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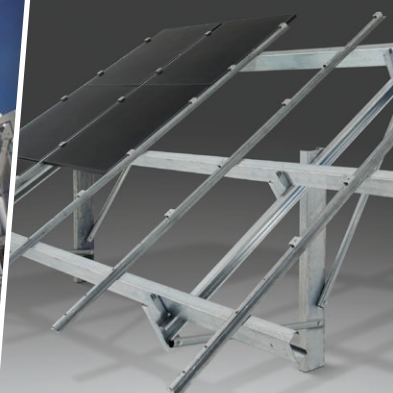
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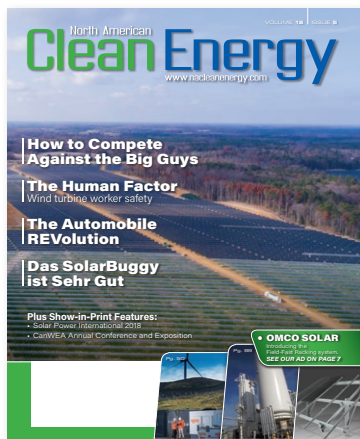
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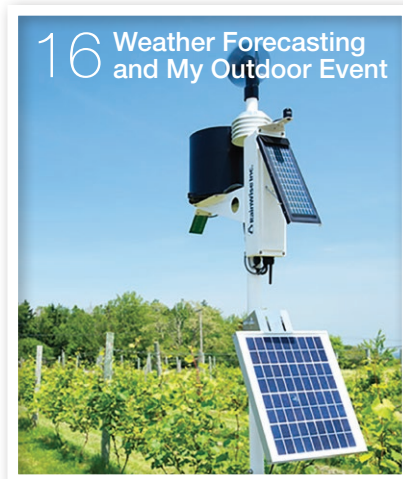


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Complacency

The erosion of safety

by Patrick Hill

There is a hidden trap waiting to ambush even the most competent construction worker, superintendent, or engineer. It is called complacency. Complacency is the feeling of self-satisfaction, contentment, and (occasionally) smugness. It becomes your reward for success. No matter how vigilant you are, however, you will eventually let your guard down.

How could this happen?

Complacency occurs when people feel satisfied with their actions; this normally affects more experienced team members rather than the novices. A new employee, or someone learning a new role, is often too worried about making a mistake. Fear of failure prevents them from being satisfied or content with his or her practices. Complacency is a natural function of the brain. Our brains are designed to automate repetitive behaviors. In other words, complacency is not necessarily the result of apathy, carelessness, or a flaw in your personality: it's simply the way the brain functions. Most of our day-to-day behavior is automated - it happens without conscious or deliberate thought. You may not be aware of it, but your brain constantly scans your environment for signs of danger. You normally notice and respond to what is unique, unusual, or threatening. Repeated exposure to situations, however, even if they are potentially dangerous, dulls our awareness and defense mechanisms. People who are repeatedly exposed to dangerous situations become less concerned about them, and less cautious. We tend to become complacent about our safety when nothing negative occurs. This absence of consequences gradually causes us to become lax about our personal safety. One of the most vexing deceptions is that you are at greatest risk when you least expect it.

What are some signs of complacency?

- Failure to act. Taken to the extreme, this can be a fault. It occurs when complacency interferes with taking action when it is needed (i.e., promising to do it right the next time, or ignoring even minor violations).
- Procrastination (i.e., "If I ignore it, maybe it will go away").
- Indecisiveness (i.e., why decide to do something differently when the current way has worked fine so far).

How can we prevent complacency?

Complacency is part of human nature; there's no way to completely prevent it. The best way to combat complacency is by consciously making a deliberate effort to apply safety strategies consistently - even in the absence of perceived danger. The key is to form safety habits that you do every day, until these habits override any tendency towards complacency. Over time, these safe behaviors will become automatic.

• Stamp out smugness

Ensure the prompt reporting of all near misses, close calls, accidents, and incidents to project management and supervision. Ensure that incident reports are completed, submitted and reviewed by top management within 24 hours. Incident briefings, regardless of the severity, should be the first items on the agenda at all group and management meetings. Use these instances, where we were lucky, to review, prevent, and improve our processes and people. Remember that we are human, and humans make mistakes; don't take a second chance at making the same mistake twice - you might not be as fortunate the next time.

- **Good enough is not good enough**
Even if your safety numbers are less than half of the industry average, and/or better than the company goals, you can always do better. Think of ways to refresh the organization's attitude towards safety. The only legitimate goal is zero: zero accidents, and zero incidents.
- **Be transparent**
Circulate. Be seen. Pop in and out. Practice the "one-minute manager". Tell employees you'll be stopping by. Catch them doing something right and praise it on the spot (or correct it if it's something unsafe). Ask employees if they have any concerns about the safety in their areas. Always get back to them with an answer, even if it's not what they want to hear. Employees need to know that management is interested in what's happening.
- **Beyond accidents**
Good safety numbers can give you a false sense of security. Don't be overconfident. Accident statistics can mask the realities of what is going on in real time. If you have 330 close calls, you'll likely end up with 30 minor injuries, which means lost production.

Shake 'em outta their easy chairs!


Even though you don't want employees to get too comfortable, don't forget to have fun! This is what we do, and everyone can get better.

Get out and about. No one can lead from behind a keyboard, so plan to make an impact. We don't have a lock on best practices; find new partners to benchmark. Work with each other. Remember, two can see better than one.


Broaden your focus beyond the day-to-day activities. Write plans quarterly, yearly, and long term (5 yr). Make sure your team knows where you want to go, and work with them to get there.




Patrick Hill, BSHSE is the Company Environmental, Health and Safety Manager for WindCom. WindCom specializes in servicing and maintaining blades and other composites in the field of wind energy. The Houston-based company has over 11 years of providing high quality services, and employs 100+ certified composite wind repair technicians.




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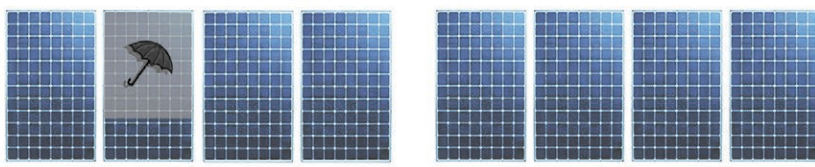


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How to Compete Against the Big Guys

by Michele Caddeo

The European landscape for PV is currently dominated by very big (and mostly Chinese) module manufacturers. They own a large market share, and generate tough competition against European module producers.



The real challenge for these small/medium sized module manufacturing companies - and for any newcomer in the solar business - is to understand first, how to be competitive against those Chinese module suppliers, and second, how to achieve not only good price levels (to stay attractive in the market) but also how to maintain a high quality, European-standard product.

A major objective for all companies, especially solar neophytes, is to maintain reasonable and mid/low company overhead along with fixed costs. At the same time, it's important to keep operating costs of the manufacturing plant as low as possible, without skimping on module production efficiency. If you know, or happen to be a PV greenhorn in this market, your best bet is to enlist the help of an established company that can offer assembling solutions and guidance. You might even opt to acquire a complete turnkey production line, where you not only benefit from proven manufacturing equipment, but can take advantage of decades of industry experience. The company you choose to help you establish your business should have a deep understanding of the production process, which will inevitably reduce your cost of entry to the PV marketplace.

It's possible to break into this business with no experience, but prepare yourself for a major challenge. You will likely hear the oft-repeated refrain of solar PV becoming more accessible and affordable across the globe, and how more nations are turning to local PV manufacturing in a bid to stimulate the development of their renewable energy markets. Indeed, many governments around the world are looking for new ways to avoid a complete reliance on imports, in an effort to increase renewable local content for their countries.



New companies in an emerging market - those joining the PV module production sector at a later stage - have the opportunity to immediately invest in optimal state-of-the-art solutions. Beware of jeopardizing your business with avoidable risks such as overhead costs, bad quality products, and low selling prices. Ally with a company that has great experience in the PV process and business, and can transfer technical know-how to newcomers to help them start out on the right foot. This avoids critical risks for the company management and optimizes the production efficiency to its fullest, from the earliest stage, avoiding the high entrance costs typical with new technology.

The raw materials used to manufacture a photovoltaic module don't involve any warranty on the final panel. In other words, the 25 years' warranty on the modules, which is the current standard, must be guaranteed by the PV module producer. This commitment requires cutting edge tools to test the quality throughout the production, from the single cells, all the way through to the complete module. These tests must guarantee the endurance of the modules, to protect the end user.

Next generation module concepts such as Bifacial, dual glass, flexible Glass-less modules, BIPV, Busbar-less cell interconnection, half-cut or shingled cells, are all in high demand by new market entrants. The objective for a new business is to provide a module assembly line of optimal flexibility, in order to keep pace with the technological changes. Laying the production line in the right configuration, for higher efficiency, means fewer minutes per completed module. It's important to work with a firm that provides its clients with a complete production line analysis, simulation, and process optimization.

Given the current growth in the PV industry, the more savvy newcomers will wisely choose to enter alongside a "long history" partner that is capable of supporting them, not only with the latest equipment technologies, but also in the manufacturing process, proven experience, and knowledge of the full PV chain and market approach. This kind of allegiance is more likely to guarantee that the novice will find success and be competitive, with the newest solutions and products. Instead of being hindered by shouldering the learning costs and entrance times to a new market, newcomers can cut down on operating risks, significantly speed their time-to-market, and boost their chances of short-term success on their new investment.

Michele Caddeo is Marketing Manager in EcoProgetti Srl. He has over 3 years of experience in the photovoltaic business, is an Italian creative, a traveler, and overall fresh mind inside the growing solar market.

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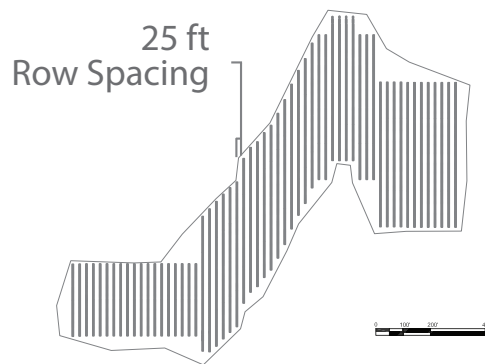
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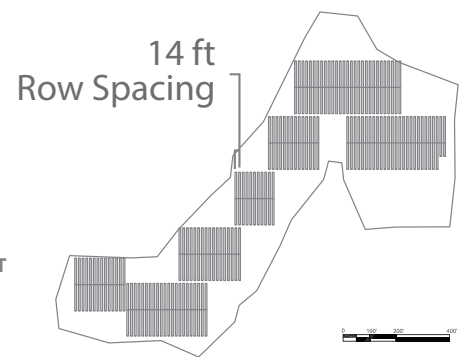
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External Transformer Oil Sampling

How to improve your bottom line with safety, convenience, & compliance

by Robert Rasor, PE








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to take transformer oil samples without first de-energizing the transformer. This saves time, money, and the hassle associated with de-energizing... and it could even save a life. Along with avoiding the costs associated with de-energizing, a big advantage to these sampling systems is safety.

Sampling is not optional

If tested frequently and correctly, transformers can show early warning signs when something isn't right. The dielectric fluid that surrounds the coils not only provides a cooling dielectric barrier, it also retains gases, oxidation compounds, moisture, and metals that are created as a result of aging, faults, or leaks. The combination, distribution, and quantities of these (in test results) can act as a fingerprint for certain conditions, allowing analysis to provide real insight into what is happening inside the unit. Dielectric fluid testing is essential for detecting those issues, in order to address them through maintenance or repair.

Planned downtime is still downtime

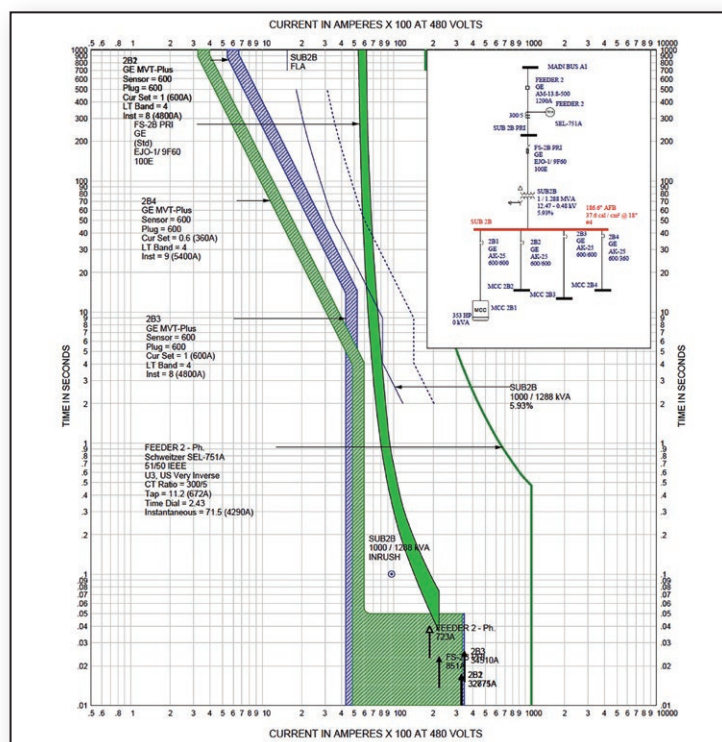
Unplanned downtime is damaging to the bottom line. If any part of a plant is not producing, it is financially damaging - even a liability. Planned downtime, however, contributes to the bottom line, because it allows for testing and maintenance that will keep the equipment healthy and performing as expected. In many instances, shutting down a piece of production equipment is necessary; the actual process of drawing an oil sample from a transformer is simple and quick. However, the costs associated with regularly pulling an asset out of service, to keep the technician safe, can quickly add up. It can even compound when assets are daisy chained.

Scheduling issues are also a factor when pulling energy producing equipment from service. Oil sampling contractors are often booked weeks in advance, but weather patterns fluctuate on shorter time scales, affecting energy production. This makes for unpredictable opportunity costs, and potentially tempts dangerous cost/benefit analyses, which can diminish the long-term objectives of the power producer for the sake of short-term profits.

The role of external sampling devices

The National Fire Prevention Association (NFPA) outlines standards that inform electrical safety practices used by OSHA. Part of standard NFPA 70E implies that de-energizing with lockout/tagout procedures is mandatory for all inspection and servicing tasks that involve opening the cabinet doors.

The NFPA also refers to the Hierarchy of Controls, a widely accepted system used by numerous safety organizations,



to illustrate best practices when working on potentially dangerous electrical equipment. At the top of the pyramid is “Elimination.” In this context, elimination refers to lockout/tagout procedures (de-energizing the system) as the most preferred method for reducing risk. The second tier is “Substitution,” which refers to the use of alternative methods of achieving the same safety result, without the same risk of injury.

Therefore, with sampling in situations where “Elimination” is not possible, “Substitution” can be achieved through the use of engineered products, and revised sampling protocols. One solution is to relocate the access point to an area of the transformer that is safe to sample.

If “Elimination” or “Substitution” is not possible, sampling may still be performed as long as an Energized Work Permit is signed. Requirements of the permit include reasons why de-energizing or substitution were not available, confirmation of risk assessments (including knowing the boundaries for shock and arc flash), and the selection of the proper PPE required to do the work. The administrative requirements also include a program for safety, training, and documentation.

External sampling devices eliminate the need to enter the transformer cabinet for routine oil sampling or processing. This gives technicians access to valves and instruments inside the transformer without the dangers associated with exposure to energized equipment. By removing the risk, they remove the need for additional precautions, which then decreases costs/increases bottom line in a quantifiable way.

“Substitution” with a lockable, external sampling device, circumvents the risk of arc flash injury or electric shock. It simplifies scheduling because in-house or contracted expertise and labor are not required to de-energize the transformer. It increases uptime and uninterrupted power generation, and provides excellent ROI. By adding a window for viewing, and possible Infrared (IR) inspections, the transformer can have the advantages of being safely IR scanned under load while a sample is taken.

External sampling is the only proven way to remove technicians from harms way while sampling an energized transformer. This allows transformers to keep doing what they do best—providing power for the communities and utilities that they serve—while continuing to improve the organization’s bottom line.

Robert T. Rasor is the Director of Transformer Services at SDMyers LLC, where he currently leads technology for the company’s Engineered Products Group, and is a regular instructor for the Transformer Certification Program. He has a bachelor’s degree from the University of Akron, and is a registered PE in the State of Ohio.

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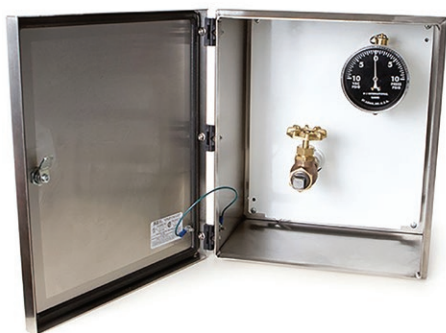
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What You Need to Know About Charging on the Go

by Fred Stampone

The rising popularity of solar has seen a flood of new products on the market, each promising clean, off-grid energy delivered by the sun. You can find a product for just about every need (a solar charging wallet has even been developed), and charging stations have become a mainstay at commercial properties, corporate campuses, parks, and universities nationwide.

These workstations become natural gathering places for connecting, socializing, and work-related get togethers, while also providing comfort for users in knowing their devices can be charged almost anywhere.

Given the wide variety of available options in solar charging stations, many potential customers are unaware of the various benefits and limitations. Before you purchase a solar charging station, here are some things to keep in mind...

Site Considerations

Although it may be obvious, a solar charging station requires placement in an outdoor space that has ample access to the sun for a good portion of daylight hours. Considering that solar charging stations are a site amenity, they are often accompanied by other site amenities - in an outdoor setting, under or near a canopy of trees, or adjacent to buildings. Be sure that the outdoor area has sufficient sun, and a level hardscape surface that will accommodate the full complement of site amenities designed for the space.

Sit-Down versus Stand-Up Stations

Most solar charging stations are sit-down designs, with a table and bench (or chair) configuration, that will seat four to six persons comfortably. These stations are typically accompanied by a relatively large solar canopy that sits above the tabletop like an umbrella, providing shade to the users seated at the table. Alternatively, compact stand-up or kiosk style stations provide no seating, a smaller canopy and tabletop surface, and are designed for a quick charge, where users may just be passing through.

Power Capabilities

While designs with small solar canopies and battery banks may be aesthetically pleasing, they may not have the power to charge many devices. Ask about the size of the solar array (in watts), as well as the capacity of the battery storage bank (in amp hours). It is also a good idea to ask how many devices can be charged per day, on average. Some spaces may not require the capability of charging 50+ devices per day; for others, it may be essential.

Charging Capabilities

What type of devices are you looking to charge? Will you simply be charging smart phones that are able to utilize USB ports, or will you need 120v outlets for laptops, tablets, and similar devices? It is important to think about how the station will be used. Charging stations located in a university quad or corporate campus will likely require 120v outlets, so that laptops may be recharged to stay connected at school or work.

Autonomy

Autonomy measures how long the charging station will function after the sun stops shining, and the charging system relies on its battery bank. This is especially important if you are in an area that has many rainy or overcast days, or if you expect a number of active users gathering to use the station at night. The number of days' autonomy provided by a solar charging system varies by geography, as well as by season, since the shorter winter days provide much less sunlight than other seasons.

Materials

It is very important to understand the fabrication materials utilized in building a solar charging station, and their purposes. Some stations are meant to be easily collapsible/transportable to other areas. Others are designed to be semi-permanently mounted - able to withstand large wind loads and harsh weather conditions. If you live in an area prone to hurricanes, tornadoes, or heavy rainfall, you will want to invest in a station made from durable materials that are wind rated to endure the elements in your location.

Design

How compatible will the charging station design be with your surrounding environment? The design may be functional, but will professionals feel comfortable working at a charging station on a corporate campus, or will students enjoy socializing at one in a university setting? How well will the station blend with the natural landscape of a local park?

Maintenance

Pay close attention to how often the exterior components of the station will have to be cleaned or refinished, or the batteries replaced. Some stations require routine maintenance, while others will barely need any.

Service Life

A solar charging station shouldn't be a short-term investment. Look for warranties and documentation on the expected service life for the station, and its component parts.

Today's market gives you the advantage of being able to choose from many different solar charging stations. Each of them focuses on different customer needs, allowing you to tailor the station to suit your circumstances. Now that you know what to look for in a charging station, you should be able to find the product that's right for you.



Fred Stampone is COO of Sunbolt. Previously known as The ConnecTable, Sunbolt has expanded its product line from charging docks to outdoor workstations. Sunbolt workstations can be found throughout the United States and Mexico.

