55°
- Standard Configuration:** 1V x 90
- Preventative Maintenance Required:** According to demand
- Tracker Power Consumption:** 1.5A
- Certifications:** TUV NORD, ISO 9001, ISO 14001, EN 1090, IEC62817
- www.grupoclavijo.net



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Raising Standards. Promoting Confidence.

OMCO Introduces New Field-Fast Mounting System

and uses 7GW of experience to showcase the *real* cost savings opportunities of the utility market



The evolution of the solar industry has just taken another big step, as OMCO Solar launches new proprietary racking and mounting systems, along with related support services, including a traveling Road Show and the OMCO Racking University. The company has also recently expanded to support the construction of their racking systems which includes module installation; a turn-key offering direct from each OMCO location.

OMCO Roll-Forming, with manufacturing facilities in four states, has been a contract manufacturer of various metal components for a wide range of industries for over 60 years, with core capabilities in roll-forming, welded tube production, stamping and assembly.

Historically, OMCO Solar has operated the same way - it has always manufactured while giving engineering support to structures specific to their customer-owned designs.

Over the years OMCO Solar evolved into the largest manufacturer of custom solar mounting structures for the utility sector. To date the company has produced over 7 GW of steel and aluminum components and assemblies while working with EPC groups, OEMs, and a customer base encompassing most of the major players in the fixed-tilt and tracker supply chain.

However, OMCO is moving in a new direction to make the market far more efficient.

Todd Owen, Director and General Manager of OMCO Solar, stated that 2016 was a transitional year for all participants as the priority of schedules for utility projects became uncertain due to the recent tax credit extension. He believes 2017 will be just as unique as major players have spread out their resources more globally and new companies enter the market due to the removal of previous completion deadlines required for the ITCs. OEMs and developers have taken time to re-prioritize which has affected immediate project demand in the US.

Owen explained that the ITC extension has been a key driver in the recent spike in project bidding and he expects that 2018 will be the year for shovel-ready solar growth to exceed analysts' expectations.

Even so however, Owen says projects in the US must continue to evolve to cut costs and remain competitive without subsidies. All these factors have had an impact on OMCO's strategic plans.

Owen says although the company has always manufactured structural Balance of System racking for its customers, and has spent years providing engineering support to achieve the best possible product at the lowest cost, the time had come to step back and revisit the current structure of the market as a whole.

The result: OMCO is unveiling the first of its new proprietary racking systems and announcing its vertical integration of the structural BoS and transformation to a supplier-manufacturer with installation capabilities.

"We have the internal capabilities to provide structural analysis to optimize each individual jobsite and we've created these product lines through a great deal of market due diligence."

Owen says OMCO understands what the jobsite needs in order to be much more price competitive with conventional energy in all regions.

"We've created innovative designs for the purpose of reducing overall project costs, this includes eliminating common headaches that our customers have experienced in the past. OMCO has compiled the research to make sure that the new tooling for these systems can accommodate various project requirements without having any delays or additional capital investments. Another benefit is that we have structured our manufacturing capacities to support projects from all four OMCO locations, a major cost advantage for the customer."

Owen believes that OMCO can save developers a tremendous amount of cost and time by educating all the participants on the features of each structure, showing actual time studies and providing hands-on demonstration. This will facilitate more competitive and realistic project costs and also help achieve or improve the target project completion date.

"It's all about educating for proper project bidding and project scheduling."

In February OMCO rolled out the OMCO Road Show and began visiting developers, EPCs, and construction firms across the country. The custom trailer showcases the new racking system and all of the benefits of the OMCO mounting structures with hands-on demonstrations. These demonstrations are coupled with an interactive software system which immediately provides jobsite head count, field costs, and daily installation velocity expectations.

OMCO has also recently launched OMCO Racking University, a free full day training program at a demo site near its solar headquarters in Phoenix, Arizona where installers construct structures with input from OMCO project engineers and product managers. The program is open to any participant in the solar industry.

Get more information and check out the videos at OMCORACKING.COM.





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Simple. Fast. Safe.

7GW
in Solar Structure
Experience



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Lightening quick
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Solar Structures & Carports

Solar power carports and structures take full advantage of large areas, such as parking lots, for the purpose of producing electricity while, at the same time, providing shade and a covered area for users. Gaining popularity over recent years, these solar structures are ideal for generating renewable power without sacrificing valuable real estate. The following listing offers details about some of the more popular options available on the market today.

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Structural Solar LLC

Product: Solar Carports, canopies, pavilions, ground-mounts

Roof Inclination: 0° to 25°

Height Clearance: Unlimited

Depth: up to 60'

Space-to-Column ratio: Columns typically on 27' centers

Configuration: All types

Options: Architectural options, roofing, lighting, charging stations

EV Charging: Yes



Panel Type: All types of modules including bi-facial frameless modules in water management system

Power Generated: no limit

Certifications: AISC certified fabrication and coating

Key Features:

- Licensed across the USA;
- Module-ready structures;
- Durable for 40 years.

www.structuralsolar.com

SEE AD ON PAGE 11



RBI Solar

Product: CP-T, CP-P, CP-LS, CP-GT carport solutions

Roof Inclination: 7° standard

Height clearance: 10' and 14' standard

Depth: 39' standard

Space-to-Column ratio: 4:1

Configuration: Portrait - standard

Options: Truss for higher loading conditions, multiple coating types, water management

EV charging: Mounting options available



Panel type: Compatible with all commercially available solar modules

Power Generated: site-specific

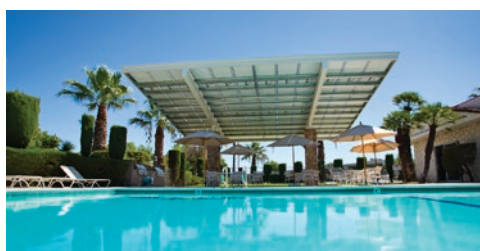
Certifications: In-house signed and sealed construction documents for all 50 states

Key Features:

- Maximize parking functionality;
- Structural single-source solution;
- No on-site welds for faster install;
- Multiple foundation options.

www.rbisolar.com

SEE AD ON PAGE 5



Baja Construction Co., Ltd.

Product: Custom designed and engineered solar support structures

Roof inclination: 0° to 15°

Height clearance: 7' to 14'

Depth: 10' to unlimited (20' to 40' is typical)

Space-to-Column ratio: 2:1 typical, with 4:1 max

Configuration: More than 3,000, standard solutions to accommodate any financial model. Most popular: full cantilever boxed

Options: Direct solar panel attachment to purlins, solar thermal panel option, thin-film or crystalline, as well as concrete bollards, field painting, fascia, standard and custom, and racking

EV charging: Available

Panel type: Neutral, can design/engineer to any model



Power generated: Based on module selection, orientation, layout and location. Baja can accommodate proposed PV layout, improving integration and implementation of solar to canopy structures

Certifications: NABCEP Technical sales/installation, certified fabricators, general contractor, licensed engineers, and certified welders. Baja is licensed in more than 27 States, plus Puerto Rico

Key Features:

- Fully designed, supplied, and installed by Baja;
- Pre-fabricated, pre-engineered, all-galvanized, and custom engineered to site, soils, local codes, and solar panels;
- Turnkey solutions with industry partnerships facilitate and improve project schedule timelines;
- Engineering includes footing design.

www.bajacarports.com



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SEE AD ON PAGE 46



Schletter Group

Product: Park@Sol Carport

Roof Inclination: Compatible with most module types, orientations and inclinations up to 20°

Height Clearance: Variable, dependent upon design

Depth: Variable, dependent upon design

Space-to-Column ratio: Variable, dependent upon design

Configuration: Customized for the customer and considers local conditions such as ground conditions, wind, and snow loads

Options: Customized foundation including cast-in-place concrete ballasts, concrete pillars, and micropile integrations

EV Charging: Compatible with most EV charging stations

Panel Type: Compatible with most module types

Power Generated: Several hundred megawatts of installed PV system for both commercial and residential applications

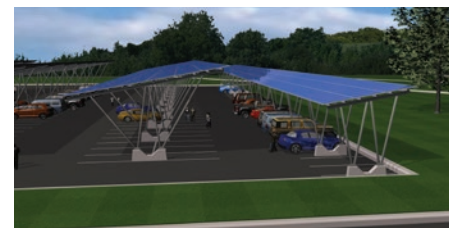
Certifications: 100% IBC 2006, 2009, 2012 code compliant systems, with PE wet stamps available in most states

Key Features:

- Park@Sol Carport allows customers to use real estate wisely with a multi-functional solar structure. Maximize space to create a usable surface for solar energy while also providing shade for parking or pedestrian areas;
- The Park@Sol system is a versatile solar carport solution offering different design options for both single and double rows of parking;
- Schletter can accommodate any site situation with customized foundation options including cast-in-place concrete ballasts, concrete pillars, and micropile integrations;
- Achieve longer spans between foundations, reduce costs, and simplify the installation process with Park@Sol.

www.schletter.us

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Inovateus Solar

Product: Solar Carport

Roof inclination: 7°

Height clearance: 14' 6"

Space-to-Column ratio: 18'

Configuration: East/West Facing V-Shaped

Options: Architectural options, roofing, lighting,

EV Charging: Available

Panel type: Canadian Solar including bi-facial frameless

Power generated: 15516 MWh/year

Key Features:

- Inovateus Core Values: PEACE - Passion, Engage, Ambition, Creativity, Esprit de Corps;
- Durable, modular, easy installation;
- No loss of parking spots;
- Module-ready structures;
- Licensed across the USA.

www.inovateus.com

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Kinetic Solar

Product: Solar Carport

Roof Inclination: 10°

Height Clearance: 7.2'

Depth: 20'

Space-to-Column ratio: Single carport occupies 2 parking spots (min 8.8' parking spot width)

Configuration: 24 Panels, landscape

Options: Off-grid with battery, grid-tied with FIT (non-roo'op), and net-metering

EV Charging: Level I or II EV chargers to charge up to 2 vehicles

Panel Type: Can accommodate any panel

Power Generated: 6.85kW system size. The installation is an off-grid setup with batteries from Canadian Energy.

Key Features:

- Level III fast DC chargers with battery option can be integrated with larger carports;
- Durable, modular, easy installation;
- Engineered to withstand over 150mph winds;
- No loss of parking spots;
- Innovative foundation solution with no excavation.

kineticsolar.com



Mounting hardware for the US and Canadian markets.



Online Design tool for metal, shingle, and ballasted rooftop coming in mid March. Powered by PV Complete. Annual output based on location. Scaled Visual layout. Bill of Material per design.

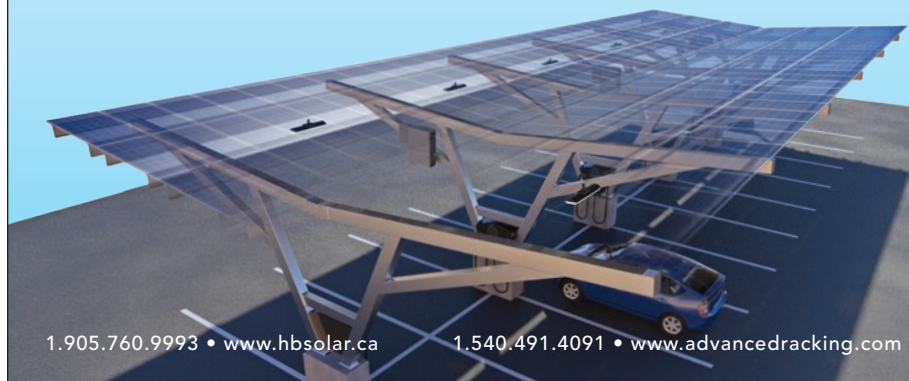
"We've been using the Total Roof Platform for nearly a year on different roof types. It's a flexible solution and has increased our installation efficiency. I definitely recommend." Craig Pals, Vice President, Tick Tock Energy

SKYPORT®

Innovation for solar carports

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- Car friendly drive through design
- EV charge ready
- Dual & mono slope capabilities
- Designed for snow loads
- Water collection features
- Stamped engineering package



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hb solar Canada

Product: SKYPORT Solar Carport

Roof Inclination: 5° or 10°

Height Clearance: 11.3'

Depth: 20.7' or 38.9'

Space-to-Column ratio: 16.2' to 26.7'

Configuration: V or mono slope

Options: LED lighting ready, water sealing and collection, banner space, decking enclosure

EV Charging: EV charger ready

Panel Type: All standard solar modules

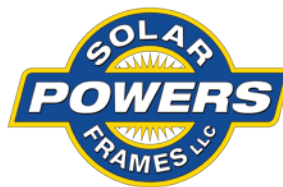
Certifications: Pending

Key Features:

- Car friendly drive through design;
- EV-Charge ready;
- Engineered for the Canadian and U.S. markets;
- hb solar focuses on solar mounting structures in Canada. Advanced Racking Solutions is the U.S. mounting division.

www.hbsolar.ca

SEE AD ON PAGE 31



Powers Solar Frames

Product: Solar Carport Racking and Mounting

Roof Inclination: 0° to 10°

Height Clearance: Up to 16' clear height

Depth: 20' to 40' typical depending on system

Space-to-Column ratio: 2:1 typical and more

Configuration: Tee Frame or Semi-Cant Frame systems utilizing patented Powers Super Purlin

Options: Panels secured to purlins using patented Gator Clamp

EV Charging: Systems are adaptable for EV charging equipment

Panel Type: Framed or frameless

Power Generated: KW hours determined by panel selection

Certifications: Gator Clamp is TUV certified to provide Bonding path

Key Features:

- Systems utilize Powers Solar Frames' patented Super Purlin and Gator Clamp;
- Reduced installation time;
- Reduced material costs;
- No need for installers to be on top of the structure;
- Manufactured to order.

www.powersolarframes.com

G-Max

Pre-Installed Connection Points

Reduces touch points, installation time, and margin of error in field

40% Span Increase
In purlins

On-site QC
Factory printed ID # and description for improved quality control

30% Pre-assembly
Girder, head, and strut unfold in field allowing for single person installation

Introducing G-Max

Schletter set high expectations with its renowned aluminum FS System, providing the industry with exceptional quality and ease-of-installation. Now, Schletter offers the next generation of racking with G-Max. Quality, exceptional ease-of-assembly in the field, and competitive pricing—in a steel mounting system.

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E-mail: mail.ca@schletter-group.com



www.schletter.us/gmax | www.schletter.ca/gmax



Orion Carport Systems & Construction, Inc.

Product: Carport

Roof Inclination: 0° to 10°

Height clearance: 9' to 14'

Depth: 19' to 40'

Space-to-Column ratio: 2:1

Configuration: Tee and semi-cantilever

Options: Single, double row carports

EV charging: Yes

Panel type: 60-, 72-cell framed or frameless

Power Generated: Approximately 17,000kwh per carport/year

Certifications: UL

www.orioncarports.com



Lumos Solar, LLC

Product: SolarScapes

Roof Inclination: 7.5°

Height Clearance: Min. 8'

Depth: Varies

Space-to-Column ratio: Varies

Configuration: Low Side (LS), High Side (HS), T Support (TS), Dual Support (DS), V Support (VS)

Options: Steel finishes (powder coat allows for almost any color), rain gutter, sealability

EV Charging: Available add-on

Panel Type: LSX Frameless Solar Modules - Clear

Power Generated: Varies

Certifications: Solar Modules Certifications

www.lumossolar.com



Skyline Solar of AZ

Product: Solar Carport Structures

Roof Inclination: 0° to 15°

Height clearance: 7' to 25'

Depth: 10' to 50'

Space-to-Column ratio: 2:1 to 6:1

Configuration: Landscape or portrait

Options: Single or double cantilevered, double post and beam, straight or tapered beams, exposed piers, deck, painted or galvanized

EV charging: Charging station can be attached to the columns

Panel type: Specified by integrator

Certifications: AISC Certified fabrication shop, OSHA Certified / CPR trained crews, Certified field welders

www.skylinesteelinc.com



YOU'RE A PROPERTY OWNER OR INVESTOR WHO ALREADY

operates or is interested in building RV and boat storage. There's an easy way to maximize the return on your investment and generate additional profit. It can even help the developer make faster headway through the approval process. What is it? The addition of solar panels to your RV and boat storage facility.