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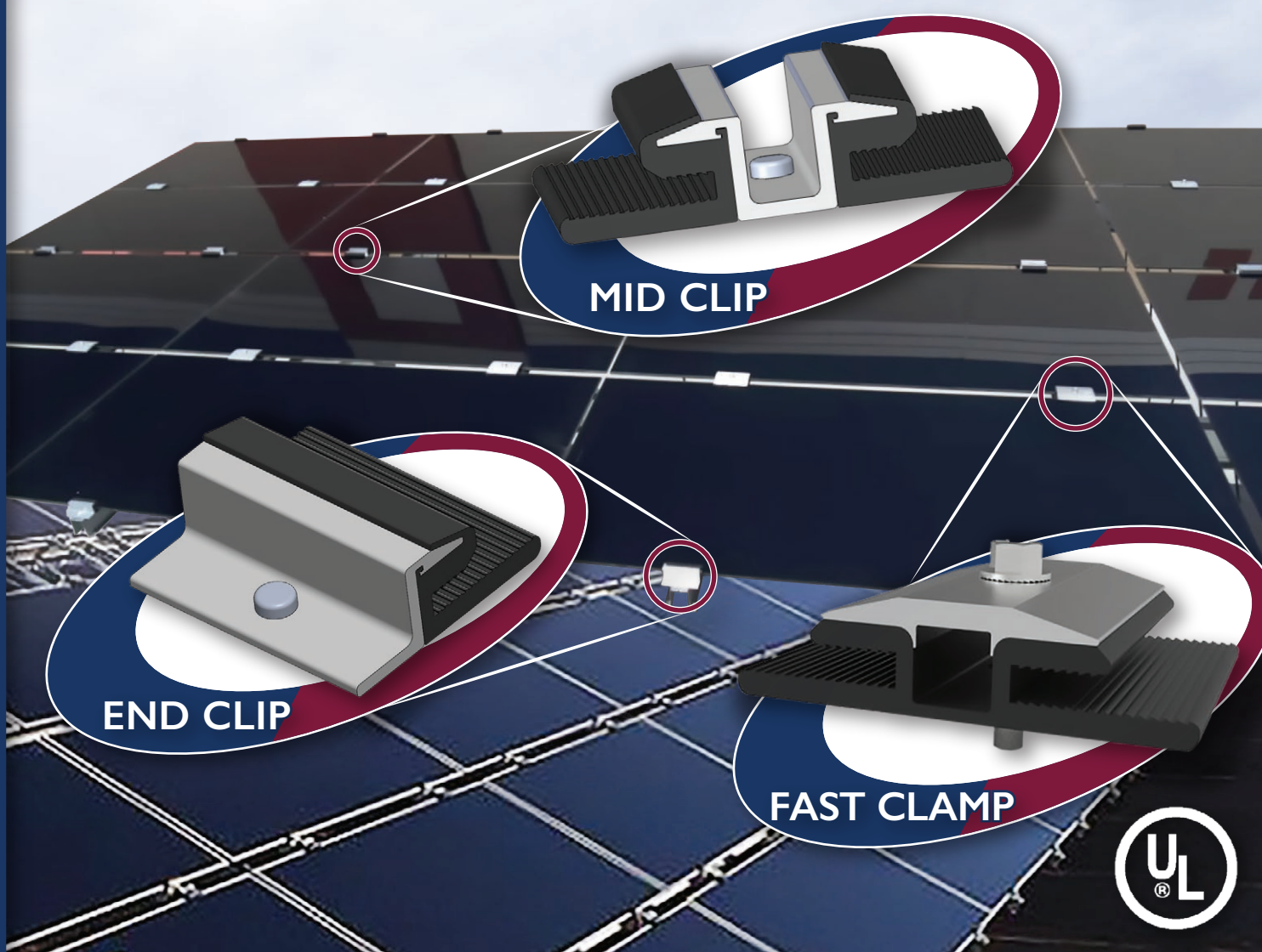
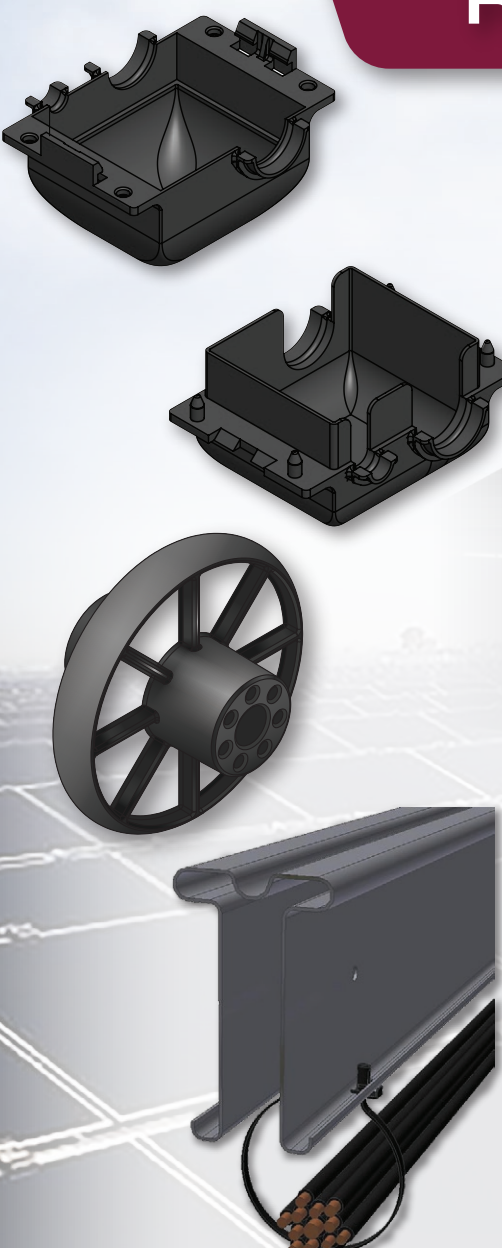
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by Ian Pu



IT'S MONDAY, JULY 30TH. THE FORECAST CALLS FOR

a cloudless, sunny sky, with a high of 93 degrees and 72 percent humidity. Two technicians in neon safety vests, with infrared cameras in-hand, drive a Kubota toward hundreds of rows of PV solar panels. Heat radiates from the panels, and the stale breeze generated by the cart provides little relief. The technicians know what lies in store: a grueling, 30-day inspection process, during which they will walk row by row, inspecting each and every panel, identifying, classifying, and assessing anomalies impacting site efficiency.

For solar Operations and Maintenance (O&M) providers, this scene is all too familiar.

This is the O&M asset inspection method of old. **Manual. Inefficient. Costly.**

Solar energy prices have fallen drastically, driven by significant advances in technology and the proliferation of sites across the US. Asset owners, financiers, and (by extension) O&Ms, have been forced to find ways to reduce operating costs to maintain their margins and remain competitive. The emergence of modern drone robotics and artificial intelligence in the past decade, has unlocked new opportunities and efficiencies in virtually every industry. This presents an exciting opportunity for renewable energies, though they have been slow to adopt these innovations. While new and rapidly developing technologies such as computer vision, machine learning, and predictive analytics, may offer a vague path toward the elusive and obscure holy grail of "Efficiency", they also threaten to disrupt, and forever transform, the industry's traditional way of doing things¹.

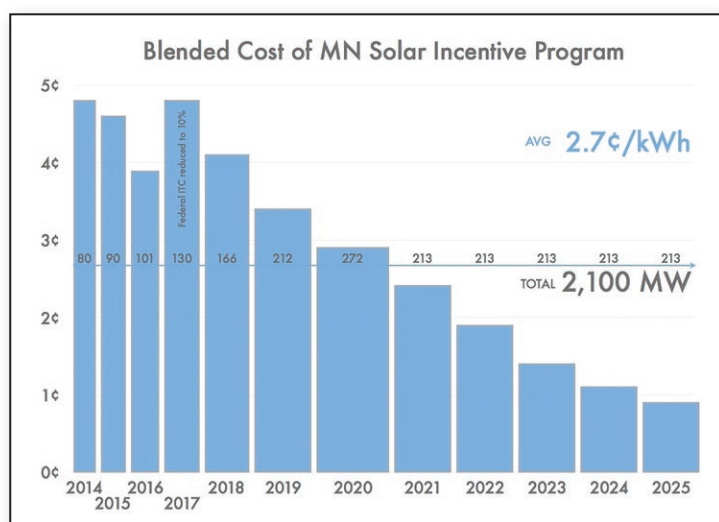


Figure 1: Blended Cost of MN Solar Incentive program. Adapted from "The Making of a Midwestern Solar Energy Standard," by J. Farrell, 2013, Institute for Local Self-Reliance. Retrieved July 27, 2018, from <https://ilsr.org/making-midwestern-solar-energy-standard/>.

It is estimated that for a 100MW site, a full-site inspection can cost more than \$40,000², making it one of O&M's costliest responsibilities. Understandably, many O&M's elect to inspect their projects once a year, at most. Even those inspections may only cover a portion of the overall site. In fact, the US Department of Energy (DOE) estimates that for a 10MW ground mounted solar site, system/inspection/monitoring account for 12-18 percent of total expenditures³.

In light of this problem, there are three dimensions in which O&M's can achieve cost savings: labor, time and analysis, and preventative measures.

Labor Cost Savings

Drone robotics have seen incredible developments in recent years, making use and ownership significantly more affordable. Additionally, drone manufacturers have developed industrial-grade models with added durability, improved battery life, and specialized camera packages for industry-specific applications. These drones can now be easily outfitted with all the equipment required for conducting thorough inspections at the sub-module level.

With drones, the inspection and data collection processes are both convenient and efficient. For a 100MW site, collecting the necessary aerial imagery takes one trained pilot three days to complete. Drone scanning yields a 90 percent cost savings, when compared to 30-day manual inspections⁴.

Furthermore, given the trajectory of drone innovation and Federal Aviation Authority (FAA) regulation, industrial applications of autonomous drones and out-of-the-box solutions could drive additional efficiencies for O&M's over the next several years. Faced with the potential to drastically improve inspection efficiency, O&M's should consider how drones can be integrated into their inspection processes, to reduce labor costs⁵.

Time and Analysis Cost Savings

Traditionally, analysis of the site and its health was inextricably linked to the inspection process – as technicians picked out hot spots amongst rows of panels, they recorded anomaly types and locations. However, if inspections become more automated, absent technicians on-site, how will O&M's spot and prioritize these issues?

When combining aerial thermography with Artificial Intelligence (AI), computer vision, and machine learning algorithms, software providers can automate data analysis. Not only can these providers identify a variety of anomalies (from diode and string failures, to cracked panels), they can also geotag issues with extraordinary accuracy, using O&M As-Built and geospatial positioning⁶. Moreover, they can do so with unprecedented levels of speed; end-to-end analysis and report generation for a 30MW site requires only one day's turnaround.

Preventative Cost Savings

Inspections have long been perceived as a cost center. Annual inspections have been habitually performed out of contractual obligation, or in reaction to major issues and unexpected dips in output⁷. However, with rapid developments in predictive analytics and forecasting, asset inspections can transition from cost center to revenue driver.

By incorporating weather forecasting, predictive analytics, and machine learning, O&M's can engage in preventative and proactive maintenance to prolong asset lifetime, and maximize output. Major applications of these future technologies include anticipatory vegetation management, inclement weather protection, and smart benchmarking.

With the solar industry in its current state of flux and rapid change, O&M's must "resolve the head-scratching equation of continuously reducing costs when the main resources they tap (people, vehicles and tools) are becoming more expensive."⁸ Despite an uncertain future, aerial thermography, AI, and predictive analytics offer a path toward improved profitability.

Ian Pu is Head of Business Development at Aerospec Technologies. Aerospec is an AI-powered smart asset management platform for the renewables industry that uses computer vision and aerial thermal imaging to improve inspection efficiency by up to 10x.

Aerospec Technologies

<http://aerospec.us/>

¹ Fehrenbacher, Katie (2016, September). How Data and Machine Learning Are Changing The Solar Industry. <http://fortune.com/2016/09/14/data-machine-learning-solar/>

² Aerospec internal calculations based on customer case study; inputs include solar technician median incomes

³ Walker, A. (2017). PV O&M Cost Model and Cost Reduction [PowerPoint Slides]. Retrieved from <https://www.nrel.gov/docs/fy17osti/68023.pdf>.

⁴ Aerospec internal calculations based on customer case study

⁵ Brehaut, Cedric (2018, January). Low O&M Prices Drive 'Digitalization' and New Technologies. <https://www.greentechmedia.com/articles/read/low-om-prices-drive-digitalization#gs.kvW74Vg>.

⁶ Weaver, John (2018, June). AI-infused drone O&M for solar farms – 50 minutes per MW. <https://pv-magazine-usa.com/2018/06/22/ai-infused-drone-om-for-solar-farms-50-minutes-per-mw/>.

⁷ Deign, Jason (2016, October). Preventive maintenance: a different approach to PV O&M. <https://www.solarassetmanagementeu.com/new-updates-source/2016/10/7/preventive-maintenance-a-different-approach-to-pv-om>.

⁸ <https://www.greentechmedia.com/articles/read/low-om-prices-drive-digitalization#gs.HdVM7CQ>

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Weather Forecasting and My Outdoor Event

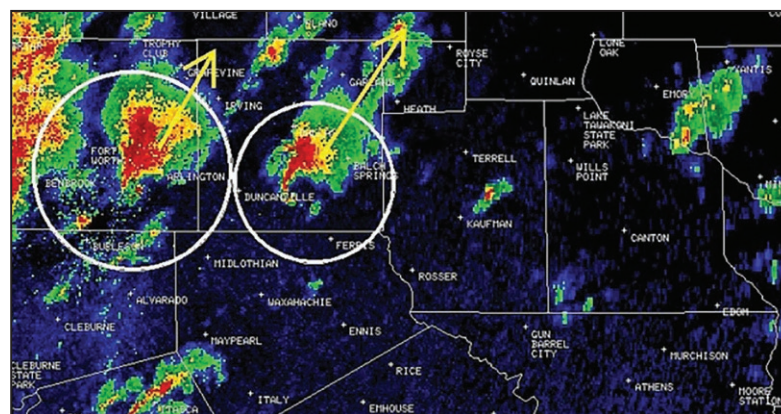
by Marc Inman



10 percent chance of rain? Mother Nature, “Hold my drink.” Boom, there goes your outdoor event! We plan, we worry, and we watch the forecast for weeks and days prior to the big event. Forecasting weather is a science, and yet, it’s the one thing you can’t control.


We utilize satellite information, algorithms based on the data output, even historical referencing, and output data that mainstream society can understand, then we make plans. We use personal weather station data to provide a direct link between the weather station and software, which lets users record, process, and distribute data on a local or global scale. We pull up the images on our wireless device and smile (or frown). Finally, on the day of our outdoor event, we hope that the chance of rain is in our favor, or that “they” are just plain wrong in their forecast.

Meteorologists use a variety of models to predict tomorrow’s weather. A slight miscalculation, and the entire forecast will either become incorrect or change dramatically. This butterfly effect makes the predictive model even more uncertain. Meteorologists use many tools for predicting weather. One such tool is persistence forecasting, which basically means that whatever the weather is doing today, it will continue to do tomorrow. Synoptic forecasting applies knowledge of atmospheric laws. Statistical forecasting factors in the records of past weather patterns. Computer forecasting calculates all the data to produce models of what the future may hold.



Forecasters can show us images to tell us where the air is mild, where the cold fronts are located, and where it’s warm. They can even pinpoint stormy weather. Looking at images, along with variables such as wind speeds, directions, or pressure patterns, they can develop a forecast. This includes the direction a storm is heading, and if it might dissipate, or grow stronger. Remember science class experiments, where you had to utilize dozens of dependent variables? What if there were no controlled variables? Take weather forecasting, for example. Our energy source is the sun. Other than rising and setting on a consistent schedule, it is an independent variable due to the Earth’s rotation. This spin causes differential heating, or consistently changing air pressure and temperature. Those fascinating clouds we all daydream to, that drift in different patterns and different concentrations of gases, affect our forecasting ability.

Leaving the weather up to chance is very risky. Using a free weather app may provide you a forecast, but still leaves out critical data, such as the actual distance of the storm, or how long the storm is expected to affect your event. Thus, having access to precise, and even real-time weather information is critical to ensure that you know when to get people to shelter, and when it is all clear to resume your events activities (if at all).



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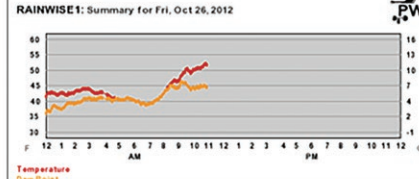
Station Observations

RAINWISE1 Rainwise Factory, Bar Harbor, ME 04609 View data in metric units

Latest Conditions	Current	Today's Max	Today's Min	Today's Average
Temperature	51.7°F	51.9°F	38.8°F	43.4°F
Dew Point	44.5°F	48.1°F	30.0°F	41.0°F
Winds	5.1 mph E	5.5 mph SE	-	1.4 mph
Wind Gusts	7.9 mph	7.9 mph	-	-
Humidity	80%	100%	80%	93%
Pressure	30.27 in	30.29 in	30.25 in	-
Precipitation	0.00 in	-	0.00 in	-

Trends Temp/Dew Point Winds Pressure Precipitation

RAINWISE1: Summary for Fri, Oct 26, 2012




Rainwise Factory Bar Harbor, ME 04609

Lat: 44.3997429696629, Lon: -68.2077813146499

Elevation: 29

Station Type: Rainwise MK-III





Integrated inverter/charger

Morningstar's new MultiWave inverter/charger successfully merges the power and stability benefits of low-frequency inverters with the agility and efficiency of a high-frequency design in a single platform. The 4000W MultiWave is a flexible inverter which addresses three key user groups: UPS/backup, Grid-tied with solar priority, and Off-grid solar with generator. MultiWave is future-proof with a Plus Module DIN-rail expansion mounting system on-board. The user can easily add control, communications, and advanced battery functions as their needs demand. The new 4kW inverter/charger is part of a global line that will include 120, 120/240 and 230VAC versions.

Morningstar Corporation | www.morningstarcorp.com

Outdoor events take lots of planning and effort. There is so much uncertainty; unfavorable weather can really impact an outdoor event. Many organizations offer real-time weather data for events; they use high-end weather computation software, online forecasting services, and precision weather instruments. Another option to consider is a personal weather system (PWS). A PWS is an easy-to-install, well-built, and sturdy system that can measure temperature, relative humidity, atmospheric pressure, wind speed and direction, and rainfall.

Personal weather stations range in price, depending on the quality and accuracy of the equipment. An especially useful feature of a PWS is the receiver/console. You can also upload your weather data directly to the Internet, or to your personal computer, laptop, tablet or hand-held cellular device with a wi-fi connection. This information can be shared with weather networks such as the Weather Underground's Personal Weather Station Network. Over 30,000 people contribute data to these networks. All of this information improves the accuracy and specificity of weather reports that are issued to the public, and can help you with current and future outdoor event planning.

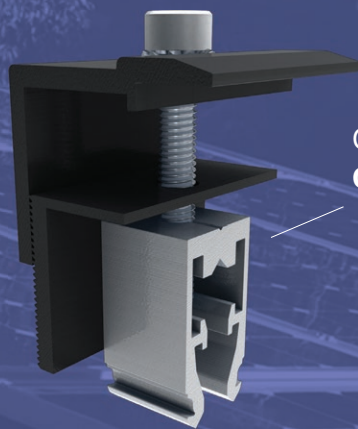
Sure, short-term forecasting seems more accurate, but when they nail it months out; WOW! Professional Meteorologist and specialized, subscription-based weather organizations are great tools to have for your outdoor event planning. We have all heard the advice "if you want to know the weather just stick your head outside". Give me a time machine and I will do just that. Until there is a tested, working-model time machine, help the meteorological society and consider a PWS. Next time, you can help someone forecast the weather for their outdoor event.

Marc Inman is the VP of Marketing and Communications at RainWise, Inc, a Professional Weather Instruments designer and manufacturer based in Trenton, ME USA.

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Hochschule Bochum
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Das SolarBuggy ist Sehr Gut

by Thomas Renner

HOPING TO SET A GUINNESS WORLD RECORD, students from a German university are building a solar vehicle that will be powered by the blazing, Australian desert sun.

Students at Bochum University of Applied Sciences call their solar buggy "Froggee". Froggee is expected to survive a 224-mile jaunt across the Simpson Desert. The team is hoping to beat the existing standard of 4 days, 21 hours and 23 minutes, set in 2017. The race - from Purni Bore to Birdsville - will be held in 2019. "We wanted to take solar mobility off-road and use solar energy in an



area it is suited best: the desert," said Birgit Reuter, a member of the 16-student team. Bochum students have been building solar vehicles since 1999. "It was just a small step for us to go from an Australian road to the Australian desert. And, there are not exactly a lot of deserts in Germany."