Adding solar to your facility increases both the revenue from the solar installation and shaded parking. This concept calculates the revenue from the solar income from either a feed-in tariff or net metering project as well as the shaded parking revenue.

Let's examine the advantages of building a solar RV and boat storage project. First it allows you to reduce your tax liability and increase your net operating income. Solar creates a secondary revenue source to bolster your storage rental income, again, increasing your NOI. A solar installation allows you to enrich the value of your real estate with a capital improvement that can be depreciated over five years rather than the standard 30. You can also receive a tax credit from the federal government equal to 30% of the costs associated with solar. Finally, when solar canopies are installed, it supports the production of solar power, while generating revenue from the shaded parking the solar modules provide above. All the power produced is being sold back to the utility, on a 20 year fixed rate contract.

The layout, design and engineering are extremely critical in the creation and success of a solar project. Generally, the project includes both solar and non-solar canopies. The goal is to maximize rentable space while erecting canopies that can support the weight of the solar components. These structures have no roof deck, and the reason they have no roof deck on them is so they qualify for the Federal tax credit and accelerated depreciation. There are other factors you need to consider when you decide to use solar for the roof shade rather than the roof decking. The solar structures require more purlins and it requires a dead load of 3 pounds per square foot, that's what the solar panels weigh. You have to design that into the structures. Most all projects are designed so that all the of the structures can support solar at some time in the future. The parking spaces are 13 feet wide and angled at 60°. Perhaps the most important element in the design of the project, the orientation of the canopies. The structures are positioned to maximize the production of solar power. The slope of the roof maximizes your production. You want to keep water off of the panels and create drainage at a 10° angle.

Modules are attached directly to the purlins of the fixed elevated structure specifically engineered to support their weight. Again, the solar arrays double as the shade structures under which boats and RVs are stored. With the deadweight of 3 pounds a square foot for the panels, you have to design the structures to support the extra deadweight with additional purlins being installed. Solar panels have to be attached in a very precise way so that their warranty is not voided and no damage to the module is incurred during or after installation. The panels generate DC wholesale power that is fed directly back into the utility grid under a small generator feed in tariff program. This translates into automatic monthly revenue for the facility owner.

There are some obstacles that could affect the budget of an RV boat or any self-storage project. Solar helped surmount some of the obstacles. In many cases the city is not overly excited about the prospect of adding another RV and boat storage facility to the already crowded market in many areas. At times the project owner is faced with a good deal of opposition and several attempts to sidetrack the project.

A few of the major obstacles I've seen are easily taken care of with solar.

-No drainage to the property. The city wanted the owner to drain the surrounding 90 acres at the cost of 1.5 million dollars. They also wanted the owner to put in 500 feet of sewer which would cost another half million dollars. SOLUTION- The city allowed a retention pond instead of installing a drainage system, that allowed the plans to include a septic tank instead of sewer.

-There was no gas, electricity or water to the property. SOLUTION- After playing around with different options of trying to get the city behind the project, the owner prevailed over many of these red lights by adding the solar component to the site design. The water district even ran water to the facility for no charge.

All of a sudden everything opens up and began to move forward. When the city is opposed to a traditional boat RV storage facility, adding solar

quickly turns the red light green. It is like a magic wand is waved and all of a sudden the negativity surrounding the project turns into a great idea.

The other primary obstacle for an RV and boat storage project is financing. Funding is challenging to find for a new project in a fairly depressed community and economy. Again, the solar components save the day. Once a project secures a 20 year guaranteed revenue stream from the public utility company, the money from lenders began to flow.

In a successful Solar RV and boat storage project, the property owner purchases, installs, owns and operates the photovoltaic system at the storage location, contracting with the utility to sell all of the energy produced at a fixed rate, paid monthly for a 20-year period. By entering a feed-in tariff contract with the utility company, the owner creates a bankable annuity that he can take to the bank to secure financing. A good example is a solar feed in tariff contract with PG&E. In this example the utility is paying the property owner \$0.13 a watt over a 20-year timeframe. Basically every kilowatt produced is fed to the electric company and they pay the owner for it. It's turned out to be way better than what the owner thought it was going to be. Having had no idea of the amount of power that were producing and the way it's being paid monthly basically covered all of the owners' debt service within 18 days. This project was cash flowing in the first 18 days. The first check from PG&E was for \$34,000. The payment to the bank was \$32,000 so the project was cash flowing from day one.

So how does this solar system work? The panels produce the power in DC and the electricity feeds into an inverter which then converts it to AC. Each inverter has a capacity of 500 kW. There are a half a million watts feeding into each inverter. The inverters then send the AC power over to the interconnection site at the utility power pole. The closer you are to the interconnection point of the utility, the better off you are.

To see and project how much energy the solar site is and should be producing, the owner can use an online monitoring program like Draker, which is the one used by Oakley Executive RV and Boat Storage. When you sell power back to your utility they're going to require a monitoring system. With the Draker system you can go online and see real-time exactly how much power you're producing per inverter. The monitoring system gives you a ton of information, way more than most people are able to read, but you can tell whether or not it's producing power and how much it's producing. There's also alarms, if for some reason there's a problem, it will send you an alarm instantaneously. The metrics also make great selling points to storage consumers.

How do you know if your property is suitable for this kind of operation and how might it compare to the general proof of concept? A good candidate would be someone that owns property in a medium demographic, average middle-class and above, around the \$57,000 average income and being near a large city or on the way to recreation is ideal. From there you can look into two of the criteria that would apply. Is there a large energy need or usage on that property that we could offset? And/or Does your particular utility and state have a feed-in tariff opportunity? Your construction team can help you identify those issues and whether they will allow you to pass the first tier. Then look at things like interconnection and the viability of current power into the grid and whether the utility is willing to receive it in. Your facility's solar options are based on your ability to secure a reservation from your local utility company for a feed-in tariff



or for net metering. The incorporation of solar to an RV and boat storage project also opens financial avenues that might not otherwise be available to you.

The differentiating factor between a traditional storage facility and a solar RV boat storage facility, is that solar allows you to debt service the entire project and that makes it very comfortable for the bank to get a 20-year contract with the utility company, guaranteed payments. As long as they can feel comfortable with that utility company and/or the AAA creditor, the business risk of starting a solar storage facility is minimized. That's what we found and that's what the bank has reinforced in asking us to find more projects that include solar with RV and boat storage.

Finally, incorporating solar into your storage project will improve the value of your real estate while creating significant tax advantages. A solar project allows you a 30% federal tax credit and that tax credit comes right off of what you owe Uncle Sam. You should consult with your accountant about how to best use the 30% tax credit and five-year depreciation schedule. If you have a tax liability, you'll like what your CPA has to say about solar. There's a whole host of ancillary benefits as well for example, the positive public perception and general goodwill a green project attracts.

The benefits of building a solar project is that it makes life easier. No one wants to be in an adversarial relationship with an alternative energy project. Everybody wants to be for Mother Earth, everybody wants to be green. I've been installing carports for over 30 years. People used to ask me, "what you do for living?" I always replied, "steel carports." They looked at me puzzled. Nowadays they ask what you do for living and I say, "I build solar carports." Their eyes light up! That's the difference. We are emotionally and politically correct when we build solar projects.

I was at a Starbucks the other day and a neighbor came over to me and said, "oh my, I just saw your commercial for the solar RV and boat storage facility. That is the coolest thing I've ever seen!" I can guarantee you if I had a commercial about an RV boat storage facility they would not have had the same reaction, because the soul element of solar makes it really cool. It makes it interesting and makes you want to learn more about solar. We're seeing that's the norm with the tenants and people interested in building a facility. It's a wow factor.

Storage operators obviously generate revenue by renting parking spaces for boats, RVs and other vehicles. They can make even more money when they add solar shade structures creating a second revenue source. It will not only take profit to the next level but will also create real tax savings, reduce tax liabilities and allow accelerated depreciation opportunities.

What is the key to all of this? A solid business partner. One who can make the dream a reality. Pick a partner that has installed many of these same structures all over the United States. Find a partner that has over 30 years of experience, they have the most knowledge and expertise about the structures. They also know the best partners as far as solar goes, nationwide. Some carport installers have worked with over 50 different solar integrators throughout the United States. They can tell you who the good guys are and who the bad guys are in my opinion. Another value of choosing a veteran installer is the way they can design and optimize production, so it's not just about fitting the most spaces at a project site. It is also about orientating the panels and aligning the canopy so that you can get the best production. With a great PV optimization tool, you should be able to give them a site plan, they can produce a layout of the support structures that will optimize solar.

So are you interested in generating additional revenue with your boat and RV storage investment? Your next step is to reach out to the professionals and find out if your existing or planned project is a good candidate to make money from the sun.



Ground Screws & Anchors

Ground screws are becoming the choice in foundation methods. They eliminate the need for concrete and allow foundations to be quickly set. The following highlights a variety of available options to suit different applications and soil conditions.

SEE AD ON PAGE 48



Krinner Solar LLC

Product: Ground Screws S-Series

Description: The Krinner groundscrew is a fast and environmental friendly anchoring system designed to install large scale PV power plants quickly and cost-efficiently.

Material: Galvanized steel

Thickness: 0.14" (.36cm)

Length: 92.5" (235cm)

Thread Width: 0.78" (.2cm)

Thread Pitch: 2.36" (6cm)

Threads: 15

Key Features:

- Easy handling;
- Material efficient production;
- Quick-to-install;
- Special machinery.

www.krinner-solar.com

SEE AD ON PAGE 48



American Earth Anchors

Product: PE46-Hex8

Threads: 17

Description: 46" aluminum screw anchor that can replace concrete footings. The 8" extended hex head comes with two 3/8" clear holes for direct mounting of a 2" schedule 40 pipe. The PE46-Hex8 screws in and out with an impact wrench for easy leveling, will not rust, and weighs only 12lbs.

Key Features:

- Replaces concrete footings, no digging, forms, pouring, or waiting;
- Tested for up to 14,000lbs of pull out and 9,000lbs of down pressure;
- Aircraft quality 356 alloy, heat treated cast aluminum;
- Fast installation with 1 3/4" socket and impact-easy leveling by screwing up or down;
- Made for temporary or permanent application.

Material: Heat treated aluminum

Thickness: 1.75" (4.45cm) shaft

Length: 54" (137cm)

Flange Size: 4" (10.16cm)

Thread Width: 3" (7.62)

Thread Pitch: 2.25" (5.72cm)

www.americanea.com



Ground Connection, LLC

Product: Foundation ground screw

Description: Ground Connection's ground screws are used in lieu of concrete foundations in many applications including highway signs, solar LED lighting, and solar installations. Ground screws use the natural compression of the earth for strength and stability. They can be installed in minutes and do not disturb the site or require extensive clean up. They are an environmentally conscious solution.

Material: Cold rolled steel

Surface Treatment: Double hot-dipped galvanized

Diameter: 2" to 5" (5.08cm to 12.7cm)

Thickness: Varies, depending on size

Length: 22ft to 200ft (6.7m to 61m)

Flange Size: Various flanges available

www.groundconnection.us.com

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Milspec Earth Anchors

Product: Solar Helical Pier

Description: Solar pier with helical plate is a foundation alternative to cement or driven H-beam. Milspec's solar helical pier allows for greater loads and has an extremely high pullout resistance. With a 50-year minimum lifespan, they are easily removed and can be reused.

Material: API pipe

Surface Treatment: Hot-dipped galvanized

Diameter: 2 3/8"(6.03 cm), 2 7/8" (7.3 cm), 3 1/2" (8.89 cm), or larger if needed

Thickness: .190w to .337w

Length: 5ft to 10ft (1.5m to 3m) as needed

Flange Size: As required

Thread Pitch: 3" (7.62cm)

Threads: 1 to 3 helices

www.milspecanchors.com

Metal Fabrication for Solar Structures

Customized shapes and formed structures designed to mount, secure, and support solar panels are a significant component to any reliable solar power project. This is where processes such as roll forming and extrusion come into play. The following highlights some of the main companies involved in metal fabrication processes for solar components and related support structures.

SEE AD ON PAGE 38



Matenaer Energy Products

Process/Technology: Stamping, machining, laser cutting, bending/forming, manual welding, robotic welding, coating

Materials: Low carbon steel, high carbon steel, stainless, aluminum

Sizing: .0149" - 1" thickness

Shapes/Structures: coil, sheet, plate, angle, castings, channel, beam

www.matenaerenergyproducts.com



voestalpine Roll Forming Corporation

Process/Technology: 42 roll forming lines; laser and dual laser welding; high-frequency welding; laser cutting; bending; post-dip galvanizing; TOX and Tog-L-Lok; rotary stitch; pre-, mid-, and post-punching; and variable thickness materials

Materials: CRS; HR; HRPO; pre-paint; pre-galvanized aluminum; Titanium, Inconel, and Hastelloy alloys; stainless steel; HSLA; as well as brass, bronze, and copper

Sizing: 0.005" to 0.375" thickness, and 0.70" to 40" wide strip width

Shapes/Structures: Cee's, Zee's, Purlins, Struts, Sigma's, and many other complex shapes

www.rfcorp.com



RPM Rollformed Metal Products Ltd.

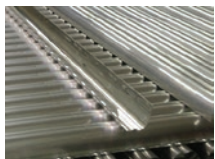
Process/Technology: Rollformed steel

Materials: Steel: Galvanized CRS, HRPO, galvalume, galvaneal and stainless, aluminum, brass, zinc, and copper

Sizing: Material 0.008" min, 0.168" max (future expansion: 0.250"); strip width 24"; length capabilities 12" min, 60' max

Shapes/Structures: Custom shapes, Z purlins, C channels, U channels, punching, notching, cut-to-length, pre-galvanized steel up to 7 gauge

www.rpmsteel.com



Samson Roll Formed Products Co.

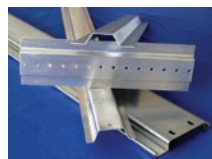
Process/Technology: Over 40 production lines offering custom roll forming services including a fully integrated service to develop, engineer, produce, and package component parts or finished products. Additional services provided include: pre- and post-punching/notching, secondary stamping, assembly, and Run and Ship Programs

Materials: Pre-coated, painted, anodized, embossed, galvanized, or laminated metals

Sizing: Range for finished profiles: 0.005" to 0.250" Thickness, 3/4" to 12" Slit Width, 6" to 480" Length, Up to 4" Maximum Part Depth

Shapes/Structures: Parabolic shaped channels, C, U, and hat channels, in a range of different coating weights, for use as brackets, photovoltaic array supports, or solar panel framing/trim, and other custom shapes for the solar industry.

www.samsonrollform.com



Johnson Bros. Metal Forming Co.

Process/Technology: Modernized equipment and tooling designed to offer roll forming services with the latest automated technology, including: pre-notching; pre-punching; cut-to-length; and post-fabricating, combined with the cut-length operations

Materials: All metals, including: ferrous and non-ferrous in either plain or pre-anodized; pre-painted; pre-laminated; pre-embossed; perforated; duplex; special alloy; pre-hard tempers; and more

Sizing: 0.005" to 0.150" thickness, and coil widths up to 20" wide before forming; maximum height of profiles 5.25" in the vertical axis

Shapes/Structures: Profiles; panel frames; reflectors; trim; support structure framing; Hat shapes; C-channels; U-channels; Zees; rings; and many other custom shapes for solar components

www.johnsonrollforming.com



Hynes Industries

Process/Technology: Hynes Industries fabricates roll formed solar racking components. Z-Purlin, C-Channel, C-Post, and custom roll formed alternatives can be used in ground piling applications in place of I-Beams or T-Beams. The material-efficient shapes offer structural strength, high bending in load bearing, and soil friction for reliable anchoring. Profiles can be nested for easy storage and transportation. Roll formed profiles are light and strong, reduce part costs, and eliminate secondary operations through in-line programmable punching of holes, slots, and other features.

Materials: Specialty corrosion resistant materials available, including hot and cold rolled, hot dipped galvanized, HSLA, pre-painted, vinyl clad and stainless steel.

Sizing: All shapes available in a wide range of standard or custom sizes.

Shapes/Structures: Z-Purlin, C-Channel, C-Post, and custom profiles for solar components.

www.hynesindustries.com

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www.nabcep.org

show in print

Features just some of the companies and technologies attendees will see at this year's show.



Strong racking for weak roofs

ISA's robust CSS Solar Racking allows for large distances between anchor posts, up to 25ft, so installers need only anchor to the building's strong main roof girders, which help support the load of the solar array. A related, cost-effective benefit is fewer mounting posts, which reduces anchor post sealing costs and minimizes the potential for roof leaks. All CSS arrays can be set up to tilt to the horizontal servicing position, allowing 4ft of clearance under the arrays for roof repair and replacement. ISA provides proposals with customized 3D layouts of the solar array on the building once module quantities, roof area, and main beam locations are known. A preliminary structural review can also be provided with the proposal.

ISA Corporation

www.isa-corporation.com



Waterproofing for composite/asphalt shingle roofs

E-Mount Lag from Quick Mount PV uses patented QBlock Elevated Water Seal technology to provide superior waterproofing on composition/asphalt shingle roofs. It is backed by solid engineering and certified for strength and waterproofing by the ICC-ES (ICC-ESR-3744). All-aluminum 9 x 12-inch flashing. All stainless steel hardware included for fast, single bolt installation. Meets or exceeds roofing industry best practices. 20-year limited product warranty.

Quick Mount PV

www.quickmountpv.com



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Rolls premium deep cycle 5000 Series flooded batteries offer dependable, long-lasting energy storage in a wide range of voltage and capacity options (80AH - 4860AH @ 20 hr rate). Suitable for use in small to large-scale off-grid, grid-tied, and backup applications, Rolls 5000 Series combines high quality, heavy-plate construction and modular cell configuration in a durable, dual-container case design. The 5000 Series premium line-up delivers superior cycle life, backed by a 120 month / 10-year warranty.

Rolls Battery Engineering

www.rollsbattery.com



Microrail pitched roof system

Unirac's SUNFRAME MICRORAIL (SFM) racking system includes a structural front Trimrail for fast array alignment and improved aesthetics. Minimize total labor with pre-assembled parts, integrated bonding hardware, and one tool installation. Compact packaging lowers logistics costs from the warehouse to the roof. Patented mounting components provide post-install height adjustment and allow for removal of individual panels for maintenance.

Unirac | www.unirac.com



AC battery

The Enphase AC Battery is simple to install, safe, reliable, and provides low lifetime energy cost for both new solar customers and retrofit customers. Installers can design the right system size to meet the needs of the homeowner.

Enphase Energy

www.enphaseenergy.com



Three-phase string inverter

Yaskawa - Solectria Solar's PVI 50/60TL three-phase string inverter is equipped with three MPPTs (five inputs per MPPT) and allow for 1.5 DC/AC ratio. These two differentiators alone allow improved design flexibility, enabling contractors to utilize varying array orientations, tilt angles, azimuth, string lengths, and modules, and therefore increasing a system's production output and ROI, and decreasing the number of inverters needed.

Yaskawa - Solectria Solar

www.solectria.com



Corrosion resistant cable management

The ACC-FPV wire management clip is made of corrosion resistant 304 stainless steel, which makes them a durable, long lasting, and reliable solution for all environments. The ACC-FPV is easy to install and slides straight on to module frames of various thicknesses up to 3.5mm. The ACC-FPV accommodates 1 to 2 PV cables up to 8mm in diameter. The rolled edges are designed to help protect cable insulation from damage. ACC-FPV clips are a solution for keeping the PV installation neat, clean, and free from ground faults. Made in the USA. UL 1565.

BURNDY | www.burndy.com



Solar ground-mount solution

RBI Solar's next generation ground-mount solution is specifically designed to reduce the cost of solar installation for commercial and utility-scale PV projects. This solution includes a wide selection of component parts using less material without sacrificing strength where strength is needed. After passing a rigorous testing regimen for bonding and grounding, the RBI Solar next generation ground-mount achieved ETL Classification from Intertek to UL Standard 2703. With five manufacturing facilities, RBI Solar customers benefit from shorter lead times and lower shipping costs on their solar racking solutions.

RBI Solar | www.rbisolar.com



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A Forecast Tailored to Your Needs

by Bertrand Crouzille



Blade intelligence

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A data story

It may seem obvious, but when it comes to forecasting the wind, you need to know a wind farm's production for a given horizon. A multitude of input data is required; the first is weather. This data may arrive in different forms, with several suppliers giving multiple resolutions and types, and could be improved with CFD (Computational Fluid Dynamics) models. CFD codes dedicated to wind resource assessment help to downscale the weather data.

Another type of data is the supervisory control and data acquisition (SCADA) produced by the wind turbine itself. This provides a wealth of information that can be processed to extract useful information for production. The last type of data is comprised of the real-time numbers of this same turbine, associated with local measurements on-site (if these are available).

In order for this information to be used in the most efficient way possible and improve your final production forecast, you must aggregate the data into a module of machine learning. A machine learning system can take various forms depending on the application. In the wind energy sector, the most frequently used is the Artificial Neural Network (ANN).

Weather data

There are several global models of meteorological data (ECMWF, GFS, GSM, GASP, Arpege, UM). Moreover, several suppliers today offer their own weather data, either from proprietary modelling or from an improvement on the global models.

It's very expensive to buy all the meteorological data from all the global models. Does it make sense to choose just one set of data? If so, which one? Each model has its own characteristics, advantages, and disadvantages. A model that works for one farm may not be appropriate for another. On the other hand, if you average all of the different data too quickly, too much information would be lost.

The current trend is to mix the models using a machine learning system. By taking a period large enough for accurate learning, you can adapt this data to any wind farm in any region.

A test was made on five wind farms with one year of weather data. Penalty savings were compared between two suppliers, as well as using a mix of the two. Notably, mixing data resulted in a gain of up to 37 percent on penalty savings.

Another way to improve weather data is by using a CFD code. Today, you have access to numerous CFD tools dedicated to wind resource assessment. They take into account a better resolution of ground and roughness, and even the thermal stability of a given location. The CFD downscaling is mainly useful in complex or forested areas, but can also aid in forecasting a new or repowered wind farm. Without historical data, the physical model with CFD is the best way to improve these results.

The SCADA data

SCADA is a veritable reservoir of information (stops, production, over and under production, curtailment, failures), which presents the following problems: What to do with all this data? How to use it? Should you keep it all? Do you need to average the availability of the farm? What about stops?

It's vital to study this data precisely, arrange it, clean it, find relevant indicators, and bring out the history of the machine. Fortunately, new software has developed to process this data optimally.

The real-time data generated by wind turbines and on-site measuring instruments make it possible to readjust measurement and forecasts. Analysing the state of the machine in real time allows readjusting of the forecast, especially on short times (using a persistent approach, in most cases).

The ANN

The excessive amount of input data (weather, SCADA, real time, etc.) must be used effectively. How can you mix this data? How can you find the best indicator for a given situation? The most commonly used machine learning system in wind energy is the ANN. The neural network is comprised of several nodes meant to mimic the biological neurons of the human brain. It creates links between each input variable and gives them weight. The goal, by studying the past, is to establish a large database that can identify all possibilities. This will ensure the highest production in any given circumstance.

The ANN must be optimized and calibrated according to the purpose of the forecast (maintenance, trading) and effectively adapt to the rules of these practices.

A study of five wind farms with one year of meteorological data found that optimized mixing allows systematic gains between 20% and 45 percent on the penalties savings.

Predict the big weather deviations

A problem that arises today, despite the learning and despite the improvement and processing of all these data inputs, is that significant deviations can appear and cause strong penalties. How can they be predicted?

Above all, you need a methodology and adapt it to your needs. You can generate reliability criteria for a given prediction. For example, when you have a deviation, what can you relate it to?

Is there a similarity between several suppliers? How is the accuracy of the deciles? When was the data last updated? Is there any confident parameter from the supplier?

The goal is to create an indicator that triggers an alert. The criteria you select are essential; you will need to arbitrate according to several. Ask yourself the following questions: How many false alarms can I accept? How many risky days without warning can I accept?

In conclusion

Regardless of the slew of data at your disposal (the precision of the input weather data, the improvement of this precision by the CFD, better use of SCADA data and real time, the improvement of learning machines) forecasting is not a one-off. You will always have to study each task, each purpose, and each goal in order to successfully tailor a forecast to your needs.



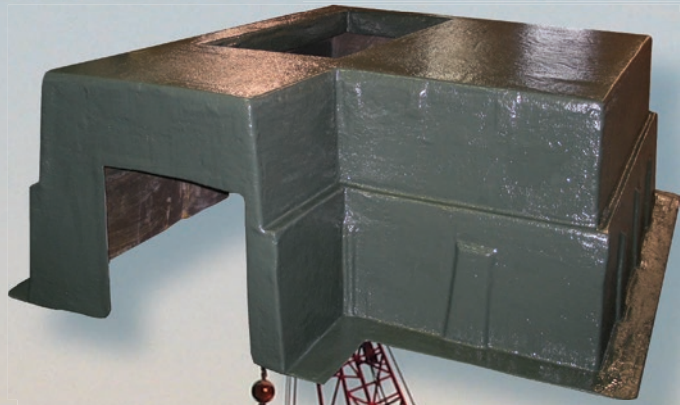
Bertrand Crouzille is the Communication, Support and Training manager for the worldwide company Meteodyn. Meteodyn develops CFD wind modeling, Operations and Maintenance and forecast software and provides climatological and energy studies (temperature, hygrometry, wind, sunshine, snow). Its consulting services focus on renewables, sustainable construction and city planning, and wind safety.

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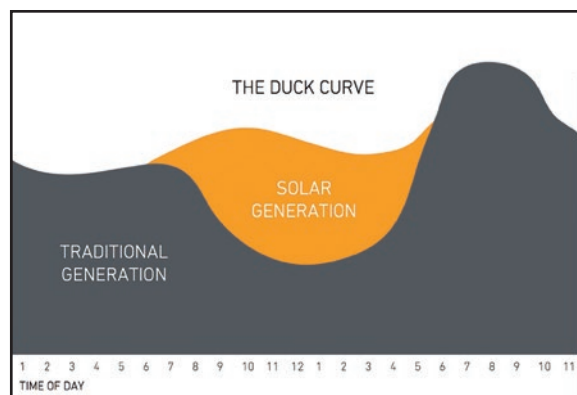


It's Time to Talk About Virtual Net Demand

by Brian Lakamp

OVER THE PAST 10 YEARS, MANY STATES IMPLEMENTED REGULATORY CHANGES to energy policy to establish net metering as a way to integrate solar into the energy mix. Net metering worked well to standardize the value of solar energy, providing clarity around the rates that solar developers can expect for the energy they produce.

Utilities have often been less than enthusiastic about net metering, though, because they are required to take inventory (electrons) at retail rates, with implied low margin on this excess inventory. As solar scales on a grid, physical and economic imbalances become more problematic for utilities as they are increasingly challenged to absorb the excess generation. Many know the consequence of this dynamic as the famed Duck Curve, which visually demonstrates the dramatic impact of scale solar generation relative to peak demand.



As solar's capacity on the grid grows and the Duck Curve takes form, net metering will be increasingly challenged. Utilities will employ various strategies to counteract it. Those strategies often include new demand charges, fixed charges and time of day energy pricing, to name a few.

On balance, fixed charges are a poor solution. They add a new cost to the rate base of users, while simply entrenching

existing market dynamics. Demand charges and time-of-day energy pricing are more powerful, creating new pricing dynamics that emerging providers and technologies (like energy storage) can leverage to create business opportunity around balancing the network.

Alarmists will tell you that these measures stand to create uncertainty and wild swings in rates for end consumers. If done blindly, maybe, but that's not a balanced assessment. Smart rate design can mute and manage the potential problems, while exposing market dynamics to propel deployment of a modern, flexible grid. On that front, New York has been a leader, and is already headed in this direction with its Reforming Energy Vision (REV) framework.

As markets evolve this way, there's will be new considerations and issues that emerge. There is one topic in particular that currently bears examination by industry and regulators.

Virtual net demand.

Today, we're largely tied to the notion that energy relationships are executed through single meters, each linked to a specific property. States like New York have started removing that dependency by enabling community solar as well as providing remote net metering allowances, albeit on a restricted basis. That's a start, but is ultimately just a coarse, monthly energy true-up, not a dynamic power balancing.

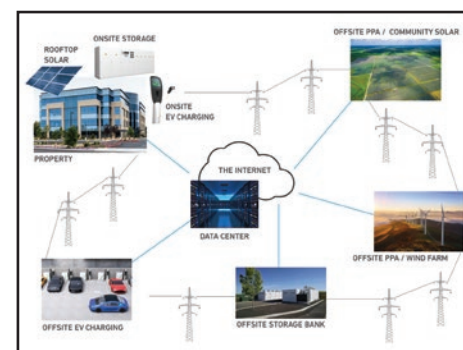
We need dynamic power balancing across properties. Virtual net demand is crucial to establish the flexibility necessary to address the Duck Curve and fully modernize the grid at speed.

In a future of community solar, energy storage, EV cars, autonomous fleets and new public-private partnerships, the marketplace needs more flexible, time-dependent relationships that span locations, measuring and optimizing demand across meters.

Imagine a future scenario with a business that:

1. Has a property with separate energy meters for the building and the parking lot
2. Subscribes to community solar for energy generation needs
3. Supports charging for owned and operated EVs (that charge both on property and off property)
4. Enables, without underwriting, charging of 3rd party EVs on property
5. Employs offsite storage to act in concert with all the above, balancing and optimizing energy usage

This is a real scenario in the near future with an energy footprint that spans locations and meters. As shown below.