The team is designing a compact, two-seat buggy that appears similar to the cars used in the Dakar Rally. The unit will be powered entirely by the sun. It includes a 40m² solar array that consists of 144 panels and 1052 silicon cells. Students are using 96 lithium ion pouch cells for the battery. Like most of the products in the vehicle, the battery is extremely light.

"We don't have any infrastructure in the desert, so we're charging within three hours via a 40m² foldable solar array," Reuter said. "This is basically our charging station to go. The energy is stored in a battery, just like any electric vehicle."

Reuter said the vehicle's output voltage is 650V at 6kW and 9.2A. "With it, we can be fully charged within three hours," she said. "We believe the buggy will be able to drive 100-150 kilometers on one charge, but frankly, we will just have to test it to see how far it can go."

Devising the power source for the vehicle has proven to be just one of the challenges for the students. Another significant hurdle is finding lightweight components that can stand up to the heat, terrain, and desert conditions. "The desert is quite demanding, and we frequently couldn't just take any parts that might fit the specs of the vehicle," Reuter said.

The different desert surfaces, such as mud, rocks, erg, and dunes, will test the durability of the vehicle's components. Stopping the infiltration of sand poses one of the most perplexing design challenges. "There will be a lot of sand around that acts like sandpaper and gets into the smallest holes," Reuter said. "The electric box will need to

be tightly closed and all outer parts need to be at least IP65." IP65 is a standard established by the Electro-Technical Commission for Ingress Protection. IP65 means the assembly is totally protected against dust ingress.

The buggy includes two motors for each axis, and a controller for each motor. The unit includes 10 cables that connect the battery to the controllers and the controllers to the motors. The cables are also shielded, oil-resistant, flame-retardant and are suitable for temperatures up to 176° Fahrenheit. The cables span 15 meters in the vehicle. The shield in the cables was one of the key advantages in selecting the component.

"We needed a shielding in our motor cables because the motor controllers are inverters and bring out alternate current

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to the motors,” Reuter said. “In this field, it is essential to have good shielding to prevent electromagnetic compatibility (EMC) problems. We needed cables that are very robust and durable and at the same time conduct 400 volts. Since space is tight, they also needed to be bendable.”

Reuter said in building the buggy prototype, students faced issues in getting the electrical components to work together along with the controllers. They also needed to acquire special components to build the axles.

Even with all of their planning and attention to detail, there is no way of determining how the “Froggee” will survive the sizzling desert heat. Temperatures can reach as high as 122°F. Simpson Desert covers 68,000 square miles and is home to the world’s largest sand dune desert. Some of the best four-wheel driving in Australia takes place in the Simpson Desert, an area popular among tourists. No maintained roads cross the desert, which averages less than six inches of rain per year.

Students from Bochum’s mechanical and electric engineering are spearheading the vehicle’s construction team, with support from students in computer science, business, economics, and sustainability. The vehicle for the 2019 race is still under construction, but Reuter said the team is ready to challenge the existing record.

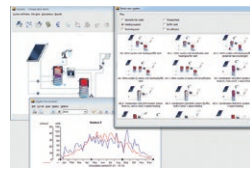
“Our vehicle is specifically made for these conditions, so we believe we will definitely be faster,” Reuter said.

More information about the team is available on:
<http://solarbuggy.hs-bochum.de>

Thomas Renner writes frequently for U.S. trade publications. He can be reached at trenner@catalystmc.com.

The chainflex cables in the vehicle are manufactured by igus, a worldwide company that makes and distributes functionally advanced polymer components and assemblies.

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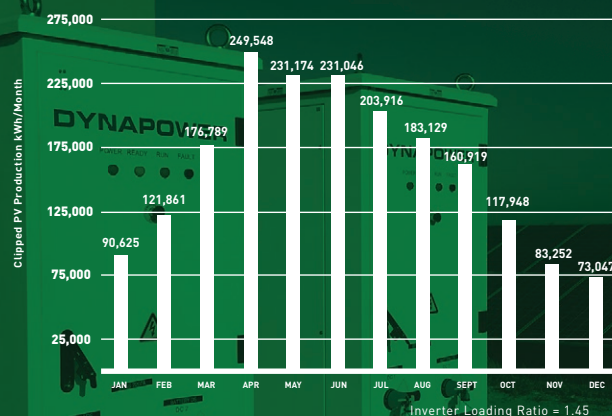
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An Innovative Approach to Commercial Solar Pool Control and Monitoring

by Gal Moyal

Designing and building large commercial pool solar thermal systems presents many interesting challenges: sizing the array to meet the pool needs, piping arrangements, thermal expansion, flow balancing, drain strategies, freeze protection, roof connections, water proofing, controls and monitoring, and more. Read on to learn how to address the unique challenge of controlling and monitoring these mega solar systems.

When designing a commercial solar pool system, keep in mind that we are about to attach an additional sub system to an already complex, good sized “water treatment plant” – one which already works to maintain a delicate relationship between its different sub systems. Running a commercial pool can cost around \$100,000 annually, broken down as follows:

- boilers 45%
- pool pump 35%
- water makeup and chemicals 20%

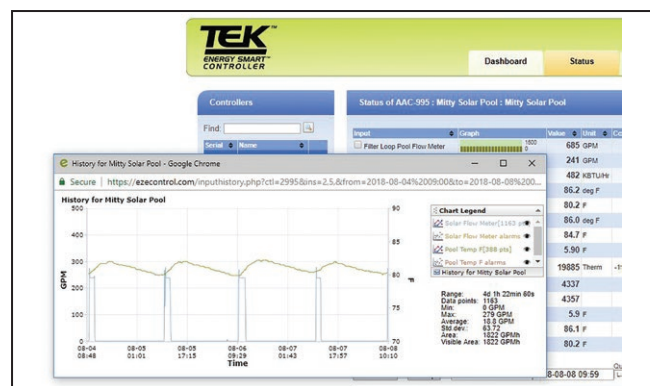
Although thermal energy takes the lion's share of pool operation, it would be smart to pay attention to other pool subsystems. Incorporating them into the control strategy can yield additional energy savings.

When a large solar system turns on, it diverts a large part of the main loop flow toward the solar array. This can disrupt the balance of the other subsystems, and cause an emergency shut down of the pool. For a solar pool to successfully maximize heat production, while keeping the other pool subsystems balanced, it takes an array of sensors, automation, software, and precise control strategy. These sensors report subsystems’ status, while the controller software performs the delicate balancing act of keeping the pool running - maximizing solar energy production as it minimizes electrical and thermal energy expense.

A successful control strategy includes measuring the pool, boiler and solar flows, pool chemistry (ORP and PH), and associated temperature of all three loops. In addition, it is important to install solar and drain solenoid valves, pumps, and boiler control switches, on top of a solar pump variable frequency drive (VFD) and required plumbing. The array flows must be balanced, and the array able to drain when the time is right.

The conventional strategy of solar control is turning the solar pump “full speed” ON or completely OFF, whenever the temperature differential (dT) between the array and the pool goes over or under a certain threshold level. Unfortunately, this method does not consider the rest of the subsystems, and will eventually send the boiler or the chemistry controller into emergency shut down.

It’s important to install a solar solenoid valve on the solar supply line, to eliminate array ghost flow. The solar pump should be operated via the solar VFD, allowing soft start, ramping speed slowly while shutting down the boilers, giving the system time to maximize heat harvesting. The solar pump VFD is used to vary the solar flow as a function of dT, which keeps the system humming at an optimal dT range while the sun is out, saving on the pump kWh spending. When the solar system turns on, keep an eye on the main loop flow - if it drops to a predetermined lower threshold, ramp



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up the main pool speed to maintain the minimum flow needed to keep the pool running. Turning the solar system off, use the VFD to soft stop the solar pump, turn the boilers back on, and shut the solar solenoid valve (to eliminate continues ghost flow through the array). One important aspect of a control strategy is the mandated CSI freeze protection. The mandate calls for the complete drain of the solar array every time the solar system turns off, which means filling it back up again as soon as the dT is right. Filling and draining the array multiple times a day is inefficient and costly. The best approach is to keep the array full of water; only completely drain it when the array temp falls under 45°F; use a drain pump that kicks in on command, for complete active array draining.

With an average solar pool system price tag of over \$500,000, real-time control and monitoring is a must. The reality is that most of these systems are built and left on the roof, with the assumption that they're working properly. A more wholistic approach involves providing online, 24/7 access to the pool via any smart device. This includes submetering the main pool pump electricity usage, boiler thermal energy consumption, and contrasting it with the solar system energy production, along with pool chemistry. By providing immediate access to a live dashboard, the operator can verify - at a glance - that all systems are operating within the set parameters.

Even the most dedicated pool operator needs help keeping tabs on his pool system. A system monitored in real time will use push notifications via text or email. As soon as any parameter gets out of permissible range, the system notifies the operator. Using the built-in control center, the operator can immediately intervene before it turns into an emergency.

As soon as a notification is received, the operator logs in. The system's built-in analytical tools help to quickly analyze and determine the root cause, and remedy. If solving the problem requires a higher level of expertise, the operator can download the information as a CSV file and share it with the appropriate party, or call the installer for service.

While monitoring the pool and solar systems is vital, it's just as important to be able to fine-tune the system for additional energy saving, or to prevent a catastrophe. A built-in control center lets the operator choose which components to turn on or off, which can save an additional annual operating cost. Scheduling the pool pump speed and boilers can increase annual savings up to 65 percent. In

the end, the most challenging obstacle to creating scaled up solar thermal systems is cost. Therefore, careful design, and reducing cost before producing for short ROI, is key.

Gal Moyal is the Founder and CEO at Maktinta Energy, a provider of comprehensive cloud-based control and monitoring solutions, energy efficiency design and implementation, and renewable energy solutions. Maktinta manages on/off grid energy efficiency of large complex mechanical systems covering hydraulic, electrical, agricultural, and renewable disciplines with emphasis on solar thermal solutions.

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Repowering Your Commercial Solar System

by Wayne Williford



SOLAR OPERATIONS AND MAINTENANCE SERVICE

is recognized as an integral part of any PV systems' operational requirements. Consistent availability, and rapid return to service times, allow asset managers to forecast energy production with greater reliability and quality. We are now starting to see, due to system aging and new technology, that the need to remove and replace part (or all) of an existing system is becoming more common.

Risk

PV systems without scheduled maintenance programs do not typically have the best ROI for the customer. Unless a maintenance plan is in place and operational, a system can underperform, often not meeting production estimates. Deferred maintenance and neglect can prematurely age a system. Believe it or not, this happens regularly, and at different degrees and times in the energy production lifecycle. Whether it's blamed on poor budget planning, or company or asset turnover, lack of maintenance poses the risk of having to address a much bigger problem than underperformance.

Hidden Costs

The largest hidden cost is failed power production expectations. A PV developer's future financing and business model can be seriously affected by an underperforming project, or the missed opportunity to accurately forecast long term system replacement costs. Expensive repairs and extensive down time can add up quickly - the resulting damage to the builder's reputation can be a steep price to pay.

Any component of the system has potential for failure, and every component left uncared for will deteriorate and fail over time. Aging of the system will also bring other issues into consideration. O&M service providers are now seeing the need to retrofit aging systems with new components, or rebuild them entirely. Ask your service provider to explain and propose their full offerings in detail, and inquire if they have the experience and capability to remove and/or replace an older system. Developing a relationship with a qualified full-service provider is more essential than ever in assuring expected energy production.

Maintenance and Remediation

It's important to remember that not all sites are designed or constructed the same, nor are they located in common environments. Any maintenance plan should be customized to the system that it is being used, and not a generic form that is good for every system in the "fleet". Preventative maintenance should be performed at least once a year. However, each site's characteristics will vary. An agricultural packaging facility may need service multiple services a year, whereas a college campus may only require an annual visit, and a utility site may involve continuous service. It is important to seek a provider who is capable of developing a maintenance package that suits each individual system's needs. Data Acquisition Systems (DAS) can provide a suite of useful information that show the service provider what and when essential maintenance services are needed. The optimum time to clean solar modules or set a tracker program can be determined through a DAS, as well as replacement of system fuses and modules. Visual inspections via photographs of the site, drone fly-bys, and thermography play an important part in scheduling maintenance tasks.

Documentation

Reputable service providers will always furnish reports upon completion of any maintenance service. This documentation is vital to the effective maintenance of the system. It details the scope, schedule, and service history that is unique to the system. It saves time and money in the short run, and the service life of the power system in the long run. Maintenance documentation can be an essential requirement when addressing warranty coverage. Many warranty holders will not provide service without it. Though documentation may require more involvement on the owner or manager side, it allows greater scrutiny and protection of your investment. Regular maintenance could mean the difference between a short-term year high production lifespan, or an extended years-plus, decreased production lifespan, along with a corresponding ROI. Reactionary services tend to be costly; full unit replacements may be necessary to return the system to operation. Systems that operate at 99 percent availability for the production year are better positioned to earn a high ROI, and increased customer and industry confidence.

Remediation/Repower

Even in cases where maintenance has been performed at the highest level, and on a regular schedule, there comes a time in the life of every facility, system, or component, where you have to decide: repair or replace? You run a real risk of losing the asset and its expected value. An active and long-term maintenance plan is essential in maintaining and assuring production; even then, an aging system will eventually need to be remediated. When considering this tough decision, make sure to reach out to those companies that have experience in the full spectrum of services required for the work. It's vital to select a company that can provide the critical EPC and service provisions, to ensure your project is completed with the expected value and reliability, using the latest design and components for the project.

Wayne Williford is V.P. of Operations and Maintenance for Stellar Energy, a large-scale, full-service solar O&M service provider with complete project development, design, engineering, procurement, and construction (EPC) management capabilities. The company also provides professional operations and maintenance services for solar power plants, as well as small business and residences.

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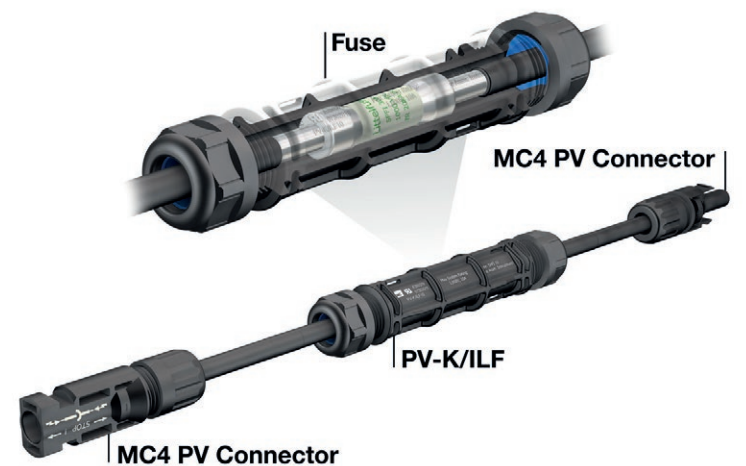
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Solar CEO 'Happy that Solar Energy is at a Dead End.'

by Scott Cramer

Solar power is at a dead end, and I say that happily. I also say it as the CEO of a solar company. On its path and in its current direction, it is impossible for solar energy to go any further.



However, that doesn't mean it doesn't matter. We just need to start looking at, and thinking about solar power differently. This is where my happiness comes into play. Dead ends in the green business world always result in one of two outcomes – a strengthening of an industry for the better, or the demise of an industry that could not find a way to survive.

Thankfully, we have the sun in our sky to shed light on where we need to go.

Although the tariff has and will continue to decrease direct investment in PV, solar power will prove itself an indispensable part in the orchestration of solar-integrating, and solar plus technologies.

Here's how we can make that happen...

Complementary Solar and Solar Plus Technologies

IoT (Internet of Things) and Solar Power

IoT (Internet of Things) can be defined as the network created in homes, buildings and businesses, when vehicles, home appliances, electronics, software, sensors and actuators connect and exchange data, based on user preferences.

In essence, the Internet of Things is a way for consumers to expend less of their own physical energy in managing power and devices in their home. Solar energy is a way for consumers to expend less of their grid-tied electricity to power their living spaces.



This doesn't just have implications for the home, though. Controlling the environmental factors in a workplace to help fuel workplace productivity – a major field of research among contemporary industrial organizational psychologists – is something commercial solar can further enhance, especially given its reduced power costs.

Solar energy and the Internet of Things will also converge through smart metering technology, smart thermostats, expansive wireless ranges, and remote monitoring (which makes controlling electrical usage in a home easier).

The Interplay of Window Technology and Solar Energy

Did you know that \$20 billion dollars of energy leaks out of windows in the United States each winter? Researchers are working on developing better insulating windows that make energy efficiency a greater priority. These could save \$10 billion annually in energy costs.

Homeowners and businesses using smart window technology will also benefit from solar power; the panels will need to produce less to sustain a building's energy demands.

Windows that insulate buildings more effectively mean less power spent on heating and air conditioning, which means fewer solar panels needed, lower installation costs, and greater accessibility to solar power for the average American.

Solar energy for businesses is already a big pull in Utah, because 100 percent of solar expenses can be written off in first year, if the solar buyer owns his or her property. Although businesses who rent out their space cannot currently qualify for this credit, that may change in the near future. Increasingly expensive fossil fuels and coal-based power, and public outcry on behalf of the environment, will pressure the government to focus more on monetary incentives for more businesses to go solar.

Storage, Backup, and Battery Backup Technologies

These solar plus technologies provide power continuity, greater energy efficiency, and more savings potential. Equally important, they promote ownership over individual power use (depending on net metering policies of the location's utility provider).

What's the difference between storage, backup, and battery backup? Although there's some overlap among them, the below distinctions will help.

- **Storage**
A device that is capable of keeping energy for use at a later time; a battery.
- **Backup**
A way to use electricity, in the event of a power outage. Can either be in the form of a battery/storage, or instantaneous use of the electricity from the solar panels.
- **Battery**
Interchangeable with storage. A battery is an electrical storage device. A type of backup. So, while all batteries are backup, not every backup is a battery.

Although current battery backup and backup prices are a tough pill to swallow, the demand for solar will rise to meet the impending environmental challenges of our time. Pooling research and development budgets into funding and engineering will eventually lead to more affordable battery backup, and secure power supply backup options.

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The Future of Solar Plus is Bright

When you take into consideration all of these advantages to solar plus products, what may have looked like a dead end for solar power becomes an open door, through which resoundingly powerful possibilities – much like the ones presented by the sun’s itself – are revealed.

Scott Cramer is the President of Go Solar Group, a Utah Solar company.

Go Solar Group | gosolargroup.com



Solar’s Role in the Soon-to-Evolve Community Infrastructure

Charging ports for electrical vehicles are emerging in greater numbers every day. As urban centers expand in number and population size, so do the consequences of relying on old school energy production like coal-based and fossil fuel-based power.

Solar power will be an effective one-two punch with environmentally conscious cities, who’ll increasingly design infrastructure around public transportation for environmental benefits, and reduced congestion/Co2 emissions. Solar will likely play a huge role in helping to recue costs to make these eco-friendly urban plans possible.

Residential Infrastructure, Real Estate, and Home Owner Associations (HOAs)

It’s difficult to calculate how much home value and resale value improves with residential solar installation. The same goes for neighborhood value, HOAs, and apartment complexes. However, solar savings are compounded in large-scale solar projects, which stand to have more positive environmental and health outcomes for area residents.

Solar Gardens

Sometimes referred to as “solar garden,” community solar projects take solar power provided by a third-party, and distribute the electricity to a community of homes.

Not only is this a viable option for lower income areas, it’s also a sustainable model for charitable solar projects. While few private entities have embraced this delivery model, government dollars have been used to reify these projects.

This delivery model will get us even closer to achieving grid parity. For most people, the price is the main reason why they don’t want solar. Community solar, on the other hand, allows more individuals the ability to afford renewable energy.



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What's the Difference?

SCADA operational management vs. performance management

by Dean Schoeder and Jae Kim

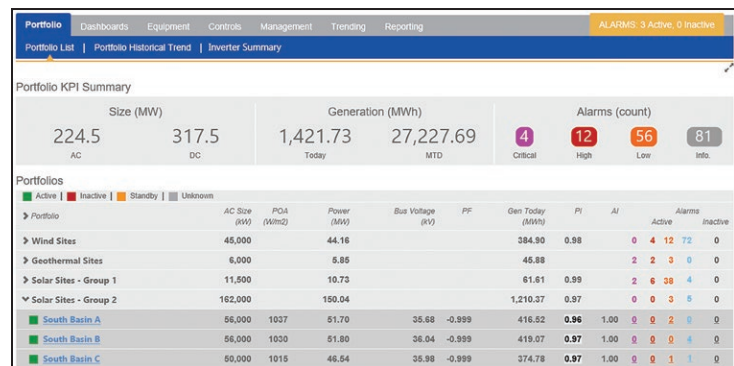
UTILITY-SCALE SOLAR PLANTS REQUIRE a SCADA system to address the unique challenges of managing PV power generation. Although SCADA systems monitor and control a wide range of devices at sites, they can be even more beneficial when used for performance management to optimize power generation, and maximize profits.

It's one thing for a SCADA system to monitor and collect data from all the devices that contribute to generating power. It's another thing to turn that data into actionable information. Is every device that is used to produce power operating as designed? Is the site producing the optimal amount of power? Has the site's power production been curtailed? A SCADA system, when used for performance management in addition to operational management, can answer these questions. This performance-related information enables smart decision-making for both operations and asset management groups.

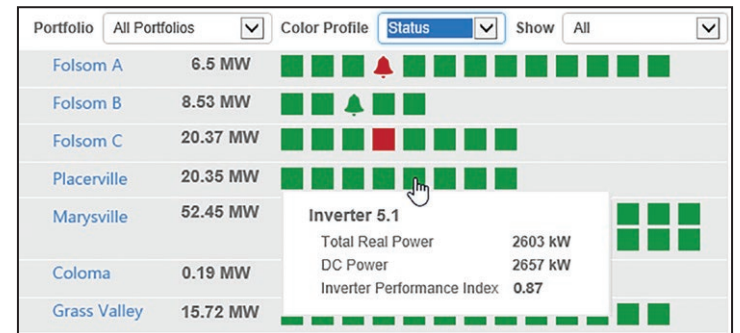
KPIs and Power Production

The best way to determine - at a glance - if everything is operating as intended, or if something needs attention, is by reviewing **Portfolio Key Performance Indicators (KPIs)** (*Dashboard 1*). The most important statistic is to see how much power is being generated in real time. For large utility-scale sites, power factor and voltage information are additional KPIs that impact a site's real power production.

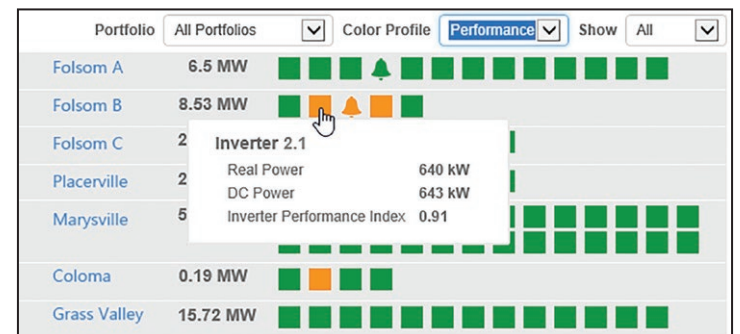
Beyond those basic indicators, deeper insights can be gained from the Performance Index (PI) and Availability Index (AI) (*Dashboard 1 - columns to the left of Alarms*). The PI shows if the site is performing at the levels it should be, given the site characteristics. For example, if a 20 MW site is producing 18 MW, is that good or bad, relative to the amount of sun energy available and the equipment conditions? The AI shows whether all of the power-producing devices are available to produce power. At any given point in time, two inverters could be offline, but the site could still be producing the full amount of power. In this case, the PI would be 100 percent, but the AI would only be 90 percent. An operator or engineer can use the KPIs to determine if there is an issue that needs further investigation. By setting alerts on KPI thresholds, staff can be notified when something is adversely impacting the availability or performance indicators.



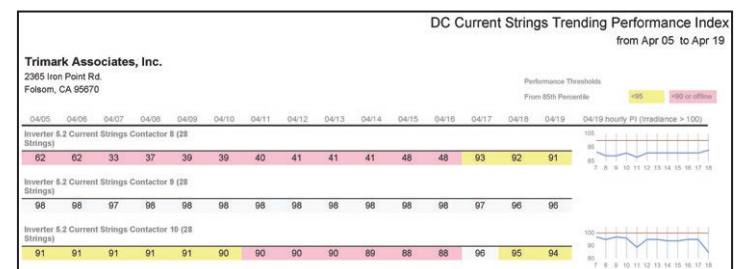
Dashboard 1 - Portfolio-Wide Key Performance Indicators (KPIs)



Dashboard 2 - Portfolio Device Summary: Status



Dashboard 3 - Portfolio Device Summary: Performance



Report 1 - DC Current String Trending Performance Index Report

Folsom B				Folsom C			
2365 Iron Point Rd, Folsom, CA 95630				2365 Iron Point Rd, Folsom, CA 95630			
Device	C / T *	Deviation from Target *	Median *	Device	C / T *	Deviation from Target *	Median *
SPC 1.1.1.04	-37 / -30	7.10	6.68	SPC 1.2.1.30	31 / -29	59.47	60.25
SPC 1.2.4.07	4 / -30	33.96	34.40	SPC 1.2.2.32	31 / -30	60.34	60.25
SPC 1.2.4.09	-8 / -30	21.91	22.35	SPC 11.2.2.05	30 / -30	59.67	59.41
SPC 10.1.2.06	-20 / -30	10.24	10.40	SPC 11.2.2.47	30 / -30	59.92	59.83
SPC 10.1.2.10	-4 / -4	0.00	26.49	SPC 2.1.1.02	30 / -29	58.85	59.83
SPC 13.1.1.33	-34 / -34	0.19	3.95	SPC 2.1.1.42	30 / -29	59.05	59.83

Report 2 - Tracker Deviation Report

Curtailment Activity			
from January 01, 2018 to April 20, 2018			
Folsom A			
2365 Iron Point Rd, Folsom, CA 95670			
Start	End	Target	Duration
2/19/2018 6:55:00 AM -08:00	2/19/2018 7:05:00 AM -08:00	0.00	0d 00:10:00.0
2/19/2018 7:40:00 AM -08:00	2/19/2018 7:50:00 AM -08:00	32.24	0d 00:10:00.0
2/19/2018 12:30:00 PM -08:00	2/19/2018 12:35:00 PM -08:00	55.40	0d 00:05:00.0
2/19/2018 12:50:00 PM -08:00	2/19/2018 1:20:00 PM -08:00	46.37	0d 00:30:00.0
2/19/2018 1:50:00 PM -08:00	2/19/2018 2:05:00 PM -08:00	34.63	0d 00:15:00.0

Report 3 - Curtailment Activity Report

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Reference "SPE Show Issue" for Free Thermal Design and Analysis... expires Nov 2018

Looking Further

If a site's PI and AI are not optimal, a staff member may look at the individual devices to determine the contributing factors. For a solar facility, this would mean looking at the inverters, DC strings, and trackers. Operators can use the **Portfolio Device Summary – Status** display (*Dashboard 2*), which graphically displays the real-time generation and status of each site inverter. Additionally, a display can be configured to show the performance index of the inverters (*Dashboard 3*) so that performance-based issues can be identified.

For inverters having performance issues, the **DC Current String Trending Performance Index Report** (*Report 1*) can provide detailed information. Whenever the sun is shining, a DC String's performance index should be near 100 percent; a lower value indicates the need to investigate the cause of the reduced performance.

Trackers can also contribute to poor site performance. Are the trackers positioned optimally – for example, are they accurately following the position of the sun? A **Tracker Deviation Report** (*Report 2*) can be used to assess each tracker's operation. Is the tracker at the angle where it should be, and at a similar inclination as other trackers at the site? If there are significant deviations, it could indicate a problem with a tracker drive or controller.

In addition to managing equipment status and performance, attention must be paid to the amount of energy lost due to underperformance. This impact factor can help determine when, and to what extent labor resources should be used to address the problems. If the site's performance is having a marginal impact on the overall energy generation of the site, rolling a truck to resolve the issue may not be worth it; remedial action could instead be combined with the next scheduled maintenance visit. Thresholds can be used to set up alerts as to when the revenue impacts are significant or pervasive enough to require further attention.

Even if all of the equipment is operating as intended, curtailment will impact a site's financial performance. If an Offtaker or Balancing Authority is regulating the maximum amount of power produced at the site, a **Curtailment Activity Report** (*Report 3*) can be created. This report is used to identify when power was curtailed, including the source, reason, and duration. In addition to performance analysis, curtailment reconciliation reports can be used to support financial settlements, and lost energy reimbursements.

Summary

Although a SCADA system enables operators to monitor and control a PV site, the real value of SCADA is in Performance Management. A project's funding is based upon expected financial returns. Performance management ensures that the site performs at those levels, and delivers the expected financial results.

Dean Schoeder is Chief Marketing Officer, BSEE, EIT at Trimark Associates, Inc., a utility-scale PV monitoring provider. Trimark delivers solutions that enable informed energy management, real-time operational control, and complete regulatory compliance. Dean is an engineer with 40 years of industry experience, and an expert in SCADA. He has been responsible for the successful implementation of over \$500 million of capital improvements related to controls, systems, networks, metering and security.

Jae Kim is Director of System Integration, Operations and Engineering at Trimark. He is a Certified SCADA Security Architect with more than 25 years of industry experience.

Trimark Associates, Inc. | trimarkassoc.com



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Most rooftop solar racks are designed around ballast blocks or cement pavers. But ballasted rack systems can move around on the roof, grind broken pieces of ballast into the roofing membrane, and leave the building vulnerable to leaks and other roof problems. More important, many buildings cannot accommodate the dead load weight that ballasted systems require.

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Spider-Rax | www.spiderrax.com



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SolarEdge | www.solaredge.com



PV off-grid system

The Solarix PLI is the first product from Steca Elektronik to offer an all-in-one package. It allows users to supply consumers with 230VAC power, charges the battery with an integrated MPPT charge controller, and at the same time permits connection to a generator or an available electricity grid. The Solarix PLI provides everything in a single device.

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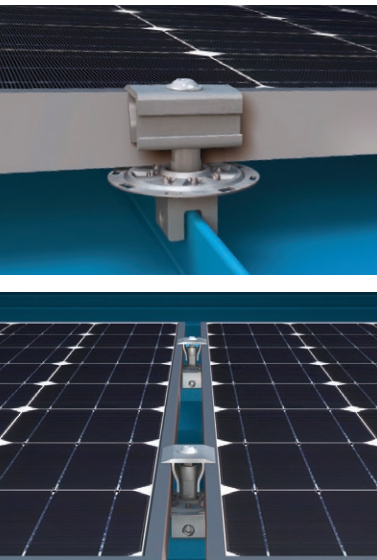
Advanced smart plug

Smappee has launched the latest addition to its smart energy ecosystem, Smappee Switch, an advanced smart plug. Smappee Switch enables homeowners to remotely control and discover the energy consumption of almost any household appliance in tandem with their Smappee energy monitors. Consumer can use Smappee Switch in any home with a Smappee energy monitor to transform traditionally "dumb" appliances into smart ones. Smappee's smart plug measures the exact energy consumption of one or a group of appliances, and directly relays this data to the free Smappee app. With a single touch of the Smappee Switch or remotely via the Smappee app, users can turn connected appliances on and off. This provides homeowners with far easier control of their appliances and ensures they are never unnecessarily using electricity in their home. Smappee's ecosystem allows for flexibility in existing, new, or to-be-built homes. Smappee Switch also enables installers to offer homeowners demand response capabilities, meaning they can better manage their energy consumption during the most economical times. For example if they have solar panels on their roof, the Switch uses smart triggers to assign excess power from the solar system to the boiler, providing greater cost savings on a homeowner's electricity bill.

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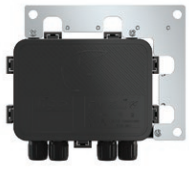
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Cost-effective rapid shutdown solution

SMA and Tigo have announced support of a new SunSpec compatible module-level rapid shutdown unit, the TS4-F (Fire Safety). The solution joins the current TS4 platform with a focus on emergency responder safety. It uses MLPE technology from SMA and Tigo to provide rapid shutdown only, creating a reliable, economical product which focuses on key functions to enable NEC compliance. The solution offers two options. The TS4-F is integrated into a smart module. The TS4-R-F retrofits a regular standard module with a module-level rapid shutdown device and is available through SMA. The new rapid shutdown solution is a cost-effective way to fulfill UL 1741, NEC 2014, and NEC 2017 requirements – especially the stricter requirements for inside the array boundary that will be effective in January 2019. It will be compatible with the power line-based SunSpec Communication Signal for Rapid Shutdown, making it simple and robust. Using the existing DC wires between the inverter and module-level electronics as a communication channel will significantly reduce installation time. The TS4-F and TS4-R-F products will offer system safety due to full integration with SMA's arc fault detection (AFCI). They join SMA's portfolio of products that comply with rapid shutdown requirements, including the Power+ Solution and the Rapid Shutdown System.

The SMA Group
www.sma-america.com



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Nine Fasteners is pleased to introduce the newest addition to their solar wire management lineup. The NFI-HANGER is a wire formed product designed to support many cables in large commercial, industrial, or utility scope projects. The NFI-HANGER is produced with hard drawn galvanized steel to withstand not only the rigors of repeated opening and closing, but also the harsh conditions in which it will be utilized. As with all of Nine Fasteners' products it is manufactured here in the U.S.

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BURNDY introduces their festoon grounding systems. These systems include the tracks, hardware, axles, and wheels needed to create a quality, active grounding system. With these festoon systems, conductors are elevated and managed to protect from things like pinch points and theft. BURNDY offers festoon systems in a variety of lengths and can assist in determining the right fit for specific applications. Each kit includes: C-Rail, Coupler Hangers, Tow and Intermediate Trolleys, End Stop, End Caps, and Mounting Clamps.

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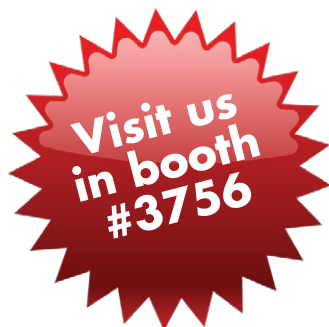
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Solar powered beacon

Larson Electronics LLC's SPLED-CL1B-MOD1 is a 14.4W solar powered LED strobe light, powered by two 8aH lead acid batteries automatically recharged in 5 hours by a 30W solar panel. The LED lamp features 30 different strobing flash patterns that can be seen for more than one mile, and comes in amber, white, blue, green, or red colors. The beacon can receive a remote 24VDC signal for operation and is equipped with a 10ft whip with a blunt-cut end for operators to send the signal to. The LED beacon is constructed of a waterproof black powder coated die cast base containing a fully potted circuit board. Protecting the LEDs is a shock resistant polycarbonate lens. The solar panel is weatherproof to protect against harsh outdoor conditions. The SPLED-CL1B-MOD1 beacon comes with a choice of three mount styles: a 100lb magnet for temporary mounting, a 1" NPT pipe mount, and a surface mount. The solar panel is configured to operate 24/7 day/night with photocell, includes a motion sensor for security purposes, an on/off switch for manual operation, or flying leads for operators to connect their own switches. The day/night motion sensor is programmed to activate the solar panel in the evening and shut it off during the day, and will activate the panel when movement within range is detected. The SPLED-CL1B-MOD1 solar powered Class I LED beacon can be customized to fit operator's requirements, including larger battery sizes, different lights, additional mounting options, and cord length options.

Larson Electronics LLC | www.larsonelectronics.com



User-friendly purchasing platform

Endress+Hauser's e-Commerce platform provides customers ability to purchase online and access order history. The platform offers customers a personalized shopping experience with a wealth of new features. The platform allows customers to purchase online and provides 24/7 access to detailed information directly on the website, for both online and offline orders. Features include the ability to access RFQs, quotes, and orders all in one place. Customers now can easily add products to a shopping cart and see their own pricing details. The new experience streamlines customer procurement processes both online and offline. All transactions are available online, including all purchase documents. It's easy to check the status of current orders and to see order history. Products can be saved in favorite lists for easy reordering and users can assign their own references to products as well. When users would prefer to request a quote first, or to ask for technical support in configuration, Endress+Hauser's network of sales representatives can easily be contacted to finalize selection for the user. Users are able to set up a secure account and password, which, once created, provides access to view and make selections and purchases from Endress+Hauser's complete portfolio.

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lower cost!

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SMP-100 SolarMax Charge Controller

Up to 100 amps
in charging power

Nominal battery voltage 24-72VDC,
with PV open circuit voltage as high as 230VDC.

Our patented MPPT (Maximum Power Point Tracking) algorithm maximizes the power output of the solar array. SolarMax allows you to use a higher voltage PV array than the batteries you are charging as it is designed to step down the array voltage, allowing greater flexibility in the choice of array for your system.



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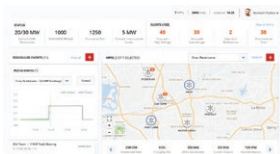
674 Rancheros Dr.
San Marcos, CA 92069



Cable tie mounts for curved and angled surfaces

HellermannTyton announces FlexTack, a new line of adhesive cable tie mounts designed to adhere to curved and moderately angled surfaces. Available immediately, the product enables installers to route wires, cables, and hoses along areas that were once considered off limits. The mounts incorporate a high-bond acrylic adhesive pad on one side and a four-way cable tie channel on the other. FlexTack is designed to work with 18- to 50-pound cable ties. FlexTack is designed for use on varnished, powder coated, bare metal, or plastic surfaces. Manufactured of heat-stabilized PA66 nylon, it is available in both black and white to complement aesthetics.

HellermannTyton
www.hellermanntyton.com



Solution for grid services and virtual power plants

SolarEdge Technologies, Inc.'s grid services offer aggregative control and data reporting enabling the pooling of PV and storage in the cloud for the creation of virtual power plants. Offering benefits to all stakeholders, the solution provides utilities with the tools to leverage distributed energy generation systems to more efficiently meet demand. Energy retailers enjoy protection from price peaks and PV system owners can increase their revenue from joining this new energy economy. The solution helps to resolve a variety of complex energy issues such as, generation shortages, transmission bottlenecks, energy arbitrage, and frequency imbalances, thus reducing the need to invest in additional and expensive infrastructure. It will also provide energy retailers with protection against price peaks by facilitating access to stored energy. As PV markets evolve from feed-in tariffs to net-metering and finally to self-consumption, the grid services will provide homeowners with the opportunity to maximize self-consumption and take advantage of time-of-use tariffs as a revenue stream.

SolarEdge Technologies

www.solaredge.com



New Group 31 size solar battery

Trojan Battery Co., LLC has announced the addition of a Group 31 size battery to its Solar line of maintenance-free, true deep-cycle absorbed glass mat (AGM) batteries designed for solar and other renewable energy applications. The Trojan SAGM 12 105 is manufactured in the U.S. and features a non-spillable design, enabling installers to customize the use and position of the batteries in customer applications. Offering a three-year warranty for stationary applications and tested to an eight-year design life under IEC 61427 standard for solar batteries, the SAGM 12 105 is specifically engineered for deep-cycling applications. The Trojan AGM Solar line was designed for maximum sustained performance and increased total energy output to meet demanding deep-cycling requirements in Trojan's wide range of stationary applications, including solar home, area and street lighting, microgrid, inverter backup, and commercial.

Trojan Battery Company

www.trojanbattery.com



1500VDC photovoltaic fuse holder product series

Mersen has announced the launch of the globally certified HP15FHM32 1500VDC HelioProtection fuse holder series for photovoltaic applications. The HP15FHM32 series fuse holders are IP20 ingress protection rated, featuring a finger-safe rotating fuse carrier that accept 10/14 x 85mm gPV fuses, introducing the next level of safety for utility-scale photovoltaic applications. The body of the fuse holder is engineered with UL94-V0 material, providing superior flammability rating and durability. The fuse holders also include a lock out/tag out feature as well as DMM probe access. The HP15FHM32 series fuse holders are offered in two variations. The HP15FHM32A features a screw clamp, and the HP15FHM32B features a tool-less CAGE CLAMP. Both are to accept standard PV rated wires with DIN rail mounting, providing added flexibility and versatility for end-use installations.

Mersen | ep.mersen.com



Sturdy stainless steel rail attachments

SolarRoofHook has worked to improve and expand their QuickBOLT with Microflashing product line (Patent # 8448407). They have updated all of their L-Foot products from aluminum to stainless steel, providing installers with a sturdier rail attachment. Along with the upgrade to stainless steel, they have also improved upon the Microflashing design. Instead of providing one 3" option, they have added a 4" Microflashing option to all of their QuickBOLT mounting kits. The 4" Microflashing provides more coverage on the roof, allowing installers to easily fix any mistakes or cover extra holes in the installation area. They have also added the Quick Ratchet Conduit Clamp specifically for running conduit on the roof. The Conduit Clamp attaches directly to any of the QuickBOLT mounting kits, making it easier than ever to complete an installation.