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Distributed Energy Property

Note: An equally likely and similarly consequential scenario could use a single-family home, a school, a mall/retail facility, a commercial real estate owner, an industrial complex, or a mutual-tenant residential facility as the examples.

Understanding the distributed energy profile starts with technology to measure and align the generation and load sources at a data center in real-time. Then, technology can help implement decision-making around that information. Energy storage and controllable load sources (EV charging) can be deployed to optimize and balance out the network, based on real-time status.

It's all about dynamic energy accounting, a true-up of all energy resources tied to an entity, even those across properties. That's what Virtual Net Demand is: an information layer that lives atop the physical grid.

Here's the simple formula for Virtual Net Demand to sum up a series of power readings at a moment in time:

$$\begin{aligned} & \Sigma \text{ Property Meters} \\ & + \Sigma \text{ Remote EV Charging} \\ & - \Sigma \text{ Subscribed Solar Generation} \\ & - \Sigma \text{ Subscribed Wind Generation} \\ & \pm \Sigma \text{ Subscribed Solar Generation} \\ \hline & \text{Virtual Net Demand} \end{aligned}$$

A series of Virtual Net Demand calculations can be taken over time to calculate the energy impact, which is effectively a Remote Net Metering calculation.

Getting to the point, the smartest route is a regulatory examination of, push for and ultimately allowances around Virtual Net Demand, within certain grid and distance confines. Here are three reasons why.

1. Optimal integration of renewable generation ultimately is a function of minimizing net virtual demand across time for specific energy properties and the grid as a whole. If renewable generation, demand/load management and storage are dimensioned perfectly, virtual net demand should trend to zero over time, addressing the Duck Curve.
2. Freeing energy relationships to live across meters offers massive new network flexibility to meet looming network challenges.
3. Exposure of virtual net demand creates exciting, new large-scale business opportunities for utilities and new business. That manifests in the form of new products and brands, new technology such as community storage, new capabilities such as EV "roaming charges" reflected on unified utility bills, and new public/private partnership possibilities.

Each of these opportunities is worth a separate post, but at this point, transmission and delivery utilities should be jumping for joy. The market dynamic smells of unprecedented new upside over the next 30 years. To get a sense of that,

think about how Verizon's and Comcast's business evolved and strengthened since the advent of the internet.

Sure, the knee-jerk reaction of most utilities will be to lament the impact to demand charges. When considered more strategically, though, the utilities stand to co-opt demand charges to underwrite asset deployments using other entities' dollars while maintaining the value of the demand charges in the system.

That's the ticket. Not to mention a few teeny-tiny side benefits; we end up with a grid and cities that are far more clean and resilient, we deploy with foundational infrastructure that propels

the development of smart cities, and we create a slew of new jobs and economic growth. All are compelling reasons why regulators and politicians should care. The safest bet is that, as they start to really understand it, they will.



Brian Lakamp is the CEO of Totem Power, a distributed energy storage product that includes expansive smart city functionality.

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Rubber Goods: All Eyes on Safety with Daily Visual Inspections

by K.D. Aiardo, Joseph A. Cardona, Eliza Wilcox, and John Voyer



“Being safe is not a matter of good luck. It is deliberate attention to what we do and how we do it which includes the highest integrity of our rubber goods, the testing services and individual ownership of their visual inspection of their rubber products.” ~Eliza Wilcox, Leader of People, HR and Safety for Green Mountain Power (GMP), an electric utility company with a strong commitment to safety education.

Every day, electrical workers rely heavily on Personal Protective Equipment (PPE) to ensure they arrive home safe at the end of their work shifts. Not only is wearing the required certified PPE the safest choice, it’s also an ASTM requirement, enforced by OSHA.

Considered the first line of defense in the event of an electrical incident, dielectric rubber goods (gloves, sleeves, blankets, line hoses, hoods, boots, and related products) are one of the most widely used forms of PPE. Since they play such a pivotal role, the ASTM F18 Committee has issued stringent requirements for required daily inspections and regular testing intervals on new and in-service goods. Because OSHA enforces ASTM guidelines, lack of compliance can mean significant fines. Ensuring that these goods are safe requires deliberate attention to one of the finer details over which we have control.

Protect what’s protecting you: Rubber is very insulating, but it’s also easily susceptible to breakdown from the elements, as well as damage throughout the course of regular use. Aside from everyday nicks, cuts, and scratches, other factors can impact integrity; these include improper storage, age, climate, and exposure to petroleum-based products. Based on its class, rubber is designed to withstand electrical conditions up to a maximum amount of voltage. The higher the class, the thicker the product, and the higher maximum electrical current it is able to withstand. For this reason, a simple weak point, nick, or cut can provide an easy gateway for potential electrical current to access the user. This can result in injury or death.

But, what if my goods are new? Surprisingly, new goods are not exempt from damage! The process of manufacturing rubber goods is laden with ways where goods can be compromised. Even new goods can have air bubbles, color splatter, folds, scratches, etc. Some of this can be missed at the quality control step before the goods leave the plant, or during the shipping process.

Per ASTM D-120, OSHA 1910.137 standards, rubber goods must be acceptance tested (also known as proof-tested) before their first use. Therefore, a rubber goods testing lab that performs a full visual inspection in addition to an electrical test, as a part of the initial acceptance process, will rule out initial quality issues with new goods, while also certifying them for use with a fresh date stamp. Shockingly, an average of 12-15% of new goods fail the initial out-of-the-box testing standards; imported rubber goods are often 3-4 times higher. Luckily, if inspection is completed at purchasing, the distributor/testing lab will typically handle the return behind the scenes and immediately sub in a replacement. The costly alternative tends to be when goods are not proof-tested at all, despite safety requirements and the threat of OSHA fines. These failures come to light at the retesting stages six months later or longer –too late for any warranty reimbursement from the manufacturer. Quite understandably, this leads to increased failure replacement costs.

Daily Visual Inspections for Safety: ASTM requires daily rubber visual inspections before every use (ASTM F496-08, F479-06, F478-06) to rule out many of these potentially damaged goods. A complete visual inspection process includes inspecting the inside and outside of the product. Gloves should also be air tested (inflated using a rolling technique or with a field inflator), as the stretching of the rubber can reveal less obvious damage.

What to check for:

- **Imperfections and damage:** ASTM F1236-96 outlines 24 types of visual failures that should prompt the user to remove the goods from service. Be on the lookout for even the smallest pinhole or scuff. (see list below)
- **A current test date:** a complete date stamp includes the name of the testing facility, tested voltage, max use voltage, and either the date of the most recent test or expiration date of the goods. If the date of test is used, please see the chart on Rubber Goods Best Practices, to determine if the amount of time between ASTM mandated tests has lapsed.
- **If damage is suspected:** Should there be any visual damage – even the smallest pinhole, scratch, age cracking or otherwise – remove the goods from service

immediately and send them to a certified rubber goods inspection lab that will provide a complete visual and electrical test to ASTM / OSHA standards. A lab that is additionally accredited by NAIL for PET (North American Independent Laboratories for Protective Equipment Testing) is recommended.

PA-XS sodar wind profiler latest design

Lidar / Sodar Intercomparison

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 Time (7 days)
 $R^2=0.982$
 — WindCube
 — PA-XS

e-mail: sales@remtechinc.com
http://www.remtechinc.com

Best Practices					
	30 Days	60 Days	6 Months	1 Year	If Damage Suspected
Gloves	Optional	Optional	Required	Required	Required
Sleeves		Optional	Optional	Required	Required
Blankets		Optional	Optional	Required	Required
Line Hose			Optional	Optional	Required
Hoods			Optional	Optional	Required



LED wind tower lighting

Take advantage of maintenance-free interior illumination of wind towers and nacelles with wind turbine LED lighting from Phoenix Contact. Specific lamp profiles for task and ladder illumination provide safe and optimal lighting of work areas and escape routes. Extend service life with rugged IP67 rating and built-in surge suppression. Enable operation down to -400C(F) without the use of heaters. Installation is fast and easy with the QPD connector system and pre-assembled cables. Eliminate battery replacement at the lamp fixtures thanks to a central UPS, and 120-240VAC operation integrates with existing tower designs and wiring. LED wind tower lighting is suitable for new tower and retrofit applications.

Phoenix Contact | www.phoenixcontact.com

24 Visual Failures

Per ASTM F1236-96

1. Abrasions & Scratches
2. Age Cracks
3. Breakdown
4. Chemical Bloom
5. Color Splashes
6. Cuts
7. Depressions or Indentations
8. Detergent Cracks
9. Embedded Foreign Matter
10. Form Marks
11. Hard Spots
12. Mold Marks
13. Nicks, Snags, or Scratches
14. Ozone Cracks
15. Parting Line or Flash Line
16. Pitting
17. Protuberance
18. Punctures
19. Repair Marks
20. Runs
21. Skin Breaks
22. Soft Spots
23. Tears
24. Tracking

Inspection continues as a part of the rest of your day. "If you suspect at any time you have damaged your rubber goods while in the work zone... come off of the project, out of the work zone, and inspect them," says John Voyer, Substation Operations Manager of GMP, "If you nick your protectors, even if you don't think it went through, come down from your work zone

and inspect the rubber. After you come back from lunch you inspect them again. It's important you do this with all safety equipment."

Reducing damage through proper storage: Protecting your personal protective equipment will support your safety initiative, while also prolonging the life of the goods. When not in service, rubber-insulating goods should be stored (clean) in a location as cool, dark, and dry as possible. Climate is very important, and can be one of the most challenging variables to control, because temperatures that are too cold, too hot, too humid or too dry can all effect rubber. Many times, goods are kept in work vehicles, storage crates, dusty warehouses, and the like. Unfortunately, even though it's not in use, the rubber goes through a breakdown or spoilage, which results in cracking or hard spots. This makes the goods inadequate for proper protection and puts the user at risk. Additionally, any storage location should be free from ozone and other chemicals that could harm the rubber. Even the plastic bags that new or newly tested goods are sent in do not protect the rubber from climate or ozone related breakdown.

Canvas bags are an excellent way to store rubber products. Make sure to remove leather protectors from gloves prior to storing, as the tanning chemicals can leech onto the gloves when wet and cause them to turn white. Store gloves with fingers up, sleeves flat, and blankets loosely rolled. Goods should never be folded or creased, as weak spots will form where the rubber is compressed.

Final field check – avoid complacency: You'll think an incident isn't going to happen... until it does. Avoid distractions. Remember that the time you take for safety is worth far more than the alternative. Always ensure you're following the ASTM, OSHA, and company best practices for safety. "The thing that is kind of unique about safety is you never know if you have gotten it right – it's hard to quantify that. It's so hard to say how many accidents have been avoided. We don't see this at GMP, however that mentality could potentially drive a lot of complacency." ~John Voyer, Substation Operations Manager, GMP

While it's easy to be swept up in the current project, a time crunch, or a feeling of invincibility or complacency... it's critical to make a daily and deliberate commitment to your safety initiatives. Daily visual inspections, regular testing cycles, proper storage, avoiding field complacency and following company best practices are a few of the ways that you can control your own safety and reap the bigger reward – going home safely at the end of the day.

K.D. Aiardo serves as the marketing manager of Hi-Line Utility Supply, a division of WESCO and a leader in tools, equipment, safety supplies and services for the electrical industry. K.D. has over five years in the industry and is committed to creating a quality customer experience based on education, the importance of standard compliance, and safety.
Hi-Line Utility Supply | www.hilineco.com

Joseph Cardona is an applications engineer with the HPS Safety Products Business Unit. His product lines include Gloves, Cover Up, Meters & Instruments, and Grounding. Joseph graduated from the University of Missouri-Columbia with a Bachelors and Masters of Science in Mechanical Engineering. He has been with HPS for six and a half years – three years with customer service and three and a half in the Safety Products Business Unit.
Hubbell Power Systems | www.hubbellpowersystems.com

Eliza Wilcox, HR & Safety Leader Eliza Wilcox – Leader of HR & Safety at GMP has strong knowledge and passion for recruitment, employee relations, leadership, employee development, training and injury prevention. Eliza has experience in a variety of corners of the business which has allowed her to proactively build and sustain strong relationships across the organization to positively impact business performance, foster creative solutions, grow our fast, fun, safe and effective culture, empower leaders, transform the traditional utility model all while our goal is set at zero injuries. As a team, we continue to foster a safety culture transformation from reactive to proactive by effectively influencing all levels and areas of the organization.

John Voyer - Manager of Substation Operations for Green Mountain Power (GMP), responsible for the safe, reliable operation and maintenance of Green Mountain Power's Substation facilities throughout the State of Vermont. John has experience in a variety positions within the electrical power industry. He is a Vermont Licensed Master Electrician, Journeyman Lineworker, and a rated Relay Technician along with experience in his previous role as Manager of Power Production at GMP.

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Widening the Scope of Due Diligence

by Simon Luby

Renewable energy markets around the world are in flux; costs are being driven down, and as a result governments and consumers expect to see significant reductions in the financial support given to renewable energy projects. The increasing use of auction systems is having the most significant impact on costs, with positive results. This is setting the scene for this approach to be used more successfully in developing wind markets.

'Timing and approach is key'

It's important to exercise caution when developing and investing in such ventures, as there is considerable pressure on developers to win concessions for new projects to allow them to continue to operate and grow. Various projects around the world (Brazil is an example) serve as a reminder that unrealistic assumptions made to support aggressive auction bids can easily result in failed projects.

Combine this risk with the high degree of competition between investors seeking to buy into projects, and it is easy to see how investor risks can potentially increase, despite the overall maturity and reliability of wind energy technologies.

Therefore, while due diligence has always been a key tool of any investor, the approach to and timing of due diligence can make all the difference between a successful project and a failing one, and between an investment that achieves its return objectives and one which causes significant loss for unwary new entrants to the sector.

De-risking with developer due diligence

Due diligence is becoming a key development tool. With developers seeking an independent appraisal of their own project, this step not only identifies potential flaws in the design, contracts or performance assumptions, but also offers advice on alternative ways to optimise costs and performance, and remain competitive. Pre-emptive due diligence does not have to be intensive or prolonged; a genuinely independent appraisal of a project at the right stage by the right people can, at a minimum, provide a developer with confidence that their winning auction price will support a financially successful project. It also gives the developer a chance to identify additional strategies for improving upside or further de-risking the project.

The developer of a project in Maharashtra, India engaged a specialist consultant to conduct due diligence on its project to assess the impact of foundation design defects. The scope involved an on-site root cause analysis of turbine foundation design defects, the procurement for remediation works and responsibility for contracts, schedules and evaluation of prospective civil contractors.

A balancing act

Successfully reducing costs without jeopardising financial viability can become complicated. The challenge is balancing procurement strategy, contract negotiations, de-risking site conditions through engineering and technology selection, optimising yield production estimates against equipment capital and operating costs, and long term O&M assumptions. The optimised project also must comply with environmental and permitting requirements, or risk having the planning refused or the operation curtailed. Early involvement of due diligence and truly independent reviews can allow developers to get this balancing act right, without jeopardising its attraction or value to investors.

Maximizing margins

Since interest in well-developed projects and operational assets is very high, investors face pressure and fierce competition when developers seek to sell down their projects. As the cost of wind energy comes down, developers' targets for project margins are also declining. Add that to the competition between investors for a stake in a project, and it can be difficult for investors to find the expected margins needed to make the deal worthwhile.