SolarRoofHook

www.solarroofhook.com

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Self-flashing mounting base

RT-MINI is Roof Tech's new self-flashing mounting base designed to attach conventional rail mounting systems and accessories including the conduit. RT-MINI is engineered to withstand wind speeds up to 180mph and ground snow up to 70psf. Providing a fast install, RT-MINI is fastened with wood screws, eliminating the need for pilot holes. As a result, there is no damage to the seal on asphalt shingles so the roof warranty remains intact. RT-MINI is fully waterproof and certified by the ICC for Flexible Flashing. Stamped PE letters are available for 37 states in the U.S. and four provinces in Canada.

Roof Tech | www.roof-tech.us



Self powered dual-axis tracker

The AllEarth Gen 4 Solar Tracker, the latest addition to the AllEarth dual-axis tracker family, uses GPS and wireless technology to follow the sun throughout the day, producing up to 45% more energy than fixed systems. Gen 4 key features include an electrically powered motor with a sleek design and incomparable efficiency. The Computer Control system is updated with new power monitoring features, allowing power generation and mode status to be checked with ease. Gen 4 is a self-powered, grid-tied system which allows it to keep following the sun even when the grid is down, because the tracker draws energy from the panels and stores it in a small battery.

AllEarthRenewables
www.allearthrenewables.com



Versatile corrosion resistant wire management clips

Introducing 3 new cable clips to Wiley wire management line. The ACC-FPV90, ACC-F4F and ACC-F490 are all 90 degree cable clips. The ACC-FPV90 holds 2 PV cables while the ACC-F4F and ACC-F490 hold 4 PV cables. PV cable diameter range for all 3 clips is 4.1mm to 8mm per each wire. These cable clips can be installed on a flange with a thickness range of 1mm to 3mm. The ACC-F4F has a unique double securement feature which makes this clip a solution for trackers and high vibration, or wind scenarios. All Wiley wire management clips are made of corrosion resistant 304 stainless steel and have rolled edges to help protect cable insulation from damage. UL1565 Listed. Environmentally Tested to UL2703 & ATSMB117.

Wiley | www.hubbell.com/wiley/en



Utility-solar landscape racking system

TerraSmart's new TF3L Landscape Racking System is designed to maximize construction efficiency on large-scale utility-solar sites thus saving the client from unnecessary civil work. In addition, the TF3L accommodates more panels per foundation, reducing overall site cost and optimizes panel capacity. The TF3 Landscape racking system is configured with 6 high rows by 8 long columns and has a tilt angle of 35°. Yielding to a max table size of 6 x 8, the rack accommodates more panels per foundation and optimizes panel capacity. The system is also paired with TerraSmart's versatile ground screw foundation that can work in any soil condition, saving time and budget on every site. With an integrated wire management, the rack has no extra parts or pieces. This allows workers to simply tuck and go, resulting with a 40% reduction in man-hour installation time. The ultra-lightweight design allows for easy handling, aiding in a longer peak performance of field workers. The two-piece simplified hardware stacks increase connection velocity. The featured Smart Bracket adapts to steep slopes, minimizing civil work and expediting project schedules. The TF3 Landscape Racking System complies with the NEC, is UL 2703 Edition 1 certified and is CPP wind tunnel tested. The system can withstand winds up to 150mph and snow weight up to 60lbs/ft and is protected under a 20-year limited warranty.

TerraSmart | www.terrasmart.com



Rodent guard frame clamp

Kinetic Solar introduces a novel solution for Rodent Guard protection. Fully mechanical, the device clamps onto the frame of any standard solar module. Once in place, rodent guard mesh can be affixed using standard 1/2" drive hardware. This product is the latest to join the family of Kinetic products that feature single tool installation, meaning less hassle and faster installs.

Kinetic Solar | www.kineticsolar.com

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Robust solar clips

Heyco's Helios UVX Clip is constructed out of their robust UVX nylon material, promising users a 20-year warranty. The unique clip is capable of holding up to two SolarEdge cables or two Enphase Q cables (or any other cable with diameters between 0.230" and 0.315"). Cables install with fingertip pressure, but cable retention is superior. The clip installs into .260" mounting holes, but Heyco's unique molding capabilities can meet other custom dimensions as requested.

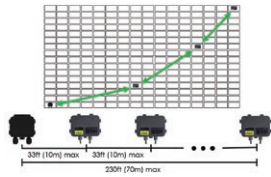
Heyco | www.heyco.com



800VDC current-compensated ring core chokes

TDK Corporation's RoHS-compatible B82724J8*N040 series features a high rated voltage of 800VDC or 250VAC in continuous operation and was developed specifically for use as DC link chokes in frequency converters. A further advantage of the new series is its thermal behavior which means that chokes with high inductance values can be operated with high currents, even at a high operating temperature. The new chokes offer a range of inductance values extending from 0.5mH to 47mH and rated currents of between 1.6A and 10A, depending on the inductance. Their rated ambient temperature without derating is 70°C. For the additional attenuation of symmetrical interferences, the power line chokes feature a stray inductance of around 0.5% of the rated value. The dimensions for all types are 18.5mm x 31.3mm x 33.2mm. The new ring core chokes are manufactured using a flame-retardant plastic that is compliant with UL 94 V-0 and certified in accordance with IEC 60335-1, Clause 30 (glow-wire and ball pressure test). In addition, the winding is completely potted, which allows its use in highly polluted environments.

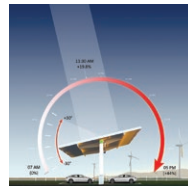
TDK Corporation | www.epcos.com



Wireless solar communication technology

Tigo's new wireless technology, Mesh solar communication architecture, simplifies the solar design process and accelerates the commissioning steps. The complete Tigo solution uses a simple yet powerful data collection technology covering wide ranges of residential and commercial installations at a low cost. With Mesh and the recently announced Tigo Access Point (TAP), customers eliminate the need to address any roof obstruction or orientation constraint. Mesh compliments the full Tigo system in conjunction with TAP, Cloud Connect Advanced (CCA), and UHD-Core TS4 units. As the software that allows each TS4 unit to act as a relay station for signals, Mesh extends the wireless range of communication up to 230ft (70m). Mesh also allows data collection from up to 300 TS4 units (~100kW systems) using a single TAP or from up to 900 TS4 units (~300kW systems) using a single CCA. Most importantly, Mesh supports multiple communication paths between TS4 units to minimize packet loss, improve data integrity, and increase reliability at high speed.

Tigo Energy, Inc. | www.tigoenergy.com



New tilting carport

SCARLET Solar, a Silicon-Valley-based designer of advanced solar systems, has just launched a new high-efficiency carport with a tilting roof. The TiltPort has two sleek white columns which support a slender roof that tilts towards the sun. TiltPort has taken three years of intensive design and engineering work. TiltPort cuts complexity and increases reliability and power output by tilting the whole roof structure. TiltPort is rated for winds up to 130mph (210km/h) and comes prefabricated for installation in hour. TiltPort is controlled remotely and offers a fully waterproof option. Any number of TiltPorts can be installed adjacent to each other. TiltPort can generate up to 44% more energy than a fixed carport using the same panels.

SCARLET Solar | www.scarlet.red



Compact industrial Ethernet-to-fiber media converter

Antaira Technologies' IMP-C100-XX series is a compact industrial Ethernet-to-fiber PoE+ media converter featuring a 10/100TX Ethernet port and a fixed fiber interface which supports ST or SC connectors depending on the model. This series is compliant with 802.3at standards which is backwards compatible with 802.3af. There are Multi-Mode and Single-Mode models to support applications with a variety of fiber distances and types. It is designed to fulfill industrial applications that require fiber optic distance extension while using minimal space.

Antaira Technologies, LLC
www.antaira.com



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www.gigavac.com

Monitoring and service support solution

SMA is pleased to introduce SMA Smart Connected for its commercial inverter solutions. SMA Smart Connected is a proactive monitoring and service support solution that saves integrators time and money while increasing system performance and simplifying O&M. It automatically detects and diagnoses plant-wide events and initiates corrective actions or repair activities, reducing truck rolls and saving commercial system integrators and owners up to \$6 million in service costs across the lifetime of a 100MW portfolio.

The SMA Group | www.sma-america.com



Solar production monitoring and management

The Tigo Access Point (TAP) is Tigo's new wireless device for communication between the Cloud Connect Advanced (CCA) universal data logger and the TS4. Similar to the Tigo's legacy Gateway product, the TAP is small in size with a wider range and increased module capacity. The TAP improves the data management of residential, commercial, and industrial solar systems by wirelessly communicating with smart modules. Each TAP collects data from up to 300 TS4 units (~100kW systems) or up to 600 modules using TS4-R-X-Duo (~160kW systems). It also improves safety with module-level deactivation for Rapid Shutdown so PV systems comply with NEC 2017 690.12 specifications. When paired with a CCA, the TAP provides clear visibility into solar installations. The Tigo system has three components. First, the TAP which wirelessly communicates with the smart modules and is hardwired to the CCA via a RS485 cable. Second, the smart PV modules that are equipped with integrated (TS4-X), retrofitted/add-on (TS4-R-X), or retrofitted/add-on for 2 modules (TS4-R-X-Duo). Third, the CCA which collects data from all PV system components - including modules, inverters, revenue-grade meter, etc. - and sends system information to Tigo's cloud.

Tigo Energy, Inc. | www.tigoenergy.com



Advanced shutdown system for rooftop PV

Yaskawa Solectria Solar (YSS) and Tigo are providing a simple, safe solution for roof-mounted PV systems to insure the safety of firefighters and first responders, and guarantee system owners of full compliance with the National Electrical Code (NEC) module-level rapid shutdown requirements. Yaskawa Solectria Solar has achieved compatibility of its PVI 50/60TL line with the entire TS4 portfolio of devices from Tigo. This includes the TS4-F (Fire Safety), Tigo's new fire-safety model, which is a simple and cost efficient method to achieve compliance with NEC 2017 requirements for module-level rapid shut down. Their system solution utilizes powerline communication and meets the latest SunSpec Alliance protocol. In addition, the PVI 50/60TL is compatible with the rest of the Tigo family of devices -TS4-D (Diodes), TS4-M (Monitoring), TS4-S (Safety), TS4-O (Optimization), TS4-L (Long Strings), allowing module-level optimization or string stretching. At this time YSS has achieved compatibility with the Tigo TS4 family with five of our commercial string inverters: PVI 23TL, PVI 28TL, PVI 36TL, PVI 50TL and PVI 60TL. Next in line and currently under test is their all-new SOLECTRIA XGI 1000 -- BAA compliant and Made in the U.S.A. with global components.

Yaskawa Solectria Solar
www.solectria.com



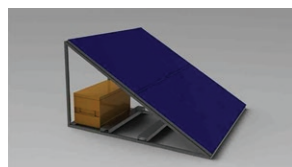
Powered by the array

UNO Solar saves you the time, the hassle, and the expense of trenching installation.

Connecting AC power lines directly to the array allows you to target specific applications. UNO Solar is designed for solar applications, with the ability to provide control power in the event of grid-power loss. This DC-to-DC power supply can convert high-voltage DC string voltage to 24 V DC.



To request a free sample and UL certificate, visit:
www.phoenixcontact.com/unosolar



Solar generator for remote locations

Larson Electronics has released a skid mounted solar generator for locations without access to reliable grid power. This solar powered generator is a solution for outdoor work sites, emergency camps, military bases, construction sites, and more. The SPGSM-53K-24X250AH-LFP4-240V generator features twenty 265W solar panels, one solar charge controller, and component control center to monitor battery voltage. The twenty solar panels generate 5.3kW and deliver 240VAC single phase output via an inverter to operate 240V equipment. The panels are attached to a galvanized steel frame which is tilted at a 45° angle to capture the maximum amount of sun. The twenty panels are wired to the solar charger control box which features a single lever action cut-off switch. Advanced cooling capability and additional air flow from a 1400 CFM exhaust helps keep this system cool, so it can operate well in hot environments.

The component control center protects all electrical components in a lockable NEMA 3R job box bolted to the skid mount trailer, which automatically cools when ambient temperature exceeds 90°F. A terminal block allows users to mount additional electronic gear without disrupting other equipment. A min/max voltage sensor system is also integrated to ensure 50% threshold on the batteries is maintained, and automatically shuts off power when capacity falls below. The skid pockets make transportation easy, especially on sites where the generator needs to be towed around.

Larson Electronics LLC | www.larsonelectronics.com



New North American commercial inverter solutions

SMA's Sunny Tripower CORE1 inverter is getting an upgrade with two new power classes. In addition to the currently available 50kW CORE1 model, a new higher power 62.5kW model is optimized for large projects utilizing higher efficiency modules, and a 33kW model will be available for projects with smaller or highly segmented arrays as well as 600V repowering projects. All three models of the CORE1 offer SMA's latest performance and safety technologies. The new CORE1 series includes advanced smart inverter capabilities to fulfill utility grid support interconnection requirements, as well as SMA's next-generation DC AFCI technology for compliance to the new UL 1699B standard for arc-fault protection. The CORE1's safety features are further enhanced with support for the new SunSpec Power Line Communication (PLC) signal for module-level rapid shutdown. Based on this industry standard, the Sunny Tripower CORE1 combined with SMA's new TS4-F module-level device provide a reliable, cost-effective solution to achieve compliance with 2017 NEC module-level rapid shutdown requirements in commercial rooftop systems.

The SMA Group | www.sma-america.com



Flexible rapid cure solution

The Sulzer MIXPAC MixCoat system is a solution for the problems plaguing small and touch-up applications in roofing. The MixCoat system solves problems roofing companies face in applying rapid cure materials. With MixCoat, when applying rapid cure sealants, only an air compressor and a MixCoat spray system is needed, and preparation time can be reduced from 2-4 hours to 15 minutes. Due to the MixCoat's use of cartridges, very small areas can be coated while minimizing coating waste, and partially used cartridges can be recapped and reused for the next project. The prefilled cartridges also protect the applicator from direct contact with unmixed material, adding another layer of safety. In addition, the MixCoat system uses low pressure compressed air, 7 bar (100 psi). MixCoat's low pressure air assisted systems also produce far less overspray, reducing the risk of environmental pollutants and unintentional property damages. Furthermore, MixCoat equipment is affordable and is easy to use. It is a simple and cost-effective method for rapid cure coating technology.

Sulzer | www.sulzer.com



Product recognition app

Mersen Product Recognition App uses a photo to identify and suggest a product cross reference based on the image. This feature gives the user the option to search for a competitive cross reference via direct text input or photo recognition. Simply use a mobile device to scan the fuse into the app for identification, Mersen's Product Recognition App will suggest a match based on the photo. The Product Recognition App lets users search for a product via photo or text input, identifies Mersen and competitive products, locates Mersen Sales Representatives nearest the user based on GPS location, and selects proper motor and transformer fuse sizing based on user input. The Mersen Product Recognition App also gives users the option to enter voltage, horsepower, or KVA rating details into an easy-to-use template to find proper protection for their motors and transformers to meet NEC requirements.

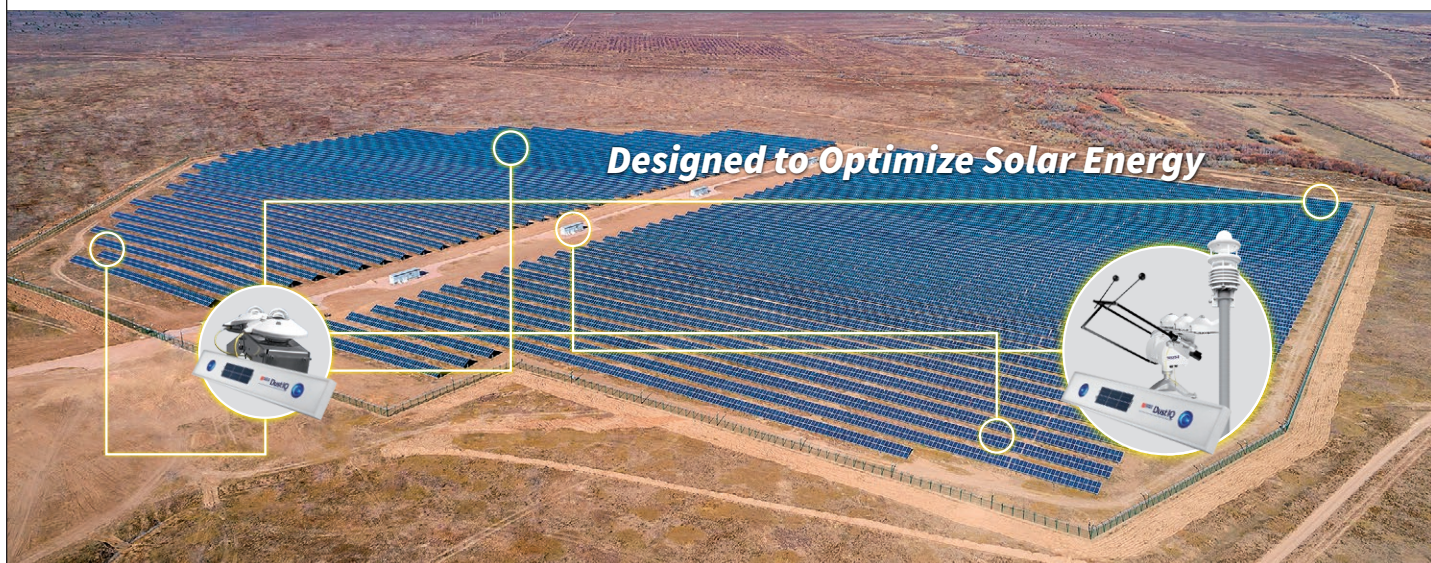
Mersen | ep.mersen.com



Performance and profitability for commercial applications

The SolariaPowerXT430Wp is optimized for commercial applications and delivers high power and aesthetically pleasing PV panels. Solaria's patented PowerXT 430W modules maximize system power and performance. The PowerXT 430W modules ensure labor savings on racking and system components and are manufactured at the company's recently expanded manufacturing facility in Fremont, California. The all-black, high output modules feature a black back sheet. The proprietary PowerXT platform uses Solaria's advanced cells interconnect and module production processes, significantly boosting power generation and providing outstanding performance. High energy yield PowerXT modules ensure solar installers maximize power deployment on customer roofs, enabling them to install attractive, cost-effective distributed power plants which accelerate payback period and profitability.

Solaria Corporation | www.solaria.com



The amount of solar radiation reaching your power plant cannot be changed; however, you can make the most of it by choosing high quality equipment. Not only by selecting efficient generating technologies, but by installing the industry's best instruments to monitor the environmental parameters affecting your solar energy project performance.

Whether it is to optimize yield, manage your assets, make investment decisions, schedule plant maintenance or to forecast the energy output reliably, we offer the instruments you need. From Kipp & Zonen smart pyranometers and Lufft weather stations, to the unique new DustIQ for continuous monitoring of module soiling, we have it all.

www.kippzonen.com/energy

Modules

Efficient design and a high-yield performance are key factors in any solar energy project. Regardless of the project size - whether for a residential project, commercial building, or utility-scale application - selecting the right module is extremely important. To help you find the right choice for your solar project, we've highlighted some of the top contenders in the industry.