In these instances, good due diligence is necessary to help reduce risks and conservatism to the safest lowest level. It's also increasingly about finding reliable and achievable upside potential in projects, to allow investors to bid for project stakes against strong competition while remaining confident that they can achieve the required target margins post-investment.

The ability to upgrade technology or improve reliability and production through better asset management and O&M strategies is becoming a common focus for due diligence and project evaluation. Taking a long-term view of asset ownership allows investors to not only identify but also subsequently achieve the improvements to project performance that are needed.

In the US, there will be a growing need for acquisition financing and due diligence for operating projects, particularly those with their PTC expiring. Independence will be a key factor here because successful projects and transactions rely on a true and balanced review.

With more and more new equity players entering wind markets around the globe, and debt being offered by alternative sources from the traditional project finance banks, it is easier and more worthwhile for developers to take a more aggressive approach to risk and performance assumptions.

Simon Luby is Head of Global Due Diligence at K2 Management. K2's global service offerings focused within wind project planning and management make it a unique wind project consultancy covering the entire value chain. Simon leads K2 Management's global due diligence service, specializing in leading acquisition and lender's technical advisor teams on major onshore and offshore mandates on behalf of sponsors and lenders.

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Tensioners & Torque Systems

The proper alignment of a bolted joint can be achieved by using either torque or tension methods of bolting. Proper bolt loads must be realized during installation or the integrity of the joint will be compromised, leading to misalignment and, if left unchecked, the ultimate failure of the joint. In this issue, we look at some of the tensioners and torque systems available today.

SEE AD ON PAGE 61



RAD Torque Systems

Product: E-RAD Blu Torque Wrenches

Description: The E-RAD Blu precision torque wrenches are designed to provide a high degree of accuracy (+/- 2.8%) and repeatability (+/- 2%). These advanced electronic pistol grip torque wrenches combine the legendary RAD gearbox design and AC Servo motor technology to reduce bolting time up to 300%, as compared to conventional hydraulic wrenches.

Power System: Electric 120V or 230V

Drive Size: 3/4" to 1.5"

Torque: 100 to 7500ft/lbs; 135 to 10,000Nm

RPM: up to 30 RPM

Weight: 11.9lbs to 33lbs (5.4kg to 15kg)

Noise Level: 75db

Key Features:

- High accuracy +/- 2.8%;
- Data collection;
- Interchangeable handles per controller;
- Password protection;
- Bluetooth connectivity with RAD Smart Socket.

www.radtorque.com



Torc LLC

Product: Torque wrench

Description: Torc LLC has simplified the hydraulic torque wrench by reducing its weight and size, and improved job-performance and reliability by the use of strong alloys and an advanced mechanism.

Power System: Pneumatic and hydraulic

Drive Size: 3/4" to 2 1/4"

Torque: 85 to 30000ft/lbs

Weight: 65lbs (29.5kg)

Noise Level: 70db

www.torc.com



Pro Torque Tools

Product: Williams Planetary Gear Torque Multipliers

Description: Williams Planetary Gear Torque Multipliers provide the operator with nut-turning power requiring only a fraction of the force required when using conventional tools.

Power System: Hand held

Drive Size: 3/4" to 1"

RPM: 750 to 3200

Weight: 25lbs to 40lbs (11.3kg to 18kg)

www.protorquetools.com



GEDORE GmbH

Product: Manual torque multiplier Dremoplus Alu DVV-40ZRS

Description: Precise (+/- 3 %) heavy duty torque multiplier with non-destructive overload safety mechanism. Slim and lightweight with high-performance aluminum housing.

Power System: Manual

Drive Size: 1/2"

Torque: 2930ft/lbs; 4000Nm

Weight: 12.6lbs (5.7kg)

www.gedore.com



Proto Industrial Tools

Product: Proto Micrometer Torque Wrench

Description: Proto Torque Wrenches are manufactured to meet precision and highly accurate standards in common industrial torque environments, general industries, heavy equipment, and maintenance. These industrial grade torque wrenches are mechanically calibrated in the horizontal position to +/-4% clockwise direction and +/-6% and counter clockwise direction at 20% to 100% of full scale. Proto currently offers both fixed and ratcheting versions and is introducing a new 90 tooth ratcheting micrometer torque wrench for precision jobs.

Drive Size: 1/4" to 1"

Torque: Ranging from 10 to 3000in/lbs, 16 to 2000ft/lbs; 16 to 800Nm

Weight: 1.2lbs to 53.10lbs (.54kg to 24.09kg)

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Motion Industries

Product: SPX Flow Bolting Systems Slimline Torque Wrench

Description: The Slimline Torque Wrench's narrow width and reduced radius design enables the tool to fit into tight areas where standard low clearance links cannot. Its small nose radius fits all standard API and ANSI flanges, and the rigid steel body construction features corrosion-resistant plating. Its fully enclosed drive mechanism was designed for operator safety.

Power System: Dependent on the application

Drive Size: Hex size 1 13/16" to 3 1/8"

Torque: Min 505ft/lbs; 685Nm, Max 2639 to 4210ft/lbs; 3578 to 5708Nm

Weight: 4.4lbs (1.99kg)

Noise Level: Dependent on the application

www.motionindustries.com



Stahlwille Tools, LLC

Product: Stahlwille Manoskop 730 Quick

Description: A time proof torque wrench with long term accuracy and no need to reset to zero due to the wear resistant mechanism design. This torque wrench now comes with improved features such as an ergonomic handle, and provides quick and easy setting of required torque. Quick adjustment from outside, no disassembly needed.

Power System: Manual

Drive Size: 1/4", 3/8", 1/2", 3/4"

Torque: 5 to 812ft/lbs; 6 to 650Nm

Weight: 1.8lbs to 7.2lbs (0.8kg to 3.3kg)

Noise Level: 75db when click of torque wrench is triggered

www.stahlwille-america.com



Torcup

Product: SR Series Stryk Electronic Torque Wrench

Description: Torcup announces the addition of electronic torque wrenches to its line of industrial bolting tools. The SR Series Electronic Torque Wrenches utilize integrated encoders that make torque and torque-angle control available through a touch screen. The SR Series offers +/-3% accuracy at set torque.

Power System: Electric 100-240VAC (50/60 Hz)

Drive Size: 3/4" to 1 1/2"

Torque: 100 to 6000ft/lbs; 136 to 8135Nm

RPM: Up to 25 RPM

Weight: 10.9lbs to 38.3lbs (4.9kg to 17.4kg)

Noise Level: 79db

www.torcup.com



Snap-on Industrial

Product: Hydraulic Torque Wrench

Description: Lightweight, heavy duty, ergonomic, +/- 3% accurate, uni-body hydraulic wrench with 360° adjustable, push-button reaction arm and uni-swivel hose couplings. The dual pawl, anti-backlash mechanism provides smooth, equal load operation and a quick release square drive allows for simple change of direction.

Power System: Electric or pneumatic over hydraulic

Drive Size: 3/4", 1", 1 1/2", 2 1/2"

Torque: 120ft/lbs to 37,000ft/lbs; 1100Nm to 50,000Nm

Weight: 2.7lbs to 77.5lbs (1.22kg to 35.15kg)

Noise Level: 75 to 80db

www.snapon.com/industrial



Hytorc

Product: Lithium Series Battery Gun

Description: The Lithium Series tools use a 36V lithium-ion battery pack for long battery life. Available in multiple sizes, with torque output up to 3000ft/lbs, these powerful, ergonomic tools easily handle the majority of maintenance work on wind turbines.

Power System: 36V battery

Drive Size: 1/2" to 1"

Torque: 35 to 3000 ft/lbs; 47 to 3067 Nm


RPM: 180 for BTM-0250, 11 for BTM-3000

Weight: 9lbs to 16lbs (4kg to 7.25kg)


Noise Level: 80 to 85db

www.hytorc.com


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Chicago Pneumatic Tool Co.

Product: Titan Hydraulic Torque Wrenches

Description: Titan's hydraulic torque wrenches are powerful, accurate, durable, robust, and efficient. They are cycle tested under load and then calibrated and certified with traceability to N.I.S.T.

Power System: Hydraulic (powered by electric or pneumatic)

Drive Size: 1/2" to 3 1/2" square drive, 7/8" to 6 1/8" hex drive

Torque: 197 to 43,000 ft/lbs; 267 to 59,308Nm

Weight: 5.65lbs to 120lbs (2.56kg to 64.3kg)

www.titanti.com



Atlas Copco

Product: Revo HA

Description: The Revo HA is a swiveling transducerized tool. It uses traceability, angle control, and monitoring to assure perfect joint quality. These high torque models can operate at comparatively high speeds. With multi torque setting buttons and operator feedback on the display, the tightening process is shortened greatly.

Power System: Electric

Drive Size: 3/4" to 1 1/2"

RPM: 10 to 65

Weight: 14lbs to 29lbs (6kg to 13kg)

Noise Level: <70db

www.atlascopco.us



Enerpac

Product: ETW-Series Electric Torque Wrenches

Description: ETW-Series Electric Torque Wrenches are designed for bolting applications requiring speed, precision, and traceability. It's operated with an interactive 7" touch-screen, or for simpler jobs, torque values may be input directly into the control panel on the wrench. Includes a pass/fail indicator which verifies each fastening.

Power System: Electric

Drive Size: 1" to 1 1/2"

Torque: 200 to 6000ft/lbs; 270 to 8135Nm

Weight: 18.1lbs to 42.1lbs (8.2kg to 19kg)

www.enerpac.com



Norwolf Tool Works

Product: Norwolf TCon K92

Description: Base bolt tensioner, single line action permits use with any 10k psi pump.

Bolt Diameter: #10 or #11 Williams rod

Stud Protrusion: 4.5" (114.3mm)

Max Stroke: 3/8" (9.525mm)

Max Load: 92lbs

Hydraulic Pressure Area (in²) & (mm²): 9.2" (233.68mm)

Outside tool diameter: 4.125" (104.775mm)

Overall height: 6" (152.4mm)

Overall distance between stud CLs: 4.25" (107.95mm)

Weight: 18lbs (8.16kg)

www.norwolf.com



ITH Engineering

Product: Bolt Tensioning Cylinder

Description: ITH bolt tensioning cylinders are designed for tightening large diameter bolts of all major OEM wind turbine applications including: foundation rods, tower bolts, bearing bolts, and other applications. Combine ITH tensioners with the standard-duty ITH Eco-MAX pump for construction jobs or the lightweight and compact Micro-MAX pump for maintenance jobs.

Bolt Diameter: M16 and larger

www.itheng.com

Bolts, Fasteners & Adhesives

Reliable tools and components are important in any industry, but particularly in wind power, where efficient turbine and blade construction and operation are essential to safety and project success. This issue, we're highlighting the latest in bolts, fasteners, and adhesives, from various companies in the industry.



Cooper & Turner Industries, Inc.

Product: Large Diameter, High Strength Threaded Fasteners

Description: Cooper & Turner is a manufacturer and supplier of high strength, safety critical large diameter (M16 <> M100) hex bolts, double ended studs, and thread rod. Employing automation (including in process NDT inspection and automatic zinc flake coating) and robotics results in high quality and consistent products, having full lot traceability, for global customer needs.

Application: For high strength, safety critical fastening on wind turbines; from foundations, to tower flange bolt sets, to nacelle/hub/rotor fastening, blade hardware kits, and spares/service.

www.cooperandturner-usa.com



Heico

Product: HEICO-Lock Wedge-Lock Washers

Description: Heico's certified bolt-fastening system works safely in dry and lubricated conditions, can be reused consistently without loss of function or quality, and costs up to 50% less than identical fasteners. Wedge-Lock Washers are suitable for use as high-tensile bolts of 8.8, 10.9, and 12.9, with their respective nuts, and are available in standard or enlarged outside diameters of M3 to M130.

Application: A wedge-locking system that delivers high-quality, anti-vibration security, for demanding bolted joint applications, such as for wind turbines.

www.heicofasteners.com



Lightning Bolt and Supply

Product: Nacelle and ISO-DIN-EU Fasteners

Description: Lightning Bolt offers a wide selection of ISO-DIN-EU fasteners that are commonly used in the wind turbine industry.

Application: Nacelle fasteners, blade bolts, anchor bolts, and tower bolts

www.lightningboltandsupply.com



Sika Corporation

Product: SikaForce-7800 RED and BLUE

Description: A 2-component, high performance, non-sagging polyurethane, structural adhesive for windmill blade repair.

Application: SikaForce-7800 RED and BLUE is used for profile shaping, surface filling, and finishing of damaged rotor blades in the wind turbine industry with available packaging specifically for onsite wind blade repair applications.

www.sikausa.com



2017

ENERGY STORAGE BUYERS GUIDE

DIRECTORY

BATTERIES

- All Iron Flow
- Aqueous Hybrid Ion (AHI)
- Lead Acid
- Li-Ion
- NiCd/NiMh
- Redox Flow

BATTERY MANAGEMENT SYSTEMS

CHARGING TECHNOLOGY AND DEVICES

COMPONENTS

CONTROLLERS

DESIGN & BUILD INTEGRATOR

ELECTRICAL ENERGY STORAGE

ENERGY STORAGE SYSTEMS

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PROJECT DEVELOPER

SAFETY SIGNS, LABELS & TAGS

SOFTWARE SUPPLIER

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THERMAL ENERGY STORAGE

VALVES

WIRE & CABLE

Batteries - All Iron Flow



ESS Inc.

ESS' 50kW/400kWh IFB delivers 6+ hours of fully useable capacity with a lifetime exceeding 20 years, while seamlessly integrating both energy and power applications. The IFB can be cycled multiple times per day with no degradation in capacity, power, or round trip efficiency. It is a solution for integration with renewable energy to smooth shorter duration intermittency requirements, while storing and time shifting low cost energy to more valuable energy applications throughout the day.

www.essinc.com

Batteries - Aqueous Hybrid Ion (AHI)



Aquion Energy

Aquion Energy's Aspen 48S-2.2 battery is a modular building block for clean energy storage systems. Based on safe, clean, and sustainable Aqueous Hybrid Ion (AHI) technology, the Aspen 48S-2.2 is engineered to meet Cradle to Cradle certification standards. Designed for years of hassle-free operation in stationary, long-duration applications, AHI batteries are optimized for storing energy for residential, off-grid, and microgrid applications.

www.aquionenergy.com

Energy.Delivered

The Ryan Company combines 650MW+ of Renewable EPC delivery with fifty years of Public and Private Sector experience to provide Battery Energy Storage Systems (BESS) into demand and load center across the United States.

303.459.8300 | ryancompany.net

Batteries - Lead Acid

BAE Batteries USA

BAE Batteries USA provides an effective low-carbon lead-acid solution for energy storage applications. The BAE battery can provide a lower cost, time-tested alternative for load smoothing, load shifting, and many power quality applications either for a renewable behind-the-meter, or a utility-scale in front of the meter application.

www.baebatteriesusa.com

Crown Battery Manufacturing Company

Crown Renewable Batteries are heavy weights with dense plates that use more active lead material, increasing battery performance and longevity. Crown batteries contain more lead content per ampere-hour of rated capacity. Their two-volt 2CRP3690 Power Module combines ampere-hour capacity availability to renewable energy system users. The battery delivers application flexibility, while providing an ideal solution for temperature management and electrical isolation.

www.crownbattery.com

Fullriver Battery

Fullriver Deep Cycle AGM batteries use more lead in creating strong connections between cells, heavy plates which increase the reserve capacity in order to maximize life cycles. Their batteries feature a fully sealed, maintenance-free, corrosion-free package, and are an investment in making sure the battery pack enhances the quality of their customers machines.

www.fullriverbattery.com



Leoch Battery Corp.

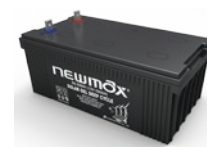
A global manufacturer of rechargeable lead-acid batteries, Leoch offers an array of configuration possibilities using 2V to 12V options, enabling scaling battery systems for residential, commercial, and industrial size projects. Choose from AGM, GEL, and flooded types in long life, deep cycle, hi-temp, and other designs.

www.leoch.us

MK Battery

MK Battery now distributes the Deka Solar Fahrenheit advanced AGM battery HT200ET which is specifically designed for energy storage in Grid Tied backup systems in high heat applications. Engineered for high power, their exclusive IPF Technology enhances energy capacity, cell consistency, and long-term reliability. The Deka Fahrenheit battery case is constructed of THT Plastic, specifically designed to resist heat and optimize compression, and the TempX Alloy helps inhibit corrosion under high temperature extremes. Epoxy-sealed posts eliminate leaks while the case and cover are heat sealed and 100% tested to prevent overall leakage. To further mitigate thermal buildup and cell dry-out, the Microcat Catalyst is utilized to lower float current and maximize the efficiency in high-heat applications.

www.mkbattery.com



Newmax Battery

Newnan Battery's thixotropic nano GEL technology provides for a true maintenance-free GEL battery. Their enhanced AGM VRLA battery is an energy storage and power backup solution.

www.newmaxbattery.co.kr



Rolls

BATTERY ENGINEERING

Rolls Battery Engineering

For over six decades, Surrette Battery Company has been manufacturing Rolls-branded premium deep cycle lead acid batteries. Chosen for a variety of Renewable Energy applications, Rolls products offer a wide range of voltage and capacity options. Built with high quality, heavy plate construction and durable, dual-container case designs, Rolls battery lines offer customers and industry professionals a dependable, long lasting energy storage solution, backed by an extended warranty. www.rollsbattery.com



Sun Xtender Batteries

Sun Xtender batteries are manufactured by Concorde Battery Corporation, a large supplier of sealed lead acid batteries to aircraft manufacturers worldwide. Sun Xtender's AGM Deep Cycle Battery technology is a solution for grid-tied and off-grid renewable energy applications. Absorbed glass mat construction allows for cycles of varying charge and discharge lengths, extending battery life. Sun Xtender batteries are maintenance free with no watering, no spewing, or spilling and ship Hazmat Exempt. Sun Xtender Batteries offers sizing available for all footprints. www.sunxtender.com

www.sunxtender.com



Trojan

BATTERY COMPANY
Clean energy for life.

Trojan Battery Co., LLC

Designed to enhance life and performance of batteries operating in PSOC, Smart Carbon is a standard feature in Trojan Battery's Industrial and Premium flooded battery lines designed to improve charge acceptance and provide faster recharge in PSOC applications where the batteries are under charged on a regular basis. www.trojanbattery.com

www.trojanbattery.com



U.S. Battery Mfg., Co.

U.S. Battery manufactures a variety of deep-cycle batteries, including for solar and renewable energy projects, which are all manufactured in the US and distributed worldwide. Products include: deep-cycle, flooded lead-acid batteries; AGM-sealed, low-maintenance batteries; and single-point watering systems. U.S. Battery's renewable energy (RE) series, deep-cycle batteries are available in two-volt and six-volt configurations. www.usbattery.com

www.usbattery.com

THIS IS PARKER

The challenge

Providing a complete solution for energy storage

With extensive experience in power electronics and energy storage, Parker has one of the largest installed bases of Power Conversion Systems in the world. The Parker Energy Grid Tie Division can provide complete solutions; from inverters and transformers to battery integration and full turnkey systems, including a robust Energy Management System. With over 350 Megawatts installed, Parker is a bankable fortune 250 company that's been engineering your success for 100 years.

parker.com/egt



ENGINEERING YOUR SUCCESS.

Batteries - Li-Ion



AXITEC

AXITEC provides solar modules and photovoltaic storage systems. The flexible and expandable high-performance Li-ion storage is suitable for all photovoltaic systems from home to industry. The AXITEC storage system AXIStorage is manufactured in Germany and combines performance, safety, and longevity.
www.axitecsolar.us



Valence Technology

Valence Technology, manufactures lithium ion batteries that can be arranged in systems between 12V-1000V, from kWh to MWh. As a result of the stable, high-quality chemistry, Valence's U-Charge family of 12V, 24V, and 36V modules have an extended cycle life and float life, suited for energy storage markets such as renewables and UPS. Through this design, lithium ion batteries can act as a "drop-in" replacement for lead-acid batteries or be easily assembled into larger systems of any voltage and capacity. The lithium iron magnesium phosphate batteries are fast-charging and safe energy storage solutions.
www.valence.com



ViZn Energy Systems

The GS200 Energy Storage System is a self-contained, modular storage system delivering cost-effective and safe energy storage. The zinc/iron flow battery incorporates an efficient and worry free non-toxic chemistry. The flexible GS200 modules can be interconnected for higher power and energy requirements.
www.viznenergy.com

Components



Harting

The Han Docking Frame makes a blind mating connection possible, allowing the use of a connector without a housing. This is achieved by means of a float mount frame, which can move freely to +/- 2mm. At the same time, leading centering pins/bushes with high mechanical stability ensure that both connector sides connect reliably together.
www.harting-usa.com



Discover

Discover

Discover Advanced Energy Systems (AES) Lithium-ion batteries provide productivity gains through enhanced cycling, charge time, and weight and volume improvements in renewable energy applications. Discover AES batteries are available in 24V and 48V systems with a range of energy between 2.8 and 6.65kWh, with fully integrated BMS. Renewable ready with optional plug and play compatibility with Schneider Electric battery based inverter chargers, charge controllers, and related components. Parallel up to ten batteries in one cluster with battery to battery communication.
www.discoverbattery.com

Batteries - NiCd/NiMh



Nilar, Inc.

Nilar manufactures high-power NiMH energy storage systems. Nilar also designs and integrates custom BMS's for customer-specific applications. The 12V energy module is the key building block in Nilar's battery and energy storage solution. The module is a maintenance free, energy optimized battery with a long service life, wide operational window, and excellent safety and environmental characteristics.
www.nilar.com

Battery Management Systems



Nuvation Energy

Nuvation's BMS is a highly configurable and chemistry agnostic off-the-shelf battery management system for small- and large-scale energy storage systems. With over 1000 configurable settings, it reduces energy storage project development efforts by providing an off-the shelf BMS that has been designed from the ground up to utility-grade standards. Product options range from an 11- 60VDC BMS for low-voltage applications to a modular 1250VDC BMS for megawatt-scale containerized storage.
www.nuvationenergy.com

Controllers



Morningstar Corporation

Morningstar Corporation is a supplier of solar charge controllers and inverters, with over 3 million units installed in over 112 countries. Morningstar's ProStar MPPT solar charge controller with TrakStar Technology provides maximum power point tracking (MPPT) and battery charging for off-grid photovoltaic (PV) systems up to 1100W. This device is a solution for industrial and residential applications, and includes custom programmable charge control, load control, lighting control, self-diagnostics, and data logging.
www.morningstarcorp.com

Charging Technology and Devices



Analytic Systems

The BCA1505MV battery charger provides up to 1500 watts to charge one 24V battery bank from a 220VAC source. This charger includes adjustable output voltage, 2 and 3 stage charge profile select, and an LED output voltage and current display. The single board design incorporates switch-mode technology for efficiency and ultra-quiet operation. Multiple stages of filtering reduce radiated and conducted noise to MIL461 levels. Can also be used as a power supply, if desired.
www.analyticsystems.com

Design & Build Integrator



Global Equipment & Mfg

Global Equipment & Mfg (GEM) is an 8-year old service provider with manufacturing available in CA, IL, and FL. GEM serves stored energy OEMs requirements for fully integrated solutions involving ISO containers, battery racking, DC combiners, inverters, transformers, HVAC, and controls.
www.gemanufacturing.com



Iron Edison Battery Company

The Iron Edison Lithium Iron battery is fully compatible with popular battery-based inverters and is housed inside a rugged steel enclosure with an integrated battery management system. Standard capacities range from 2kWh to 42kWh, with custom high-capacity and high-voltage models available for commercial applications like peak load shaving and UPS. The battery is designed and assembled at the company's headquarters just outside of Denver, Colorado.
www.ironedison.com



GILDEMEISTER energy storage GmbH

The CellCube allows for a clean, zero-emission and fast energy supply. With these features it offers a solution to provide power in combination with renewable energy at any time. The use of vanadium salts increases the safety and operating life of the battery, as they are neither flammable nor explosive, and are not subject to cycle degradation. This leads to almost unlimited cycles of charging and discharging with up to 80% efficiency and a 100% depth of discharge capability.
www.energy.gildemeister.com/en

Electrical Energy Storage



Fluidic Energy

Fluidic delivers cost-effective, long-duration energy storage solutions worldwide ranging from multi-kWh to MWhs, to enable widespread renewable adoption. Fluidic solutions, which integrate proprietary Zinc-air storage technology and intelligence into a single turnkey platform, are capable of 4 - 72 hours continuous runtimes. With high system and grid availability at a low cost, Fluidic systems are optimal in long-duration applications from off-grid renewable micro-grids to grid reliability.

www.fluidicenergy.com

Energy Storage Systems - Commercial



Adara Power

Adara Power introduces the Adara iC3 Platform which integrates battery and inverter controls with cloud-based software and a robust IoT connectivity solution. The platform has launched with a scalable 125kW, 250kWh inverter and battery suitable for commercial-scale applications. Backed by 10-year warranties and performance guarantees, the system can be used to significantly reduce the amount of energy drawn from the grid during peak load periods/events, maximize the benefits of operating large scale solar installations, and increase consumption of on-site energy. The system qualifies for the Federal Investment Tax Credit of 30% and California buyers can also apply for the state Self-Generation Incentive Program.

www.adarapower.com



Canadian Energy

Canadian Energy provides batteries, stored energy solutions, DC power solutions, and renewable energy solutions all across Canada and all over the world.

www.cdnrg.com



Green Charge

Green Charge provides customers with an efficient energy storage platform combining cloud-based analytics software with battery storage systems. The root technology of the GridSynergy platform is a smart controller which monitors facility loads on a second-by-second basis, predicts and manages variable building loads, and dispatches available battery capacity at targeted times to create a leveled load profile and drive significant energy bill savings.

www.greencharge.net



Rhombus Energy Solutions

The Rhombus 125kW Battery Energy Storage Inverter System is UL certified and supports bi-directional grid-tied operation. It comes with an integrated grid-side isolation transformer and liquid cooling system. This power conversion inverter has ultra-fast, step response to rapidly follow grid utility power delivery demands and their patented Power Management Technology produces quality grid power. Multiple units can be paralleled for higher power requirements. VectorStat Software included on MOQ.

www.rhombusenergy.com



NR Electric

NR offers a power conversion solution for grid-scale Battery Energy Storage System (BESS). Their Power Conversion System (PCS) solution includes advanced converter/inverter technology and a comprehensive control, protection, and management system to ensure the safety, reliability, and flexibility of the BESS. It can reduce power supply cost, improve power system stability, regulate grid frequency, and compensate load fluctuation. NR's PCS, with various battery technologies, is flexible enough to provide a wide range of functionalities demanded by the smart grid.

www.nrec.com

wanzek.com
 701.282.6171
WANZEK
 a MasTec company

Renewable Energy Construction & Services from Proven Professionals
 Wanzek's history of **BUILDING STRONG** is due to our
Construction Excellence, Exceptional Services and Outstanding Teams

stem



Stem

Stem's turnkey PowerStore service for businesses and institutions automates energy savings, controls energy risk, and supports a sustainable grid. PowerStore leverages Stem's software and versatile energy storage hardware, which includes indoor and outdoor solutions developed with their partner battery suppliers. Stem's active network includes energy storage systems ranging in size from 36kWh to 4.8MWh. Systems are sized using Stem's proprietary modeling platform, which analyzes energy consumption patterns, tariff options, on-site generation, and available demand response programs for each facility in order to maximize savings and revenues. Reliable savings projections are informed by energy data from more than 10,000 facilities of every conceivable type, ranging in size from 30kW to 20MW, and over 3.5 million hours of field runtime from 300 active energy storage systems.

www.stem.com

Energy Storage Systems - Grid-Connected



Alevo

Alevo's non-flammable Li-Ion energy storage system and smart data analytics provide safety, robustness, and reliability. The source agnostic Alevo GridBank ESS can be used anywhere along the electricity supply, and works with both conventional and renewable generation. As a vertically engineered turnkey energy storage solution, Alevo manufactures its batteries, assembles its GridBanks, and is also a systems integrator and project developer.

www.alevo.com



Darfon

The H100 is a hybrid storage solution that handles direct solar DC input, power storage, and AC output all in one enclosure. It uses DC-coupling to maximize power utilization of the system. Power from the solar panels, batteries, and grid are intelligently controlled to support storage, essential loads, or back feed power to the grid. The H100 offers preset programs for various applications, such as backup, off-grid, and time-of-use to optimize energy flow and minimize the power bill.

www.darfonsolar.com



Enphase Energy

Enphase Energy's high-performance energy storage solution provides intelligence and value, with its low cost of entry and long lifetime value. It pairs seamlessly with Enphase microinverters and other solar technologies. The Enphase AC Battery is simple to install, safe, reliable, and provides low lifetime energy cost for both new solar customers and retrofit customers.

www.enphase.com



Lockheed Martin Energy

Lockheed Martin Energy provides turn-key energy storage solutions for utility, commercial, and industrial applications. Lockheed Martin Energy's GridStar energy storage systems reduce facility energy costs, improve the efficiency and stability of the electric grid, and enable the increased use of renewable energy. For short- and medium-duration energy storage requirements, Lockheed Martin Energy offers GridStar Lithium energy storage systems. GridStar Lithium systems are compact, easy to install, and can be used for 100kW to multi-MW projects. The GridStar Lithium energy storage system architecture consists of modular, scalable, and purpose-built energy storage units containing batteries, local controls software, and all required balance-of-system components. Each GridStar Lithium energy storage unit can be configured to provide up to 375kW of power and up to 600kWh of energy. These units can be AC coupled together to scale to multi-MW projects. Systems also come with extended warranty and long term maintenance options.

www.lockheedmartin.com/energystorage

WATTNODE[®]

Power (kW) and Energy (kWh) Submeters



Revenue-Grade and Standard AC Metering

PV Production Metering • POU Consumption Submetering
Energy Management • Building Automation and
Demand Response • Battery Storage

ESA Conference • Denver, CO • Booth #701

Continental Control Systems, LLC

1-888-WattNode (928-8663) • ccontrolsys.com



Dynapower

The BTM-250 is a fully-integrated, scalable behind-the-meter energy storage system for commercial and industrial applications. The modular system couples a Dynapower MPS-250KW energy storage inverter with enclosed racks of the latest Samsung Li-Ion batteries. The easily scaleable and cost effective system has a compact footprint and low acoustic signature. The BTM is capable of both demand reduction charge management, and the seamless transition to backup power in the event of a power outage.

www.dynapower.com



NEC Energy Solutions

The GSS(R) grid energy storage platform is a flexible, versatile, AC-interconnected battery system providing the grid energy storage services at scales ranging from 1 to 100MW per installation. With over 250MW installed, under construction, or in late stages of development, this grid energy storage product provides safe, reliable, efficient service to utilities, power producers, and C&I sites.

www.neces.com



POWER Engineers

POWER Engineers provides technical expertise in storage and renewables interconnection and integration, system studies, site selection support, distributed generation, substation protection, and control and microgrid engineering and design. They also support the non-technical needs of storage programs, such as financial and economic analysis, and program management. This ranges all the way from tendering to project execution, resulting in cost-effective and reliable projects.

www.powereng.com



Powin Energy

Powin Energy's BESS delivers full control to megawatt+ energy storage systems from peak demand management to grid support services. The simplified interconnection and optional chassis-mounting give Powin Energy's BESS a unique portability. Features include system Intelligence (bp-OS), fully integrated plug and play functionality, a modular system design, and easy shipping and installation.

www.powinenergy.com



Saft America, Inc.