SEE AD ON PAGE 38



Solarland USA Corporation

Product: SLP180S-12

Application: Off-grid

Maximum Power (Pmax): 180W

Maximum Power Point Voltage (Vmpp): 19.48V

Maximum Power Point Current (Impp): 9.24A

Open Circuit Voltage (Voc): 23.03V

Short-Circuit Current (Isc): 9.77A

Module Efficiency: 18%

Operating Temperature: -40°F to 176°F (-40°C to 80°C)

Normal Operating Cell Temperature (NOCT): 113°F +/- 2° (45°C +/- 2°)

Max. System Voltage: 1000V

Power Tolerance: 0 / 5W

Cell Type: PERC Mono

Glass: Tempered glass

Frame: Aluminum

Weight: 26lbs (11.8kg)

Dimensions: 60.83" x 28.35" x 2.76" (1545mm x 720mm x 70mm)

Warranty: Solarland guarantees for a period of 10 years from the date of sale to the original consumer that the output power of the PV module (at standard test conditions) will remain at 90% or greater of the Solarland Minimum Specified Peak Power Rating. Solarland guarantees for a period of 25 years from the date of sale to the original consumer that the output power of the PV module (at standard test conditions) will remain at 80% or greater of the Solarland Minimum Specified Peak Power Rating

Key Features:

- Newly introduced PERC technology;
- Reduced electron recombination;
- More light absorbed;
- High internal reflectivity.

www.solarlandusa.com

SEE AD ON PAGE 40



www.axitecsolar.us

AXITEC, LLC

Product: AXIblackpremium

Application: Commercial

Maximum Power (Pmax): 300Wp

Maximum Power Point Voltage (Vmpp): 32.37V

Maximum Power Point Current (Impp): 9.29A

Open Circuit Voltage (Voc): 39.72V

Short-Circuit Current (Isc): 9.75A

Module Efficiency: 18.44%

Operating Temperature: -40°F to 185°F (-40°C to 85°C)

Max. System Voltage: 1000V

Power Tolerance: -0 / +5Wp

Cell Type: 60 mono crystalline 6"

Glass: 0.13" hardened, low reflection

Frame: 1.38" (35mm) black anodized aluminum frame

Weight: 39.68lbs (18kg) with frame

Dimensions: 64.57" x 39.06" x 1.38" (1640mm x 992mm x 35mm)

Max Load: 5400Pa

Tests/Certifications: UL, IEC

Warranty: 15-year manufacturer's warranty

Key Features:

- Micro crack free due to 100 % EL inspection;
- Easy to install due to 43.3" JB wires.

www.axitecsolar.us

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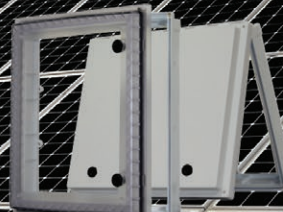
ARCA - JIC with raised back panel and swing front panel



ARCA - IEC



MNX



IPW



ARCA - JIC

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And Make Difficult Easy

410.760.9696 sales@fiboxusa.com



ARCHITECTURAL SOLAR



Hanergy Thin Film Power America

Product: HanTile Solar Roof Tile

BIPV Form: Solar roof tile

BIPV Type: Thin film

Power Density: 7.86W/sqft

Power: 30W

Open Circuit Voltage: 10.6V

Short-Circuit Current: 4A

Max Power Voltage: 8.6V

Max Power Current: 3.5A

Max Length: 27.91 (709mm)

Max Width: 19.69 (500mm)

Max Thickness: 1.61 (41mm)

Weight: 22.05lbs (10kg)

Warranty: 25-year solar generation warranty

www.hanergyamerica.com



First Solar

Product: First Solar Series 6

Application: Commercial, industrial, utility-scale

Maximum Power (Pmax): 420W+

Maximum Power Point Voltage (Vmpp): 180.4V

Maximum Power Point Current (Impp): 2.33A

Open Circuit Voltage (Voc): 218.5V

Short-Circuit Current (Isc): 2.54A

Module Efficiency: 17%+

Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)

Normal Operating Cell Temperature (NOCT): 113°F (45°C)

Max. System Voltage: 168.7V

Power Tolerance: 317.2W

Cell Type: CdTe thin film

Weight: 79.36lbs (36kg)

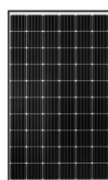
Dimensions: 79" x 48.5" x 1.9" (2009mm x 1232mm x 48.5mm)

Max Load: 2400Pa wind, 5400Pa snow

Tests/Certifications: IEC 61215 & 61730 1500V, CE 61701 Salt Mist Corrosion, 60068-2-68 Dust and Sand Resistance, UL 1703 1500V Listed, CSI Eligible, FSEC, MCS, CEC Australia, JET, SIL, InMetro, Long-Term Sequential, Thresher Test, PID Resistant, ISO 9001:2008 & 14001:2004, OHSAS 18001:2007

Warranty: 98% warranty start point, 0.5% warranted annual degradation rate, 25-year linear performance warranty, 10-year limited product warranty

www.firstsolar.com



Itek Energy

Product: Itek SE 60 Cell Solar Module

Application: Residential

Maximum Power (Pmax): 305W

Maximum Power Point Voltage (Vmpp): 33.1V

Maximum Power Point Current (Impp): 9.1A

Open Circuit Voltage (Voc): 40V

Short-Circuit Current (Isc): 9.8A

Module Efficiency: 18.19%

Operating Temperature: -40°F to 194°F (-40°C to 90°C)

Max. System Voltage: 1000V

Power Tolerance: ± 2%

Cell Type: High-efficiency monocrystalline p-type cells

Glass: Low iron, tempered, patterned solar glass with ARC

Frame: (prismatic/matt) solar glass, ARC

Weight: 41lbs (18.6kg)

Dimensions: 65.94" x 3.94" x 1.57" (1675mm x 100mm x 40mm)

Max Load: 113psf

Tests/Certifications: UL 1703 / Pid 500+ hrs

Warranty: 25-year power output warranty, 12-year workmanship warranty

www.itekenergy.com



AIMS Power

Product: 120W Portable Foldable Solar Panel with Built-in Carrying Case and 10A Charge Controller Kit

Application: Residential

Maximum Power (Pmax): 120W

Maximum Power Point Voltage (Vmpp): 22V

Maximum Power Point Current (Impp): 5.5A

Open Circuit Voltage (Voc): 26.4V

Short-Circuit Current (Isc): 5.9A

Module Efficiency: 19.2%

Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)

Power Tolerance: +/- 3W

Cell Type: Monocrystalline

Frame: Rugged, water resistant, poly built-in carrying case

Weight: 5lbs (2.26kg)

Dimensions: 20.6" x 11" x 1" folded (523mm x 279mm x 25.4mm); 20.6" x 55.9" x 0.19" expanded (523mm x 1420mm x 645mm)

Tests/Certifications: CE, ETL, TUV, RoHS

Warranty: 10-year, 80% warranty

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SEE AD ON PAGE 37

Panasonic



Panasonic

Product: N325K Photovoltaic Module HIT BLACK

Application: Residential

Maximum Power (Pmax): 325W

Maximum Power Point Voltage (Vmpp): 59.2V

Maximum Power Point Current (Impp): 5.5A

Open Circuit Voltage (Voc): 70.9V

Short-Circuit Current (Isc): 5.94A

Module Efficiency: 19.4%

Operating Temperature: -40°F to 185°F (-40°C to 85°C)

Normal Operating Cell Temperature (NOCT): 111°F (44°C)

Max. System Voltage: 600V

Weight: 40.81lbs (18.5kg)

Dimensions: 65.3" x 43.7" x 48.5" (1658mm x 1110mm x 1232mm)

Warranty: 25-year workmanship and linear power output

Key Features:

- 19.4% module efficiency and sleek all black appearance;
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- Water drainage frame design prevents rain accumulation, eliminates water stains from panel surface.

na.panasonic.com/us/solarpanels

SEE AD ON PAGE 40



www.axitecsolar.us

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AXITEC, LLC

Product: AXIpremium

Application: Residential

Maximum Power (Pmax): 360Wp

Maximum Power Point Voltage (Vmpp): 38.45V

Maximum Power Point Current (Impp): 9.38A

Open Circuit Voltage (Voc): 47V

Short-Circuit Current (Isc): 9.77A

Module Efficiency: 18.55%

Operating Temperature: -40°F to 185°F (-40°C to 85°C)

Max. System Voltage: 1000V and 1500V

Power Tolerance: -0 / +5Wp

Cell Type: Mono 6"

Glass: 0.13" hardened, low reflection

Frame: 1.57" (40mm) silver aluminum

Weight: 50.7lbs (23kg)

Dimensions: 77.01" x 39.06" x 1.57" (1956mm x 992mm x 40mm)

Max Load: 2400Pa

Tests/Certifications: UL, IEC

Warranty: 15-year manufacturer's warranty

Key Features:

- Micro crack free due to 100% EL inspection;
- Easy to install due to 43.3" JB wires.

www.axitecsolar.us



Atlantic Clean Energy Supply (ACES)

Product: Solar panel

Application: Commercial, industrial, utility-scale

Maximum Power (Pmax): 340W to 370W

Tests/Certifications: UL

Warranty: 10-year workmanship warranty, 25-year performance warranty

www.atlanticces.com



Giga Solar FPC, Inc.

Product: Giga Solar Lightweight Rigid Module GS-OG49

Application: Residential

Maximum Power (Pmax): 156W

Maximum Power Point Voltage (Vmpp): 18.0V

Maximum Power Point Current (Impp): 8.7A

Open Circuit Voltage (Voc): 22.8V

Short-Circuit Current (Isc): 9.2A

Module Efficiency: 15.5%

Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)

Nominal Operating Cell Temperature (NOCT): 116°F +/- 4°F (47°C +/- 2°C)

Max. System Voltage: 600V

Power Tolerance: -0% / +2%

Cell Type: Poly c-Si

Glass: No glass

Frame: Frameless

Weight: 11.5lbs (5.2kg)

Dimensions: 60.2" x 26.0" x 0.26" (1530mm x 660mm x 6.5mm)

Max Load: 5400Pa

Warranty: 3-year manufacturing warranty; 10-year, 80% power output warranty

www.gigasolarpv.com



Hanwha Q CELLS

Product: Q.PEAK BLK-G5

Application: Residential, commercial

Maximum Power (Pmax): 320W

Maximum Power Point Voltage (Vmpp): 33.80V

Maximum Power Point Current (Impp): 9.47A

Open Circuit Voltage (Voc): 40.56V

Short-Circuit Current (Isc): 9.94A

Module Efficiency: 19%

Normal Operating Cell Temperature (NOCT): 109°F +/- 5.4° (43°C +/- 3°)

Max. System Voltage: 1000V IEC/UL

Power Tolerance: -0W / +5W

Cell Type: Monocrystalline Q.ANTUM half-cell

Glass: Thermally pre-stressed glass with anti-reflective technology

Frame: Black anodized aluminum

Weight: 41.2lbs (18.7kg)

Dimensions: 66.3" x 39.4" x 1.26" (1685mm x 1000mm x 32mm)

Max Load: 5400Pa / 4000Pa

Tests/Certifications: UL 1703, VDE Quality Tested, IEC 61215:2016; IEC 61730:2016, Application class A

Warranty: 98% nominal power during first year, thereafter max. 0.54% degradation per year

www.q-cells.com/na

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ZNSHINE PV-TECH Co., Ltd.

Product: Glass on Glass / Bi-Facial Solar Panels

Application: Residential, commercial, industrial, utility-scale

Maximum Power (Pmax): 370W

Maximum Power Point Voltage (Vmpp): 38.4V

Maximum Power Point Current (Impp): 9.66A

Open Circuit Voltage (Voc): 45V

Short-Circuit Current (Isc): 10.23A

Module Efficiency: 18.9%

Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)

Normal Operating Cell Temperature (NOCT): 107.6°F +/-2° (42°C +/-2°)

Max. System Voltage: 1500V

Power Tolerance: +3%

Cell Type: N-Type

Glass: Tempered 2.0mm

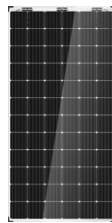
Frame: Aluminum alloy

Weight: 45.2lbs (20.5kg)

Dimensions: 77.87" x 39" x 0.98" (1978mm x 992mm x 25mm)

Tests/Certifications: CE, TUV, CSA, MCS, JET, ETL, CQC, RoHS

en.znshinesolar.com



Trina Solar

Product: Duomax Twin

Application: Commercial

Maximum Power (Pmax): 375W

Maximum Power Point Voltage (Vmpp): 39.8V

Maximum Power Point Current (Impp): 9.17A

Open Circuit Voltage (Voc): 48.2V

Short-Circuit Current (Isc): 9.75A

Module Efficiency: 18.4% (front side)

Operating Temperature: 111°F (44°C)

Max. System Voltage: 1500V

Power Tolerance: 0 / +5W

Cell Type: Monocrystalline bifacial

Glass: 2.5mm, high transmission, AR coated, heat strengthened glass, low iron (back)

Frame: Framed and frameless options available

Weight: 62.8lbs (28.5kg)

Dimensions: 78.38" x 39.53" x 1.10" (1991mm x 1004mm x 28mm)

Max Load: 5400Pa, 2400Pa

Tests/Certifications: IEC61215, IEC61730, UL1703, IEC61701, IEC62716

Warranty: 30-year, 0.5% annual degradation power warranty

www.trinasolar.com/us



LG Electronics

Product: LG NeON R

Application: Residential

Maximum Power (Pmax): 350W

Maximum Power Point Voltage (Vmpp): 36.1V

Maximum Power Point Current (Impp): 9.7A

Open Circuit Voltage (Voc): 42.7V

Short-Circuit Current (Isc): 10.77A

Module Efficiency: 20.3%

Operating Temperature: -40°F to 194°F (-40°C to 90°C)

Normal Operating Cell Temperature (NOCT): 111°F +/-3° (44°C +/-3°)

Max. System Voltage: 1000V

Power Tolerance: -0% / +3%

Cell Type: Monocrystalline / N-type

Glass: High transmission tempered glass

Frame: Anodized aluminum

Weight: 40.79lbs (18.5kg)

Dimensions: 66.93" x 40" x 1.57" (1700mm x 1016mm x 40mm)

Max Load: 6000Pa, 125psf (front), 5400Pa, 113psf (rear)

Tests/Certifications: IEC 61215, IEC 61730-1/2, UL 1703, IEC 61701 (Salt mist corrosion test), IEC 62716 (Ammonia corrosion test), ISO 9001

Warranty: 25-year warranty

www.lg.com



Canadian Solar, Inc.

Product: HiKu CS3U-W Poly

Application: Commercial, industrial, utility-scale

Maximum Power (Pmax): 405W

Maximum Power Point Voltage (Vmpp): 38.9V

Maximum Power Point Current (Impp): 10.42A

Open Circuit Voltage (Voc): 47.4V

Short-Circuit Current (Isc): 10.98A

Module Efficiency: 18.33%

Operating Temperature: 77°F (25°C)

Normal Operating Cell Temperature (NOCT): 68°F (20°C)

Max. System Voltage: 1500V

Power Tolerance: 0 / +5W

Cell Type: Polycrystalline

Frame: Aluminum

Tests/Certifications: IEC 61215 / IEC 61730: 2005 & 2016: VDE / CEUL 1703: CSA

Warranty: 10-year materials and workmanship warranty, 25-year linear power output warranty

www.canadiansolar.com



SunWize Power & Battery

Product: SWPB 150W Solar Module with J-Box

Application: Industrial

Maximum Power (Pmax): 150W

Maximum Power Point Voltage (Vmpp): 18.3V

Maximum Power Point Current (Impp): 8.2A

Open Circuit Voltage (Voc): 22.5V

Short-Circuit Current (Isc): 8.7A

Module Efficiency: 14.9%

Max. System Voltage: 1000V

Power Tolerance: 0% / +3%

Cell Type: Single crystalline

Weight: 25.4lbs (11.5kg)

Dimensions: 57.8" x 26.5" (1490mm x 674mm)

Tests/Certifications: UL Certification

Warranty: 15-year limited performance warranty

www.sunwize.com

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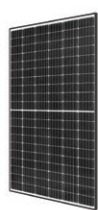
GCL System Integration Technology Co., Ltd.

Product: PV Module
Application: Residential, commercial, industrial, utility-scale
Maximum Power (Pmax): 370W
Maximum Power Point Voltage (Vmpp): 39.4V
Maximum Power Point Current (Imp): 9.39A
Open Circuit Voltage (Voc): 47.8V
Short-Circuit Current (Isc): 9.97A
Module Efficiency: 19.1%
Operating Temperature Range: -40°F to 85°F (-40°C to 29°C)
Normal Operating Cell Temperature (NOCT): 45°F +/-2° (7°C +/-2°)
Max. System Voltage: 1000Vdc / 1500Vdc
Power Tolerance: 0 / +5Wp
Cell Type: Monocrystalline
Glass: High transparency solar glass
Frame: Silver, anodized aluminum alloy
Weight (lbs & kg): 48.9lbs (22.2kg)
Dimensions: 77" x 39.05" x 1.38" (1956mm x 992mm x 35mm)
Max Load: 2400Pa (wind), 5400Pa (snow)
Tests/Certifications: CSA
Warranty: 10-year product warranty, 25-year linear power warranty
en.gclsi.com



Silfab Solar

Product: SLA-M 310Wp 60-cell
Application: Residential, commercial
Maximum Power (Pmax): 310W
Maximum Power Point Voltage (Vmpp): 33.05V
Maximum Power Point Current (Imp): 9.38A
Open Circuit Voltage (Voc): 40.25V
Short-Circuit Current (Isc): 9.93A
Module Efficiency: 19%
Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)
Normal Operating Cell Temperature (NOCT): 45°F (40°C)
Max. System Voltage: 1000V
Power Tolerance: -0W / +5W
Cell Type: 60 Si monocrystalline
Glass: 3.2mm high transmittance
Frame: Anodized aluminum
Weight: 41.8lbs (19kg)
Dimensions: 65" x 39" x 1.5" (1650mm x 990mm x 38mm)
Max Load: 5400Pa
Tests/Certifications: ULC ORD C1703, UL 1703, IEC 61215, IEC 61730, IEC 61701, CEC Listed, IEC 62716 ammonia corrosion, IEC 617001 salt corrosion, FESC Listed
Warranty: 12-year warranty
www.silfab.ca



REC Group

Product: REC N-Peak
Application: Residential, commercial
Maximum Power (Pmax): 330W
Maximum Power Point Voltage (Vmpp): 34.6V
Maximum Power Point Current (Imp): 9.55A
Open Circuit Voltage (Voc): 41.3V
Short-Circuit Current (Isc): 10.36A
Module Efficiency: 19.8%
Operating Temperature: -40°F to 185°F (-40°C to 85°C)
Normal Operating Cell Temperature (NOCT): 111.2°F (44°C)
Max. System Voltage: 1000V
Power Tolerance: -0W / +5W
Cell Type: 120 half-cut mono c-Si n-type
Glass: 3.2mm solar glass with anti-reflection surface treatment
Frame: Black anodized aluminum
Weight: 39.68lbs (18kg)
Dimensions: 65.9" x 39.3" x 1.18" (1675mm x 997mm x 30mm)
Max Load: 7000Pa
Tests/Certifications: UL1703, IEC61215, IEC61730
Warranty: 12-year product warranty; 25-year linear power output warranty, max degradation in performance of 0.5% p.a., giving 86% at end of year 25
www.recgroup.com



Upsolar America, Inc.

Product: Upsolar Monocrystalline 60-cell - Black Series
Application: Residential, commercial
Maximum Power (Pmax): 310W
Maximum Power Point Voltage (Vmpp): 32.6V
Maximum Power Point Current (Imp): 9.51A
Open Circuit Voltage (Voc): 41.6V
Short-Circuit Current (Isc): 9.85V
Module Efficiency: 19.1%
Operating Temperature Range: -40°F to 194°F (-40°C to 90°C)
Normal Operating Cell Temperature (NOCT): 113°F +/-2° (45°C +/-2°)
Max. System Voltage: 1500V IEC/UL
Power Tolerance: 0 / +3%
Cell Type: Monocrystalline
Glass: High Transparency Tempered Glass 0.125" (3.2mm)
Frame: Anodized aluminium alloy type 6063-T5
Weight: 40.8lbs (18.5kg)
Dimensions: 64.5" x 39" x 1.37" (1640mm x 992mm x 35mm)
Max Load: 75 lbs/ft² (UL Standard); 5400Pa (IEC Standards)
Tests/Certifications: IEC; CEC; UL; TUV; Bureau Veritas; ETL - Intertek; CE
Warranty: 25-year Peak Power warranty, 12-year product guarantee
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Heliene Photovoltaic Modules

Product: 72-cell monocrystalline photovoltaic module
Application: Commercial
Maximum Power (Pmax): 370W
Maximum Power Point Voltage (Vmpp): 40.23V
Maximum Power Point Current (Imp): 9.26A
Open Circuit Voltage (Voc): 48.66V
Short-Circuit Current (Isc): 9.77A
Module Efficiency: 19.3%
Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)
Normal Operating Cell Temperature (NOCT): 113°F +/-2° (45°C +/-2°)
Max. System Voltage: 1000V, 1500V (optional)
Power Tolerance: 0 / +4.99W
Cell Type: monocrystalline
Glass: Low-iron content, high transmission PV solar glass
Frame: Double webbed 15 micron anodized aluminum alloy
Weight: 52.4lbs (23.6kg)
Dimensions: 77" x 39" x 1.6" (1956mm x 992mm x 40mm)
Tests/Certifications: ULC/ORD-C1703-1, UL1703, UL1703 Fire Classification Type 1, IEC 61215, IEC 61730, CEC, CE
Warranty: 10-year product warranty, 25-year linear performance guarantee
www.heliene.com



Phono Solar Technology Co., Ltd.