Saft's Intensium Max is a ready-to-install containerized solution designed for today's electricity grids and for the smart grids of tomorrow. It provides a complete, fully integrated energy storage system at the megawatt scale comprising Li-ion battery modules, power management and control interfaces, air conditioning, and safety devices.

www.saftbatteries.com



Sargent & Lundy LLC

For 126 years, Sargent & Lundy has provided broad-scope services on battery energy storage projects, including engineering, consulting, construction support, and EPC services. Their experience spans the spectrum of markets, applications, interconnection requirements, and technology types. Clients include utilities, developers, financial institutions/lenders, constructors, and manufacturers.

www.sargentlundy.com

Energy Storage Systems - Off-Grid




SimpliPhi Power
SimpliPhi Power's PHI 2.6 and PHI 3.4kWh batteries have a 98%+ efficiency charge/discharge rate and 10,000+ cycles. They can scale up, integrate into residential and commercial on/off grid systems, pose no risk of thermal runaway, and feature a non-toxic LFP chemistry, proprietary architecture and power electronics, and -4 to 140° operating temperature. They integrate with all industry standard inverter charge controllers, making them suitable drop-in replacements for existing battery banks.

www.simpliphipower.com



SunWize Power & Battery

SunWize Power & Battery designs and builds reliable, stand-alone industrial power solutions and electronic assemblies for integration into OEM products and off-grid field applications. Their solar, battery backup, and hybrid power systems are pre-engineered, assembled, and tested for easy installation and minimal maintenance. They also offer a broad spectrum of remote industrial power products.

www.sunwize.com

Energy Storage Systems - Residential



Baker Electric Solar

Baker Electric Solar now provides residential energy storage systems in Southern California. Whether as a new component of an existing PV System or as part of a combined PV/storage installation, they work with vendors to provide custom solutions including increased energy independence, simple battery back-up, and optimizing solar systems.

www.bakerelectricsolar.com



Mercedes-Benz Energy

A complement to home solar, Mercedes-Benz Energy Storage Home uses the same lithium-ion technology developed for use in Mercedes-Benz electric and hybrid vehicles. Up to eight energy modules, each with a capacity of 2.5kWh, can be combined to create a custom sized system. The benefits of Mercedes-Benz Energy Storage Home include protection against fluctuating energy costs, utilization of self-produced clean energy, energy independence, and a reliable energy supply.

www.mercedes-benz-energy.com




SimpliPhi Power
SimpliPhi Power's AccESS is a complete plug-and-play solution that optimizes equipment and streamlines cost calculations. It's an all-in-one unit that integrates power storage into new and existing on/off grid solar installations. It includes SimpliPhi's battery technology combined with Schneider Electric inverter charge controller and associated power electronics and system management in one box. Available in 10.2 or 6.8kWh, the AccESS can scale up and be safely installed outside and inside.

SimpliPhi Power

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www.simpliphipower.com



sonnen, Inc.

The sonnenBatterie eco systems help residential customers use solar + storage to meet up to 100% of their energy needs. Sonnen's intelligent energy management system provides customers with greater energy control through increased solar self-consumption, reduced peak energy usage, and reliable backup power during outages, contributing to a cleaner and more reliable energy future. Sonnen's fully integrated, intelligent battery storage systems integrate with new and existing solar systems and are scalable from 4kWh - 16kWh in a single unit.

www.sonnen-batterie.com

EPC Services



Blattner Energy, Inc.

Blattner Energy is a diversified engineering, procurement, and construction (EPC) contractor providing construction solutions for the power delivery industry and expertise in renewable energy. Blattner provides complete EPC services for utility-scale energy storage projects, and PV, CPV, and CSP solar projects as well as wind energy projects. Blattner has installed more than 30GW of renewable energy in North America. Their project management skills and self-performance allow them to deliver high levels of safety, quality, schedule, and productivity.

www.blattnerenergy.com



Rosendin Electric

Rosendin Electric is an EPC builder of mid to large-scale solar photovoltaic (PV and CPV) systems bringing turnkey expertise and EPC capabilities to develop efficient and cost-effective solar solutions. Rosendin has installed more than 12,000MW of clean, renewable wind energy throughout the country. For 98 years, Rosendin has been building electrical and communications installations and creating value for clients.

www.rosendin.com



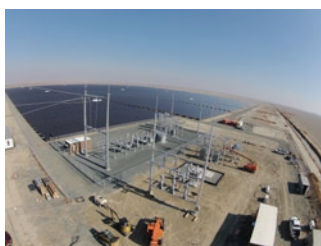
Signal Energy Constructors

Signal Energy Constructors is a design/build general contractor providing EPC services. Their experienced engineering and project teams have produced more than 8,000MW of utility-scale projects. Signal Energy Constructors possesses the expertise to build stand-alone energy storage projects or integrate energy storage into the design and construction of renewable power projects. www.signalenergy.com



The Ryan Company, Inc.

A QUANTA SERVICES COMPANY



The Ryan Company

The Ryan Company combines 650MW+ of renewable EPC delivery with 50 years of public sector experience to provide battery energy storage systems into demand and load centers across the United States. These battery storage systems are designed with a detailed understating of the strengths, capabilities, and limitations of battery technologies when addressing resource adequacy, demand shaving, load shifting, voltage/frequency reg, utility upgrade deferrals, emergency backup power, and microgrid systems. www.ryancompany.net



Trimark Associates, Inc.

Trimark's integrated bulk energy storage systems unify metering, monitoring, and controls required to align utility-scale storage with generation, connect to the electric grid, and participate in real-time energy markets. Trimark delivers certified revenue metering and secure, real-time data telemetry. Trimark also provides integrated, PV-storage control systems that manage firming, shaping, and energy reallocation logic; automate responses to AGC dispatches; and monitor performance. www.trimarkassoc.com



a MasTec company

Wanzek Construction, Inc.

Wanzek Construction, Inc. is a direct-hire, heavy industrial contractor serving the power, renewable energy, oil & gas, heavy/civil, and industrial agriculture energy sectors with service lines including crane services, oil & gas services, and renewable services. www.wanzek.com

Financial Services



RODMAN CPAs
COLLABORATIVE APPROACH. PRACTICAL ADVICE.

Rodman CPAs

Rodman CPAs provides tax advisory, accounting, and business strategy services to small and mid-sized emerging and established businesses. The Rodman "Green Team" provides renewable energy producers and businesses that pursue energy efficiency initiatives with expertise in renewable energy tax accounting and business strategy. They offer tax advisory, financial, and accounting services for companies involved in solar, wind, biomass, waste-to-energy, and energy efficiency projects. www.rodmancpa.com

Hybrid Systems



EnSync Energy Systems

The Matrix is a behind-the-meter control system participating in C&I, multi-tenant, and utility environments. Matrix utilizes patented "Auto-Sync" DC-Bus controls which enable simple, real-time integration of all AC and DC inputs, and automatically route electricity in an efficient and cost-effective manner. Modular and configurable, Matrix is designed to meet the building's current needs, and its electrical applications in the future. www.ensync.com



Tabuchi Electric Company of America

Tabuchi America, a solar inverter manufacturer, offers an all-in-one solar+storage solution; Eco Intelligent Battery System (EIBS). The system includes a 5.5kW hybrid solar inverter and 9.89kWh lithium-ion storage battery. EIBS is easy to install and is equipped with a bi-directional DC/DC converter, automatic transfer switch, and a built-in battery management system. EIBS is programmed for 4 modes: self-consumption, demand response, time-of-use (TOU), and backup. The remote controller makes it easy to change modes based on current energy needs. The EIBS is optimized for energy management and cost performance. www.tabuchiamerica.com

Inverters



COTEK The Americas

The compact size COTEK SP Series inverters are available in 12V/24V/48V, and 700W-4000W models. With pure sine-wave output and high surge, these stand-alone inverters have advanced design topology and functions including built-in multistage power saving control, wide DC input voltage, and wide operating temp to fulfill a majority of applications. The stylish, low profile design can also be paired with the TR40 bypass accessory for additional functionality. E13, UL, CE, and FCC approved. www.cotek.ca



Eaton

Eaton Power Xpert 2500kW energy storage inverters provide high power ratings for grid-tied, utility-scale projects. The Eaton solar inverter technology yields low levelized cost of energy (LCOE) and 98.5% efficiency by the California Energy Commission (CEC). They also enable a skid-less inverter station design to reduce equipment requirements and installation costs, and work with a wide-range of battery chemistries to store and transmit power when needed. www.eaton.com/solar



Fronius

Fronius introduces the Fronius Smart Solution, the next generation of solar systems. The Fronius Smart Solution, for residential and commercial systems, provides flexible system design, shade mitigation, NEC compliance, high performance, and monitoring while keeping the number of components low and the installation easy. The Fronius Smart Solution consists of cell-string optimized modules, the Fronius Rapid Shutdown Box, a Fronius SnapInverter, the Fronius Smart Meter, and the Fronius Solar.web monitoring portal. www.fronius.com



Ingeteam

Ingeteam's storage central inverters are UL9540 and UL1741 compliant. Available in two different topologies; 1,000V and 1,500V, these battery inverters provide power density up to 1640kVA in a single 3,770lb inverter. Moreover, they feature both stand-alone and grid-tied operation, Black Start capability, and advanced grid support performance including ramp rate control, fast frequency regulation, power factor control, digital Q compensation, and peak-shaving. www.ingteam.com



Parker Hannifin Corporation

The Parker 890GT-B is a 2MW PCS for Battery Energy Storage applications, designed for direct outdoor installation. No air conditioner is required, as the system is cooled by Parker's two-phase advanced cooling system. The cooling system is self-contained and requires no chilled water or external condenser. The small footprint and integrated transformer connection results in a space saving installation. The 890GT-B employs a modular inverter design for ease of maintenance and service. Output power is handled by replaceable phase modules, which are cooled by Parker's advanced two-phase cooling system. The easily removable modules weigh only 35lbs, and average time to swap is under 15 minutes. Cooling and AC power connections are quick disconnect type, with connections made as module is installed. AC output filters also utilize a modular tray design for easy maintenance. This modular construction offers a low MTTR for high system availability. www.parker.com/egt

Power Electronics for Storage Systems



SMA America

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www.sma-america.com



Phocos

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www.phocos.com



Socomec, Inc.

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www.socomec.us

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www.uticom.net

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www.geli.net



JobNimbus

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www.jobnimbus.com

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Outback Power

A pre-tested, wired, and configured package complete with energy storage, OutBack Power's SystemEdge offers solar installers a simple and cost-effective installation path. It provides custom quality and craftsmanship in a pre-assembled system that can be ordered as one part number and installed quickly. SystemEdge is a UL-1741 single-brand solution from rooftop to battery for any energy scenario.

www.outbackpower.com

Thermal Energy Storage



Ice Energy

Ice Energy's Ice Cub is a compact, home-optimized, solar-compatible HVAC system comprised of an ultra-high efficiency compressor and ice tank with heat exchanger. The Ice Cub compressor can cool the home like a conventional AC unit, or store energy by freezing water in the ice tank to later provide up to four hours of cooling to an entire home. When heating is required, the circuit reverses and the compressor operates as a heat pump to provide all the heating required for a home.

www.ice-energy.com

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Sun Bandit by Next Generation Energy

Sun Bandit by Next Generation Energy, is the first solar PV water heating solution to be ICC-SRCC certified, representing a paradigm shift in the way solar energy is captured, stored, and used to heat water. Sun Bandit requires no net-meter connection and uses solar PV modules that simplify installation, operation, and maintenance making it easy to reduce utility costs and provide consumers with a simple, clean, and dependable on-site energy storage solution.

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Superior Essex is a U.S. manufacturer and supplier of energy wire and cable products serving the commercial, industrial, utility, and renewable energy markets. Low voltage 300V and 600V instrumentation cables for control systems, audio, intercoms, energy management, and alarm controls; low voltage 600V control and power cables for industrial or utility substation circuits; low voltage secondary URD for utility underground power distribution; medium voltage 5kV through 35kV power cables for primary power. Their MV Primary UD 35kV cables are suitable for underground collection systems designed for wind applications. These cables are offered with conductor strand filled, gauge sizes up to 1250kcmil, aluminum, TR-XLPE, or EPR insulation, multiple concentric neutral configurations, and LLDPE jacket, meeting the applicable ASTM, ICEA, and AEIC standards, and are RUS accepted.

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The ESA 27th Annual Conference & Expo will be held April 18-20, 2017 in Denver, CO. It's the must-attend event in energy storage – bringing together the global energy industry for three days of forward-looking content, hands-on learning and site tours, and unique networking and business development opportunities.

www.energystorage.org

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Features just some of the companies and technologies attendees will see at this year's show.



Compact lithium and flexible flow systems

Lockheed Martin Energy provides turn-key energy storage solutions for utility, commercial, and industrial applications. Lockheed Martin Energy's GridStar energy storage systems reduce facility energy costs, improve the efficiency and stability of the electric grid, and enable the increased use of renewable energy. Lockheed Martin Energy has two core energy storage offerings: GridStar Lithium systems for short- and medium-duration energy storage, and GridStar Flow systems for long-duration energy storage. GridStar Lithium energy storage systems are compact, easy to install, modular, and scalable for 100kW to multi-MW projects. GridStar Flow systems feature Lockheed Martin Energy's proprietary flow battery and offer flexible, durable, and affordable long-duration energy storage for utility-scale projects.

Lockheed Martin Energy

www.lockheedmartin.com/energystorage



Energy storage PCS

The Parker 890GT-R is an 80kW PCS designed to manage an individual battery string which typically is installed in the same 19" racking unit. While the DC bus of each unit must be isolated from others, the AC side may be paralleled directly with other PCS units (up to 45) and connected to the same three phase windings on a step-up/ isolation transformer. The Parker 890GT-R includes AC L-C-L filter, IGBT power circuit, internal power supplies, control board, fuses, and isolation devices necessary to run and disconnect the PCS from the AC grid. To minimize the total cost of ownership, the 890GT-R has been designed with a compact architecture in mind. With the standard 19" rack mounting configuration and sliding rails, installation of a unit in the field is a quick and easy task.

Parker Hannifin Corporation

www.parker.com/egt



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Eaton's Power Xpert 2,000kW and 2,200kW solar inverters provide high power ratings for grid-tied, utility-scale projects. The Eaton solar inverter technology yields high leveled cost of energy (LCOE) and 98.5% efficiency by the California Energy Commission (CEC). The solar inverters are designed and tested to meet the UL 1741 standard, are outdoor-rated, and feature a wide Maximum Power Point Tracking (MPPT) voltage range. A proprietary Eaton control strategy and filter design optimizes the inverter efficiency, while providing ultra-low output distortion.

Eaton | www.eaton.com/solar



Interconnection solutions for flexible BESS

Based on comprehensive experience and solutions, NR Electric offers a sophisticated interconnection solution for flexible Battery Energy Storage System (BESS), which includes advanced converter/inverter technology and comprehensive control, protection and battery energy storage management system to ensure the safety, reliability, and flexibility of BESS. NR Electric has experience in energy storage system applications, has acquired comprehensive knowledge of storage media, and partners with various battery manufacturers. NR can help procure the battery and supply a turnkey solution according to their customers requirements.

NR Electric | www.nrec.com



Integrated software and energy storage

Stem combines powerful self-learning software with advanced energy storage to help organizations reduce energy costs. Stem shifts energy use away from times when it is most expensive, learning the building's energy patterns to maximize value. With Stem's turnkey service, organizations unlock the benefits of energy storage with no upfront costs or disruption. Together, Stem's customers form a vast network that helps utilities create a more efficient, sustainable, and resilient electrical grid.

Stem | www.stem.com



Analytics software

Alevo Analytics is helping to solve the complex problems of today's energy industry through insightful, powerful, and accurate analytics. Alevo Analytics provides insights regarding where the deployment of distributed energy resources will yield the greatest benefits. Alevo Analytics offers the GridMaestro suite of software, designed for optimizing the Alevo ESS and also offers consulting services including advanced analytics, simulations, and advisory services.

Alevo Analytics | www.alevo.com

Avoiding the Technology Trap

by John Brown

TECHNOLOGICAL INNOVATION IS ONE OF THE DEFINING CHARACTERISTICS

of the clean energy sector. The pace of advancement is staggering at times. Faced with this rapid growth and change, companies often find themselves rushing to implement new software technologies to help them operate more efficiently, increase productivity, scale their business, and extract greater value from the enterprise. People generally seem to be in their comfort zone when creating simple requirements documents, looking at demos, selecting a vendor and then moving forward. So tempting is the feeling of accomplishment from all this activity, that people tend to dive in without really thinking through the full ramifications or requirements of the business. This often leads to creating spreadsheets as workarounds that take on their own life... sometimes to the point that the operation is run more on spreadsheets than on the solution that was selected. Eventually it all gets ripped out and the process starts over again. This is expensive, disruptive to operations, and leads to many uncomfortable conversations with your boss and your boss' boss, etc. People lose jobs and companies lose money. This is the definition of pain. We call it the "technology trap."

The good news is the technology trap is completely avoidable. By properly managing the three dimensions of technology implementations – people, processes, and technology – you can avert it. Below we'll review the steps you can take to avoid the trap and get on the road to better technology implementations.

The Technology Trap

Let's say you are part of a wind energy marketing or operating organization. You've undoubtedly encountered one or more of these common technology hurdles:

- Over reliance on spreadsheets
- Multiple and duplicate data entry points in often duplicate systems
- Error prone processes and/or data
- Resource intensive processes requiring lots of bodies
- Excessive execution time – things just take too long
- Redundant and/or overlapping systems

You might think, "I should install some new technology and fix this!" After all, it's not rocket science. It should be easy to put in a new maintenance/work management/billing/market interface/etc. system. You just need to follow a few tried and true steps:

- Create a wish list
- Research the top vendors
- Get some demos
- Pick one
- Negotiate the price
- Implement the solution
- Reap the benefits

Viola - that wasn't so bad!

In this situation, the best-case scenario is that you'll get the solution implemented pretty much on time and within budget and with most of the functionality you wanted. Then people will start using the system and you'll cruise happily along. Problem solved. Life is good. You're living the dream.

Except that you just fell into the technology trap. Some groups won't use the new system at all, you're using even more spreadsheets than before, some business processes are taking longer than ever, many of your old problems still exist and you're seeing problems you didn't even realize you had. And you just spent a million dollars or more. So, what happened?

Unless your "problem" is very specific, technology by itself won't fix it. Most companies assume that adopting a new technology will:

- Make them more efficient
- Reduce errors
- Improve processes
- Make their people more engaged/productive/happier/etc.
- Save money, ultimately
- Provide a competitive advantage

Unfortunately, technology is only one part of the solution. For technology transformations to be successful you need to address each of three critical dimensions: People, Processes, and Technology. You need to address all three dimensions and you need to address them in that order. People first, then processes, and finally technology. Furthermore, it is an iterative and ongoing

process. When you get to the end of the technology piece, you need to loop back to people. This is a complex ecosystem.

Put People First

People are the foundation of the system and need to be considered first. Ideally you would map out your staffing needs, then build a fulfillment plan, bring the staff onboard, and so on. In almost all cases, however, you won't have the luxury of starting with a clean slate. Or pesky budgets will prevent you from creating your dream team from scratch. In those cases, you must understand your starting point so you can build the roadmap for where you want to go. You need to take an unbiased view of your staff to ensure you have the right people with the right skills to perform the necessary functions at the required level. In addition, it's vital for staff to have a good cultural fit with the organization, because it directly affects morale and productivity.

Do you have the right number of people? Are all roles filled? Do you have people doing "double duty" that might impact the quality of work? Do you have too many people because existing processes are overly manual or technology isn't working?

Formalize the Processes

Everyone has business processes. But, do you have the right ones? Does your team know them? Do they follow the processes? Are the processes documented?

Talking about processes evokes unpleasant scenarios that include bringing in truckloads of consultants and spending months developing massive Level 1 – Level 4 process maps.

The reality, however, is that process mapping needs to be sized to fit the specific situation. At the highest level, there are five steps to follow:

1. Document the processes
2. Match processes to procedures and business rules
3. Train people to follow the processes
4. Monitor the results and make sure people follow the processes
5. Identify process improvements

At the end of step four you go back to step one and adjust your processes. How deep you need to go in step one (i.e., Level, 1, Level 2, etc.) will depend on your specific business.

Companies that decide to skip the process step tend to have similar attributes:

- Perpetual turnover seeking new people or management that can solve the problem
- High costs due to inefficiencies and the wrong number of people
- Inability to grow
- Numerous internal meetings to "get everyone in a room" to sort out problems
- Massive numbers of spreadsheets (with no one quality checking formulas)

Tackle Technology

Now you're ready to tackle the technology. Identify your needs by performing a system assessment. High-level activities should include the following:

- Review Business Processes: Make sure your business process definitions are up-to-date.
- Define and Document Clear Business Objectives: All stakeholders should agree on this.
- Develop and Validate Requirements: At a minimum, identify high-level requirements.
- Prepare a System Selection Criteria Matrix: The matrix should include business and technical requirements, cost, vendor viability, vendor implementation capabilities and other parameters.

In most cases, you aren't going to get everything you want in the first pass. Resources are limited and some things will inevitably need to wait. Make sure you create a roadmap of future enhancements and a plan to achieve them.

What Does Good Look Like?

Congratulations!

- Your people are on-board and trained
- Processes are defined, communicated, being followed, and monitored
- The technology is implemented and you met your business objectives and success criteria

Can you stop now? No! Remember that the three dimensions – people, processes, and technology – are a continuum. You need to decide "what does good look like" and how good you want to be.



John Brown is an Owner, Partner and Member of the Skipping Stone Board of Directors. Whether strategy, implementation, outsourcing or problem solving, the Skipping Stone experience-based approach has proven to provide the perspective and results clients value on thousands of projects across the globe.

Skipping Stone | www.skippingstone.com



Closed-circuit fluid cooler

SPX Cooling Technologies, Inc. announces the new Marley LW Fluid Cooler, an induced-draft counterflow closed-circuit fluid cooler. The new fluid cooler design incorporates patent-pending heat transfer technology and a lower height to address local code restrictions. The closed-circuit design keeps the process fluid in a clean closed loop. Copper heat transfer coils offer corrosion resistance and greater thermal efficiency. The copper coils are also bacteriostatic, recyclable and require less process fluid volume. With standard unit heights less than 10.5 feet, the Marley LW Fluid Cooler meets many code height requirements and offers low visibility for rooftop installation. Other installation advantages include single-piece installation, single-point power connection, factory-installed controls, and factory wiring and testing. Operational benefits include electronically commutated (EC) direct drive fans requiring no routine maintenance, a low-clog spray system and multiple doors that allow access to interior components without tools. Thermal performance of the Marley LW Fluid Cooler is certified by the Cooling Technologies Institute (CTI).

SPX Cooling Technologies, Inc.
www.spxcooling.com



Passive infrared wall switch sensor

Legrand, North America announced additional improvements to its portfolio of Wattstopper lighting controls. The Wattstopper Passive Infrared (PIR) wall switch occupancy sensor, the WS-301, now features convenient Manual-ON control ensuring maximum energy savings and code compliance. These economical sensors replace existing wall switches and are a solution for retrofit projects and other applications. Installing WS-301 sensors into areas such as offices, conference rooms, and break rooms can generate energy savings up to 60% by turning lighting or fan loads on and off based on occupancy and ambient light level. The WS-301 also meets electrical safety {2011 NEC} and energy {California Title 24 (2016)/ASHRAE 90.1 (2013)/IECC (2015)} code requirements.

Legrand | www.legrand.us

VFD-Induced Bearing Currents Kill Motors!



Electrical bearing damage causes unplanned downtime

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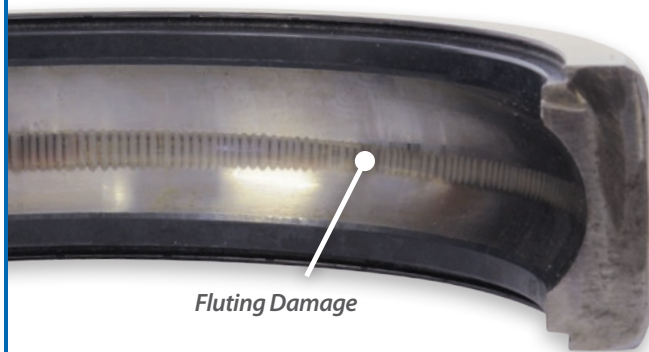
www.est-aegis.com/handbook



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Vantage's complete range of wireless lighting control options for the home are designed to be easy to install, program, and update. The new Universal Dimmer Station (UDS), is an easy to install wall box dimmer simplifying the specification and control of forward phase or reverse phase load types including LED fixtures. The UDS is aesthetically consistent with Vantage's wide range of keypads and faceplates, including the programmable RadioLink EasyTouch II low voltage programmable keypad.

Vantage | www.vantagecontrols.com



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At its plant in Richardton, North Dakota, Red Trail Energy produces ethanol from corn using a dry-milling process.



Installed on the 500 HP ventilation fan motor at the Red Trail Energy Ethanol Plant, these rings have 6 rows of conductive microfiber brushes (and millions of shaft contact points) providing the high current-carrying capacity needed for large (500 HP or greater) low-voltage motors, medium-voltage motors, and DC motors (300 HP or greater).

Proper Shaft Grounding Solves Motor Bearing Problems at Ethanol Plant

by Adam Willwerth

SOMETHING WAS DESTROYING THE MOTOR

bearings of the centrifuge and ventilation fans at the Red Trail Energy Ethanol Production Plant in North Dakota. Plant maintenance personnel realized the bearings on these large motors were failing long before they should have been. The high cost of replacing the bearings soon caught the attention of the plant manager, who called in a specialist to determine what was causing the damage.

When the Red Trail plant's grounding systems had previously been evaluated, stray voltages on the cabinets of variable frequency drives (VFDs) that control the speeds of various motors in their production process were discovered. Without proper grounding, stray electrical currents can do tremendous damage to a plant's systems. The National Electric Code requires system resistance to be at the 25-ohm level, but in some cases can be down to 5 ohms or less.

Diagnosing the problem

Shaft voltage readings were taken on the 30 HP and 150 HP centrifuge motors and the 500 HP ventilation fan motor. These motors exhibited premature bearing damage — long before reaching the L10 life of their bearings. The cause was diagnosed as stray currents — VFD-induced voltages that were building up on motor shafts and discharging through motor bearings.

Implementing a long-term cure

VFD-induced shaft currents discharge to ground along the path of least resistance, and without long-term shaft grounding, that path is typically through the motor bearings. It was recommended to install shaft

grounding rings (SGRs) on all motors controlled by VFDs, to channel the harmful discharges away from bearings and safely to ground.

SGRs come in mating halves to allow fast, easy installation on in-service motors without having to decouple the motor from attached equipment. After removing any dirt, corrosion, and paint that might interfere with adhesion and conductivity, the rings were installed on the 30 HP and 150 HP centrifuge motors using conductive epoxy.

Because of its large size, rings with 6 rows of conductive microfiber brushes providing high current-capacity were installed with mounting brackets on the 500 HP ventilation fan motor.

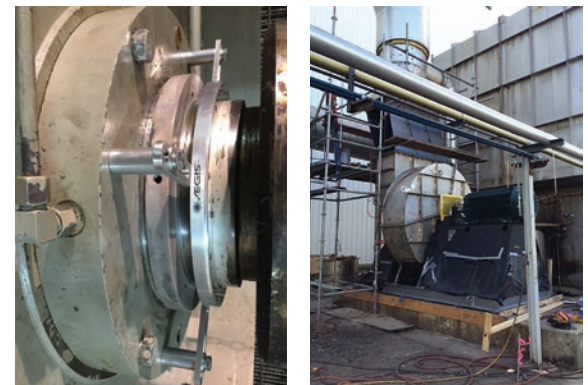
Once the installations were completed, follow-up readings were taken on the running motors to check shaft voltage levels. Readings that were as high as 19 volts before the rings were installed, dropped to less than 1.3 volts (too low to cause premature bearing damage).

In order to guarantee stable resistance through the changing seasons, the recommendation was made to add the protection of electrically “bonding” all motors to an electrolytic deep-well ground rod system.

Since the installation of the rings, Red Trail has not had any problems with their motor bearings; no more high-pitched squealing from damaged bearings, and costly downtime has been minimized.

Adam Willwerth is the sales and marketing manager at Electro Static Technology

Electro Static Technology | www.est-aegis.com



The rings were installed using universal mounting brackets (left) on the 500 HP motor for a large ventilation fan (right) at the Red Trail Energy Ethanol Plant in Richardton, North Dakota.



SGRs were installed on the plant's 30 HP and 150 HP centrifuge motors using conductive epoxy.

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- 19 CEEA Business Forum & AGM**
St. Andrew's Club & Conference Center – Toronto, ON; www.energyefficiency.org
- 24-25 The Future of Energy**
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San Diego Convention Center – San Diego, CA; www.events.solar/expo
- 07-11 LIGHTFAIR International 2017**
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- 19-21 tcbiomass 2017**
Radisson Blu Aqua – Chicago, IL; www.gastechnology.org/tcbiomass

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13	Structural Solar LLC	www.structuralsolar.com
55	Superior Essex	ce.superioressex.com
34	TerraGen Solar	www.terragensolar.ca
64	The Ryan Company, Inc	ryancompany.net
34	TRA Snow & Sun	www.trasnowandsun.com
67	Wanzek Construction	wanzek.com

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* 2003-2015 SOURCE: U.S. Census Bureau

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