Product: Mono PERC solar module (All black)

Application: Residential, commercial, industrial, utility-scale

Maximum Power (Pmax): 380W

Maximum Power Point Voltage (Vmpp): 39.39V

Maximum Power Point Current (Impp): 9.66A

Open Circuit Voltage (Voc): 48.36V

Short-Circuit Current (Isc): 10.03A

Module Efficiency: 19.58%

Normal Operating Cell Temperature (NOCT): 113°F +/-2° (45°C +/-2°)

Max. System Voltage: 1000V/1500V (IEC/ETL)

Power Tolerance: 0 / +5W

Cell Type: Monocrystalline

Glass: 3.2mm toughened glass

Frame: Anodized aluminum alloy

Weight: 49.6lbs (22.5kg)

Dimensions: 77.01" x 39.06" x 1.57" (1956mm x 992mm x 40mm)

Max Load: 5400Pa

Tests/Certifications: TUV, CSA, CEC, CE, UL, ETL

www.phonosolar.com/en



LONGi Solar

Product: Hi-MO3

Application: Residential

Maximum Power (Pmax): 410W (front), 308W (back)

Maximum Power Point Voltage (Vmpp): 44.2V (front), 44.7V (back)

Maximum Power Point Current (Impp): 9.29A (front), 6.88A (back)

Open Circuit Voltage (Voc): 52.8V (front), 52.5V (back)

Short-Circuit Current (Isc): 10.02A (front), 7.56A (back)

Module Efficiency: 18.9% (front) and 14.2% (back)

Operating Temperature: -40°F to 185°F (-40°C to 85°C)

Max. System Voltage: 44.2V (front) 44.7V (back)

Power Tolerance: 0 ~/+5W

Cell Type: Monocrystalline / Half-cut / PERC / Bifacial

Glass: Ensures 30-year product lifetime with annual power degradation < 45% and 1500V compatible to reduce BOS cost

Frame: 40mm frame design enables easy installation and robust mechanical strength

Weight: 66.1lbs (30kg)

Dimensions: 85.83" x 39.21" x 1.57" (2180mm x 996mm x 40mm)

Max Load: 5400Pa (front), 2400Pa (back)

Tests/Certifications: IEC 61215, IEC 61730, UL1703, ISO 9001, ISO 14001, TS62941, OHSAS 18001

Warranty: 30-year warranty for extra linear power output, 10-year warranty for materials and processing

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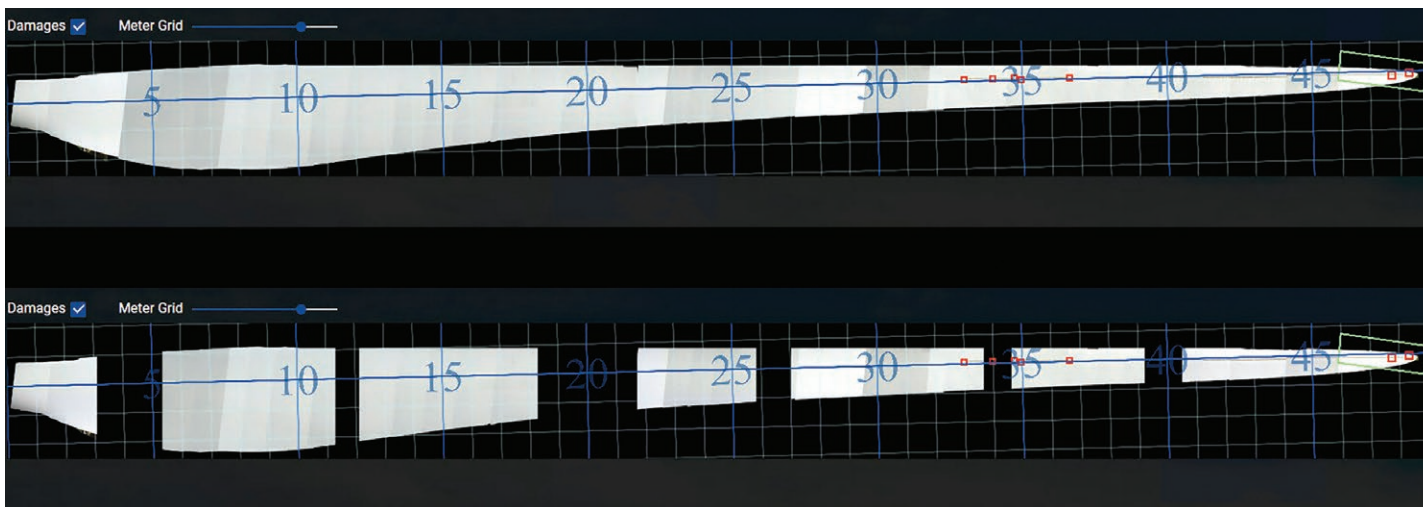
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Data, Analytics, and AI

Driving change in the wind industry

by Chris Shroyer

WIND ENERGY GENERATION CONTINUES TO GAIN

ground on traditional fossil fuel production, but there is still much work to be done. Every turbine asset needs to perform at maximum capacity and maximum useful-life, to reach industry sustainability. Wind energy providers must meet cost and annual energy production (AEP) goals, while extending the life of every asset. If the goal is to create efficiencies, minimize downtime, and keep turbines running as long as possible, we must proactively manage them. The solution is to capture data, and quickly compute that data to create actionable intelligence, so operators can use it to make wise business decisions, and meet productivity expectations.

At almost any wind farm, among the rotating turbines are a handful of turbines that are at a standstill. To maintain productivity, it is essential to determine why some turbines may not be performing as well as the rest. To the naked eye, everything may appear normal. There may not be visible damage, but wind turbine efficiency is determined by many factors - including the blades. When blades are not performing at peak efficiency, owners and operators must decide whether to make the necessary repairs. This decision, to avoid downtime and extend blade life, should be informed by data.

Capturing Data

The wind industry is driven by data. Whether it's a 10-turbine farm, or a fleet numbering in the hundreds, keeping a finger on the pulse of every turbine is a necessary challenge. The key to managing inspection data - maximizing production - lies in a process that captures relevant data quickly, then derives value from that data through a convenient dashboard view. When the data is easy to consume, it can be used for both immediate and long-term life-cycle management of assets.

Seemingly minor amounts of leading edge erosion can result in 3-5% loss in AEP, so it's critical to catch damage early. Blades bearing heavy wear can decrease AEP by



up to 15 percent. In harsher environments that have a higher level of abrasive particles in the air, blade damage is even more pronounced. Early detection matters, so regular inspections make all the difference.



Until recently, all blade inspections were conducted by human teams; they either climbed down the blade, or used scopes to examine it from a distance. Once a turbine was shut down, an inspector would assess the blades in a one-time event. Inspecting all three blades could take a full day with rope climbing. Using distant scopes was also time-consuming, and did not provide a complete picture of each blade. In the end, the inspector would hand the wind farm operator a piece of paper or a hard drive full of images, leaving the management, review, and analysis to the internal team.

Inspection has been transformed by the adoption of unmanned aerial vehicles (UAVs) to capture damage. What took human teams days to complete, UAV pilots can accomplish in minutes. Operators began working with flight teams to collect inspection





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data. Each flight required three or more turbine stops to ensure a pilot could capture adequate imagery for each blade.

Improvements to drone technology have streamlined flight capabilities dramatically. For the wind industry, this means faster, more accurate inspections that can capture all three blades in a single turbine stop.

Using on-site tools with the newest software on the market ensures that the captured images cover every centimeter of each blade. The software can assess, categorize, and label each high-resolution image automatically in the field, creating a full mosaic image of the blade, and packaging the files for further analysis.

From Data to Action with AI-Assisted Analysis

Back at the office, the files are analyzed within a proprietary software portal, where artificial intelligence (AI)-driven algorithms evaluate thousands of images, looking for signs of wear and damage. In a matter of minutes, the software can automatically pinpoint areas of damage, wear, or erosion on each edge of an inspected blade.

This technology is shaping the future of the wind industry. Instead of spending hours reviewing thousands of inspection images by hand, the always-learning AI can locate damage in minutes. The software stitches the images together, creating a high-resolution mosaic of each edge of the blade, and highlighting trouble spots. Quality data empowers owners and operators to make informed, proactive maintenance decisions on repairs.

Data informs important decisions in wind energy production, and helps the industry to increase efficiencies and work smarter. Data helps us to know when to operate and when to conserve, when to repair or replace, and when to push through. Data from UAV inspections and AI-driven analytics are critical to successful blade management programs; they ultimately increase AEP, extend life, and reduce the total cost of repairs.

We've come a long way in just a few years. Industry leaders are moving beyond thoughts and ideas, to develop game-changing technology that is changing the face of wind energy production. As technology continues to improve, we will move toward a future of cleaner, more reliable, and less costly renewable energy.

Chris Shroyer is President and Co-Founder of BladeEdge. His background spans more than 25 years of experience in technology sales and service, from start-ups to Fortune 100 organizations. BladeEdge is a software portal that transforms raw data from blade-condition assessments and wind farm management systems, into actionable intelligence.



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Geotechnical Surveys for Offshore Wind Farms

5 important considerations

by Cara Watson and Catherine Bradley

Some level of Site Investigation has been completed on every offshore wind farm to date. But what does the process entail, and how can developers plan ahead to maximize the value of these surveys, while avoiding project delays and cost overruns?

What are geotechnical surveys?

When developing an offshore wind farm, the interaction of the turbine foundations with the seabed introduces many factors for consideration.

What are the soil conditions and characteristics? Will the seabed provide sufficient bearing capacity to support the turbine foundations? How will the soils behave under different loadings? What are the effects of wind, wave, and tidal action? Will there be any changes to the soils behavior over time?

To answer these questions, let's take a two-pronged approach, consisting of both geotechnical and geophysical surveying.

Geophysical work uses remote sensing technology, such as multibeam echosounder, side scan sonar etc, to determine the nature of the seabed surface. Sub-bottom profiling work allows us to determine the composition of the seabed, while bathymetry determines the depth of the water.

Geotechnical surveying is used to 'ground truth' (in other words, to verify) the data collected during the feasibility stages of the project and geophysical surveying.

There are many different techniques that can be employed here. However, generally speaking, the survey will either obtain samples for geotechnical testing, or use an in situ test (such as a probe) to gather information through internal sensors. Geotechnical engineers will choose the optimal regime of testing and sampling for each location, taking into account the expected ground conditions and likely foundation option.

In combination, the two survey techniques provide a comprehensive data set, from which we can build a 3D model of the site. This is subsequently used to inform the foundation design of the turbines.

As the offshore wind industry advances, developers need to plan and manage the geotechnical surveying process more effectively than ever, in order to ensure that project timelines are not compromised. Here are five things to consider:

Stakeholder Engagement

While often underestimated, engaging stakeholders is an important factor in ensuring that geotechnical surveys can be completed properly and on schedule. Of particular significance are wildlife organizations that lead on protecting marine mammals, and local fisheries.

Geotechnical surveying can be noisy and disruptive to local wildlife, and it's important to minimize these effects as much as possible. For example, 'soft start' drilling can minimize disturbance to sea mammals such as porpoises. Meanwhile, certain locations must be avoided to ensure seabed colonies are not disturbed; avoiding certain months of the year can allow salmon migration to occur uninterrupted.

We have seen some close calls, where geotechnical survey vessels were almost held up in port due to a lack of amicable agreement between the developer and the local stakeholders. The delays, and the accompanying financial losses, can be significant.

To avoid this, it's important to engage with local stakeholders early in the process, and well in advance of beginning geotechnical survey work.

Offshore Representation

In terms of project timelines, offshore surveying is undertaken only when the feasibility stages have been completed. At this stage, desk studies, and any previous work in the area, have provided an idea of anticipated ground conditions - but these can vary from actual conditions on site.

We must therefore be prepared to tweak our survey strategy in 'real time', while onsite, to ensure the survey is undertaken safely and efficiently, as well as ensuring we get the best possible information for project design.

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Playing the long game

Finally, developers should take a holistic view when designing and constructing an offshore windfarm. Investing more heavily in the earlier stages of a project, and undertaking a detailed geotechnical survey, will mitigate the ground risk at the site and enable a much more efficient foundation design.

Knowledge is power. More comprehensive surveys mean fewer risks to the project, lowering the likely cost of the construction phase. Investing early in surveys yields cost savings later in the development process.

Cara Watson and Catherine Bradley, Lead Engineering Geologists at Longitude Engineering, a part of the leading international marine and engineering consulting firm LOC Group

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On one survey, a team got out to the site only to find that the seabed was too soft to support the machinery needed to drill the CPT borehole. Every time they lowered down the heavy framework, it just began to sink into the seabed. They ultimately decided to de-ballast the rig, in order to collect the data.

Making these decisions offshore, and under time pressure, can be considerably eased by the presence of a developer's representative, who is knowledgeable in geotechnical engineering, and who can weigh in on the decision-making process to help ensure the best possible outcome.

Planning ahead

Geotechnical surveys are sensitive to adverse weather conditions, as well as delays in the planning stages, and in negotiations with stakeholders. Good planning and realistic timescales go a long way towards minimizing the risk of delay.

Developers often underestimate the lead times needed to test the samples collected during geotechnical surveys. With only a handful of specialist labs in the world that offer advanced tests, such as cyclic or centrifuge, lead times can be significant. It's important to plan well in advance, to avoid project plans being held up by the lab testing stage.

Developers should also ensure that they have a buffer (both for time and budget) to allow for further investigation of unexpected soil behaviours or anomalies, if necessary.

Understanding deeper waters

As offshore wind moves further away from coastlines - and with the advent of commercialized floating wind - developers will need to account for the longer investigation times and higher vessel costs that come with necessary surveying.

In order to survey deeper waters, geotechnical experts working in the renewables space are likely to look to the oil and gas industry for inspiration. The offshore oil and gas industry has long used technology such as Remotely Operated Vehicles (ROVs), along with more advanced techniques, to gather project site data; this approach is likely to be increasingly adopted by renewables, as the offshore wind sector advances in both ambition and scale.



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The Human Factor

Wind turbine worker safety

by Doron Fuchs



WIND POWER CONTINUES TO BE A GROWING DRIVER

for renewable energy. The United States currently boasts 90,004 MW of cumulative installed wind capacity; more than 54,000 wind turbines are operating in 41 states, plus Guam and Puerto Rico, with over 1,000 MW already installed in 2018. There are now 18,987 MW of wind capacity under construction, and 18,806 MW in advanced development. The combined 37,794 MW represent a 46 percent year-over-year increase, a 13 percent increase over the previous quarter⁵.

Today, the U.S. wind industry powers more U.S. families and businesses than ever before, and employs a record 105,500 men and women across all 50 states⁵. With increased deployment of equipment, there is increased focus on measures to ensure safety for workers, and the public.

Wind turbine manufacturers already take safety very seriously. Many have instituted training programs for technicians¹. They are beginning to utilize the promise of camera-equipped drones for inspection. Yet, until recently, there have been no standardized training programs⁴. As wind turbine development accelerates, more technicians will be needed to perform hands-on work during the construction, maintenance, and demolition of wind turbines.

In April of 2018, The American Society of Safety Professionals, in conjunction with the American National Standards Institute (ANSI), issued the first U.S. industry consensus standard (ANSI/ASSP A10.2) written specifically for the construction and demolition of utility-scale, land-based wind generation/turbine facilities.² This standard mandates a more rigorous planning program for companies to ensure worker safety.

Many factors impact wind turbine worker safety. Dramatic mechanical failures, such as fires, are relatively infrequent – around

50 each year across a 300,000-strong international fleet of wind turbines (a rate of 1:6000).³ Yet, when it comes to worker safety, the most critical element to understand is the ‘human factor’.

It is well known that, when a technician is up on the nacelle handling some mechanical break or replacing a small part, with hands covered in oil or grease, he may become distracted for many reasons. He may have forgotten to bring a tool with him; he may slip and break a wrist or arm, or worst case, fall from his platform. Imagine doing a task, even a well-known, often repeated task, when you’re 100 meters (200 feet) above ground, working in a very small area – if you drop a tool, you won’t be getting it back anytime soon. Technicians are under enormous pressure and tension. Also, given the remote location of many wind farms, successfully deploying rescue teams to reach injured workers can be difficult and time-consuming, especially when every second counts.

Roadblocks to Safety Awareness

Currently, there is no North American database documenting specific wind farm technician accidents; there’s no way to obtain a specific accident forecast or probabilities. No other energy industry works with such secrecy regarding incidents. This is because the wind industry “guarantees confidentiality” of incidents reported. Please refer to <https://www.renewableuk.com/page/RISE>

In the UK, for example, the Health and Safety Executive (HSE) does not currently have a database of wind turbine failures, on which they can base judgments on the reliability and risk assessments for wind turbines. Please refer to <http://www.hse.gov.uk/research/rrpdf/rr968.pdf>.

Although there is a general model (as presented by GWO) of the safety pyramid, it is always repeated that we don’t know what to do with regard to electrical safety. There are no risk assessments and, generally, no specific data for small accidents that occur; we have no basis for probability of being injured while on site.

Statistics about accidents that happen at home illustrate that even the easiest daily task can be very dangerous. In the UK alone in 2007, nearly 2.7 million people were injured in a home accident [source: RoSPA].

Out of 8,800 wind turbines in UK, 180 accidents were reported. If we extrapolate this data to the number of turbines in the United States (> 54,000) we may estimate over 1,100 accidents during 2017, with over 800 accumulated fatalities from 2000 to 2017.

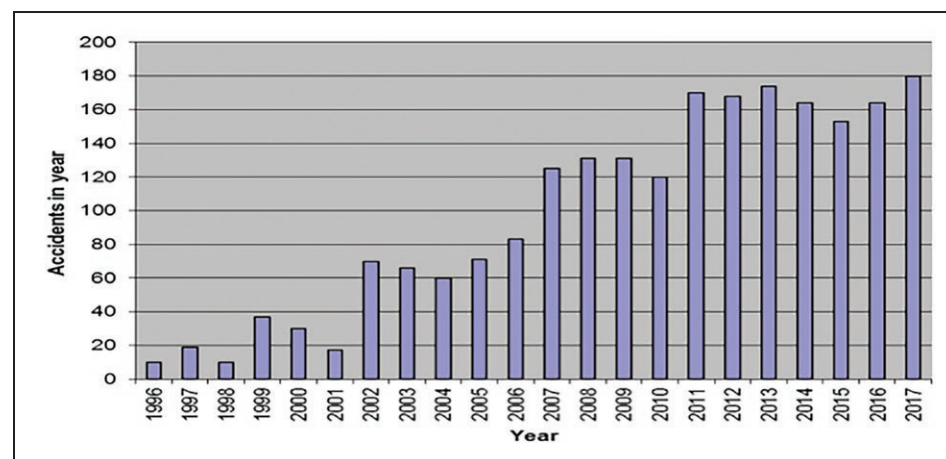


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Fatal accidents - Number of fatal accidents: 137 [from 2000 to 2017 only in the UK]
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¹ http://aeasseincludes.assp.org/professionalsafety/pastissues/057/02/044_049_F1Slaven_0212.pdf

² <https://www.assp.org/news-and-articles/2018/05/09/setting-the-standard-for-wind-turbine-construction-and-demolition>

³ <http://www.gcube-insurance.com/en/news-en/technical-topic-tackling-turbine-fires/>

⁴ <https://www.businessinsurance.com/article/20180705/NEWS08/912322458/Renewable-energy-sector-presents-unique-work-site-hazards>

⁵ American Wind Energy Association U.S. Wind Industry Second Quarter 2018 Market Report

- Without routinely collecting all accident data, and reporting to a general database, we will not have any possible way to assess the risks of working on a nacelle, or determining which measures might best improve safety.
- Evacuating a person from the nacelle should be executed so that, at a minimum, first aid will be available before any injury can deteriorate.
- We need industry standards for accessories available when working on the nacelle, including items such as: protective work outfit, special shoes, gloves, protective glasses, helmet, fall arrest, life line, nacelle-based first aid kit, and pre-installed tool box suited for working at heights.

Given the anticipated expansion of wind farms worldwide, worker safety must remain in the foreground. Establishing a standard, such as ANSI/ASSP A10.21, is a very promising development, as it calls for companies to assess risks to their technicians and other workers, and institute formal safety plans and programs.



Doron Fuchs, B.Sc. is Head of Professional Solutions Division for SkySaver Rescue Ltd., a company dedicated to the research, development and manufacturing of safe and intuitive emergency evacuation solutions. Doron has 30 years of engineering background and experience working with companies like IBM, Converse and Elron Group. SkySaver's products have received numerous certifications, and have been tested for compliance with multiple safety regulations, including CE, ANSI, NFPA, ASTM International and TUV.

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Online Rotor Unbalance Monitoring

A critical measurement for future condition monitoring systems

by Ulrich Oertel, Holger Fritsch, and Nicholas Waters

WITH MANY WIND TURBINES APPROACHING OR

exceeding their 20-year design life, and owners trying to reduce the Levelized Cost of Energy (LCOE), a growing segment of the industry is geared towards the wear and tear of individual components. Rotor unbalance is often the culprit. This unbalance, which originates at the blades, transfers through the entire drivetrain, shortening the service life of the mechanical components and turbine structure - even the foundation. Failures translate to long downtimes and excessive costs to owners. Traditionally, unbalance calculations have been performed by experts; the process presents safety risks, and loss of production. Moreover, unbalance calculations are generally only triggered by gross deviations from the norm, which then prompt technicians to positively identify the need for balancing. Online systems for rotor unbalance calculation can reduce safety risks and production loss, as well as provide a clear trend with greater sensitivity for balancing. As part of a condition monitoring system, rotor unbalance calculation can enable owners to incorporate rotor balancing into their predictive maintenance strategy, reducing the cost of turbine operation, and decreasing the LCOE.

With a budget of €75 billion, the European Union established its Horizon 2020 initiative: it's aimed at promoting research and data transparency throughout the EU, in an effort to create jobs, stimulate innovation, foster entrepreneurship, and continue to position the EU as one of the global leaders in scientific research. The ROMEO project, which is funded as part of Horizon 2020 initiative, strives to minimize the cost of offshore wind energy through advances in O&M technology. ROMEO consists of 12 participating companies, each with a specific area of focus. One goal is to develop an online unbalance calculation system as part of a condition monitoring solution for offshore wind turbines.

Here are some preliminary results of the research.

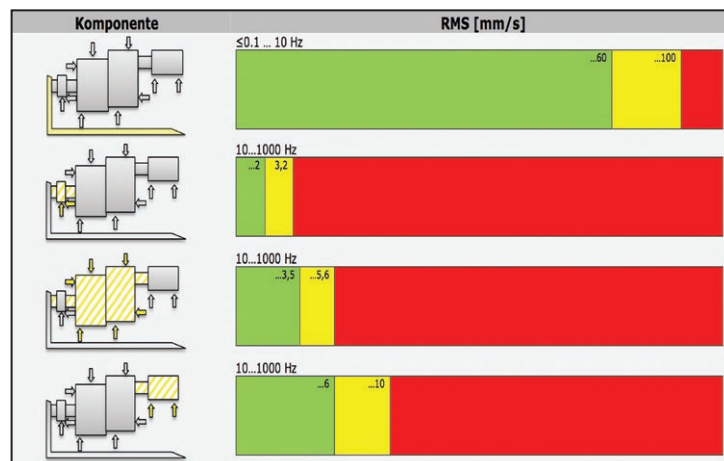


Figure 1: Frequency ranges for calculating velocity RMS values for different WT components based on ISO 10816-21. Warning and Alarm thresholds for velocity RMS values are in units of mm/s.

The International Organization for Standardization (ISO) released standard ISO 10816-21, related to monitoring mechanical vibrations in horizontal axis wind turbines. The standard provides basic instructions for measurement and assessment of the mechanical vibration of wind turbines (WT). General guidelines for sensor placement, fault frequencies, and alarm thresholds are provided for the different wind turbine components. Although the standard is simply provided as a general guideline/starting point, it highlights key concepts and explores the complexity of implementing vibration monitoring. Figure 1 provides general

guidelines relating to root mean square (RMS) average vibration levels, for velocity signals based on ISO 10816-21.

For the ROMEO project, an algorithm was developed for detecting and diagnosing rotor unbalance. Data was collected from two WTs, using biaxial accelerometers mounted to the main bearing housing of each WT. A turbine operating under healthy operating conditions (denoted WT1), was compared to a turbine operating with an existing unbalance (denoted WT2). The rotor unbalance was later corrected by the standard method of weight addition.

By comparing the RMS values for acceleration and velocity (as defined in the standard) for different rotational speeds, a large amount of variance between RMS values for each given speed was observed for the frequency range of 0.1-10 Hz for both WTs, preventing a clear identification of the rotor unbalance (shown in Figure 2). This was due to a variety of vibrational excitations and resonances occurring within this frequency band, which masked the rotor unbalance. This demonstrated that looking at broadband RMS values alone would not suffice for rotor unbalance detection. Narrow frequency band analysis would be required for early detection.

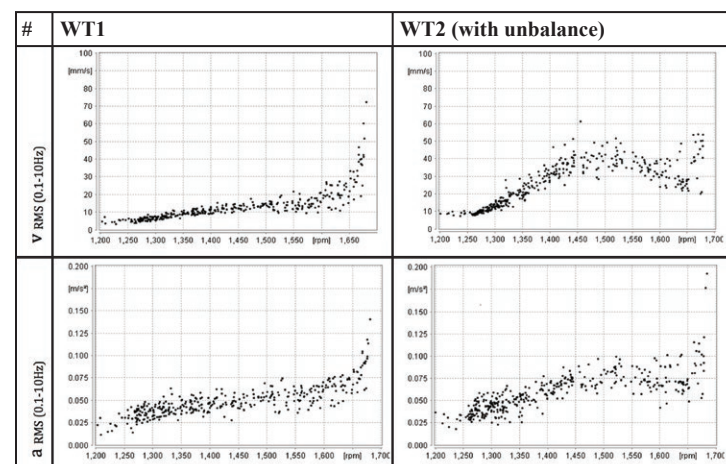


Figure 2: Velocity RMS (v RMS) and Acceleration RMS (a RMS) calculated across the frequency band of 0.1 Hz - 10 Hz at different rotor speeds for WT1 and WT2. Data was collected over the course of 3 months.

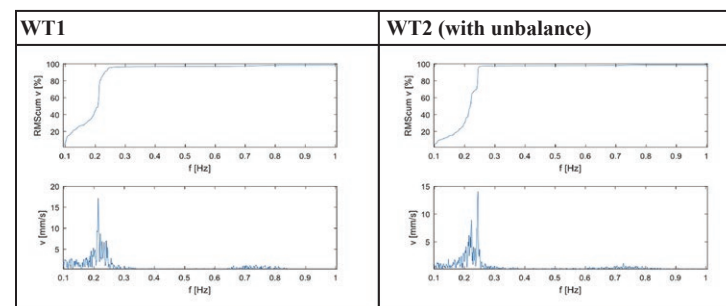


Figure 3: Plots of the vibration amplitude spectrum and cumulative RMS values (in % of total value, averaged across 0.1-10 Hz and zoomed in to highlight the 0.1 Hz - 1 Hz portion of the spectrum) for a fixed rotor speed of 14.5 RPM.

A closer look at a typical frequency spectrum, based upon velocity measurement, shows dominant amplitudes in lower frequency ranges for the turbine with unbalance, as compared to the healthy turbine. These frequency components are masked in the overall RMS value when calculated over the entire frequency range of 0.1-10 Hz. Looking at the frequency spectrum, however, clear peaks can be seen that are related to the unbalance. Figure 3 shows frequency spectra for the healthy turbine (WT1) and the turbine with unbalance (WT2), along with plots of the percent of total RMS value as a function of frequency for 0.1 Hz - 10 Hz. After having collected

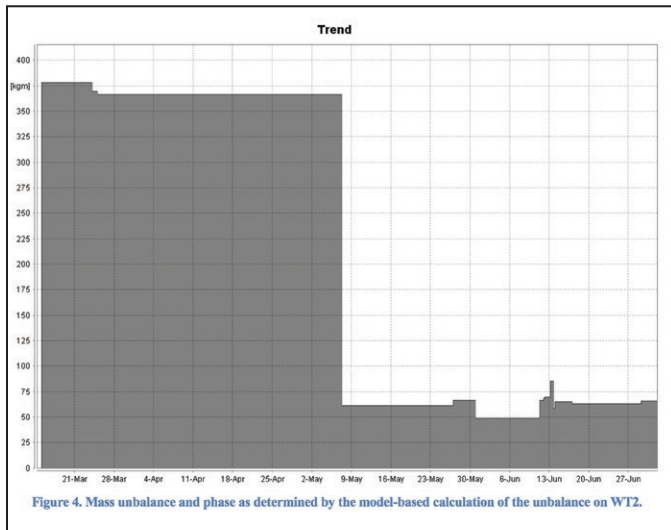
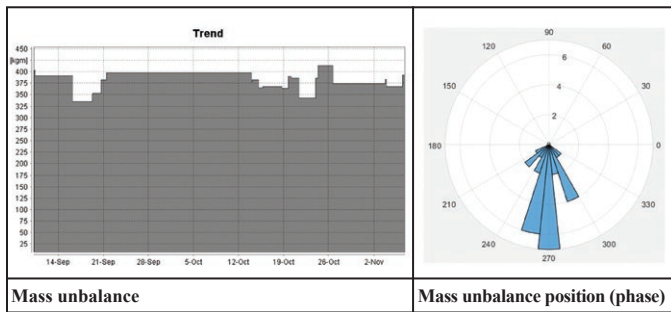


Figure 4: Mass unbalance and phase as determined by the model-based calculation of the unbalance on WT2.



Holger Fritsch is a Managing Director of Bachmann Monitoring, with over 20 years of experience in the condition monitoring field. He studied Physics at the Otto von Guericke University in Magdeburg Germany, and worked in Research and Development related to micromechanical resonant vibration sensors within Otto von Guericke University's department of Process Instrumentation and Electronics. He boasts a strong technical background in Finite Element Modeling simulation, sensor design, and data analysis related to machine diagnostics.



Ulrich Oertel (Uli) is the Head of Monitoring Technologies Development for Bachmann Monitoring, and has over 18 years of experience in the field of condition monitoring. He studied physical technology and biomedical engineering at the University of Applied Sciences Jena in Jena, Germany. Before joining Bachmann's condition monitoring group, Uli served as a Research Scientist for the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, Germany, with a focus on neuroimaging analysis and magnetoencephalography.



Nicholas Waters is a Key Account Manager for the Bachmann Electronic North American office. He earned his B.S. in Applied Mathematics from the University of California, Davis, and his M.S. in Ocean Engineering from Florida Atlantic University. He serves the wind community by promoting products centered around open data access for owners, working closely with sites to understand and solve unique challenges, and advocating for predictive maintenance strategies.

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and analyzed data from actual turbines, the unbalance algorithm was optimized.

By creating a mathematical model of the turbine, comprised of material and structural properties, the unbalance was calculated. This model was then incorporated into an algorithm capable of both calculating the mass unbalance, and determining its position. By studying unbalance on WT2, along with trending vibration levels over the course of several months, the estimated unbalance and location were determined for the turbine. In a subsequent balancing exercise, the actual unbalance of the rotor was found to be 376 kgm, at a position of 271° from the reference point. Comparing this to the unbalance calculated for the turbine, the algorithm's mean results agreed with the test weight, based calculation to within approximately 5 percent, (as seen in Figure 4). The unbalance found on WT2 was corrected, and measurements retaken. After weight correction, it was determined that the mass unbalance was reduced to approx. 60 kgm, (Figure 5).

Although work for the ROMEO project is ongoing, the preliminary results have been promising. The advanced algorithm has proven its ability to be integrated into a condition monitoring system for calculating rotor unbalance, and trending levels for early detection and mitigation. As part of a predictive maintenance strategy, rotor unbalance measurements will help owners drive down their cost of ownership by allowing them to address severe unbalance before it accelerates wear throughout the drivetrain components.

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Temporary Power Generation Keeps Wind Farm Construction Projects on Schedule

by Bill Cook

It takes power to make power. While under construction, offshore wind farms need standby power from auxiliary generators for a range of functions. When provided reliably, the construction project is more likely to be complete on time.

Throughout the wind farm construction and commissioning phases, temporary power for large and small loads can be supplied with a wide range of generators. Once the project is operational, other power needs arise.

For the offshore construction phase, 30kW generators are provided and placed on the man-access platform (MAP) and are charged using a wind turbine. Such units power the various electrical equipment used during the initial construction phase. These units weigh less than a ton, so they can be lifted off by a davit crane without requiring a large vessel for the installation.

Crew transfer boats, cable laying vessels, and jack-ups can also use temporary generators for supplementary supply. This can potentially

involve multi-megawatt applications.

Temporary generation is often deployed at each turbine platform, but may also be distributed from a central power plant on land, depending on the specific project requirements. Operators are essentially restricted from operating substations prior to grid readiness, and the consequences could include costly voiding of warranties, among other penalties. Long-term rental solutions can be customized to the platform requirements, such as dual generators on load demand for fuel consumption optimization, monitored 24/7 by a remote operations center.

Heating and drying for the stores protect important electrical equipment, along with the nacelles and blades. This can be done using heaters, dehumidifiers, or electrical (dehumidification) systems that are also used on vessels. Also, companies with trenching machines, cranes, or ROVs may want additional power both onshore for testing and commissioning, and offshore on vessels for operations.

Generators are also used to commission or condition the turbines offshore. This often includes use of generators on the MAP that power the essential equipment, followed by a greater amount of power to pitch and yaw the turbines.

Failure to provide this motion could result in damage to the turbine. Novel offshore solutions have resulted in generators that are lightweight and durable, and can sync together to minimize the load. LV and HV back feeding solutions can be provided for the offshore substation, minimizing cost for the developer. Cooling can also be provided for HVDC convertor station transformers.

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Connecting to the grid

The electric grid has to adjust supply in response to the fluctuating characteristics of wind power and demand. These fluctuations will continue as the wind energy industry expands.

Certain variability and induction problems with wind farm projects over the past 20 years continue to make connecting to the utility grid challenging. This is where temporary power suppliers have played a pivotal role in wind farm commissioning. The average size of wind-driven generators has increased from 0.5 MW units in the mid-1990s, to up to a few 8-MW units in the latest offshore models. Mini-grid solutions expedite commissioning these systems into service, providing the capability to manage power from the turbines, along with an associated array of scalable generators and transformers.

Above all, the generators and load banks supplied to the industry allow commissioning turbines prior to connection to the power grid, saving time, and directly benefitting return on investment by allowing the developer to begin production as soon as the wind farm's substation is complete. Saving time is important to allow wind farm owners to realize the tax incentives and credits available once the wind energy system has been commissioned and is fully operational.

Operations and maintenance

Following commissioning, low-voltage power can be supplied at the base of each turbine, to power ancillary equipment such as lighting, and the hydraulic pumps to turn the rotor and prevent bearing lock-up. Alternatively, a central high voltage package can power the integrated system from one point of connection, keeping transformers and switchgear running, in addition to the turbines.

Maintenance typically uses temporary power from standard generators, while transformers are also made available for the higher voltages, such as 690V (the industry standard for many years). In fact, transformers have been supplied for multiple uses. To connect the circuits in the field, 480 V/34.5 transformers in the 2,500 to 5,000 kVa range are provided. To keep the system operational, power has been supplied to the field when the main transformer has failed, or the utility has to take the distribution system out of service.

Lifecycle extension

Similar to the experience with onshore wind farms, the emergence of the offshore wind-power industry makes necessary contingency plans, to enable fast response to problems.

One capability that has benefitted wind farm power plants is the installation of embedded generators for turbines and substations. With unique designs and rental models available, they can significantly reduce the lifetime cost of an outage. The capabilities of such generators continue to expand as the industry transitions into offshore projects in North America and elsewhere, requiring a turnkey package, such as auxiliary vessels and refueling capabilities for offshore projects. This is why the multiple "layers" of expertise needed in the wind energy business are already available.



Bill Cook is a Renewable Energy Sector Manager for Aggreko, an international provider of power generation and temperature control solutions. In his role, Bill is focused on driving the company's business strategies and relationships within the renewables market. He has been leading Aggreko's business in the renewables sector for the last 12 years.

Bill spends most of his time traveling and working with industry experts to develop solutions to their individual challenges.

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- AT80D/FF tip adaptor
- 4 mm rigid sleeve set and handle/grip
- 12 ft (3.6 m) guide tube for 4 mm scopes
- Carrying case

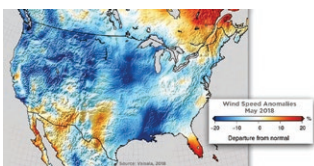


Contact your Olympus sales representative for more information.

www.olympus-ims.com

Olympus and IPLEX are registered trademarks of Olympus Corporation.





Wind energy forecast tool

Vaisala has launched a new Vaisala Energy Budget Outlook service to provide independent assessment of the impact of weather on wind portfolio performance. The launch comes amid increased demand from wind energy operators for tools to more accurately forecast revenue, and for the ability to adjust these forecasts based on recent wind performance. Typically, pre-construction estimates of wind speeds and actual energy production figures are used to forecast a site or portfolio's energy production (energy budget). This new service provides a range of information on how more recent anomalies in wind speeds will affect an individual project or a wider portfolio. In doing so, it allows wind energy operators to more accurately set project budgets for the coming months.

Vaisala Energy | www.vaisala.com



Cost-effective, fire-resistant cable technology

Prysmian Group North America announced the launch of its Lifeline MC and Lifeline MC LSZH cable systems. With these new systems, Prysmian provides UL 2196 FHIT Certifications for a cable-and-in-conduit solution that is also an armored MC solution. Engineered to withstand temperatures up to 1850°F, Prysmian's UL 2196-Certified Lifeline products allow emergency circuits within buildings and transportation systems to continue operating for at least two hours in extreme fire conditions. The new Lifeline MC and Lifeline MC LSZH systems will utilize self-contained raceways, in addition to cable-in-conduit, to provide maximum flexibility and cost savings for an array of fire-resistant applications. Prysmian's Lifeline products employ ceramified silicone technology to safeguard circuits from failure due to fire, providing fire pumps critical power to provide life-saving sprinkler coverage throughout the structure. Powering ventilation, exit lighting, and occupant elevator systems allows first responders to safely evacuate occupants from burning buildings. Prysmian customized its products to meet U.S. building safety codes, which require fire protection methods to ensure circuit integrity of emergency systems.

Prysmian Group North America
na.prysmiangroup.com



User-friendly flip extension for haulers

XL Specialized Trailers designed a solution for hauling longer wind turbine blades, with its new patent-pending BladeMate Flip Extension. The Extension provides significant cost savings to haulers over purchasing a new trailer. XL's 27-foot long Flip Extension can be added to the rear of XL's BladeMate trailer, or any blade-hauling trailer. The final trailer length will depend on what model the flip extension is paired with. The XL Blademate Flip Extension was made to be user friendly. By moving the lever at the front of the trailer, six-inch hydraulic cylinders flip the extension up or down within minutes. The cylinder linkage can be unpinned and lowered flat to allow for more loading space on the top of the trailer. The rear bolster, at the end of the Flip Extension, offers a 20,000-pound capacity, making it suitable as the rear-loading platform for the common two-point load set-up. The Flip Extension is secured with a lug and pin system, allowing the tail to be completely removed when it is not needed. The XL BladeMate Flip Extension offers benefits to the driver even when hauling shorter blades. If the driver uses the Flip Extension instead of fully extending the BladeMate trailer, the wheelbase of the trailer is shorter and reduces the trailer's turn radius.

XL Specialized Trailers
www.xlspecializedtrailer.com

SKYLOTEC.COM

NEW PRODUCTS FROM SKYLOTEC

CLAW

NEW

IGNITE PROTON WIND

RESCUE PRO 2.0

SKYSAFE PRO FLEX

LORY PRO

CONREST

SKYLOTEC offers you a highly innovative and functional range of fall protection equipment featuring the new smooth running **CLAW** Vertical Cable Sleeve for 3/8 & 5/16 inch diameter wire ropes. The **IGNITE PROTON WIND** and **RESCUE PRO 2.0** Harnesses are light weight designs built for durability and comfort. The **SKYSAFE PRO FLEX** Lanyard includes an energy absorber designed for 6 and 12 foot free fall applications. The **LORYPRO** positioning lanyards allow you to work hands free with complete adjustability. The **CONREST RESCUE** Stretcher is ideal for tight confined space rescues. These products are ideal for work at height in the telecommunications, electrical utilities and wind energy industries. For more information please email us at info-us@skylotec.de. skylotec.com

SKYLOTEC North America LP | Denver, CO USA | Tel 1-303-544-2120



Easy-to-use, quick install, reliable cable

General Cable's new EmPowr CL Edge medium-voltage (MV) cable is an MV cable for renewable energy that combines four of the most effective features in the cable industry for greater efficiency, protection, and reliability: compact phase conductor and flat strap neutral conductor, two non-hygroscopic rip cords, cross-linked polyethylene (XLPE) jacketing, and all black semi-conductive polyethylene (SCPE) coating. EmPowr CL Edge is also UL rated MV-105 which means that users can run this cable at higher temperatures knowing there won't be a loss of reliability.

General Cable | www.generalcable.com



Irradiance calibration with improved repeatability and reliability

The new Atlas Ci4400 Weather-Ometer is an advanced instrument providing easy and effortless operation, uniformity, increased capacity, and a sleek design, delivering value and performance. It offers a user-friendly touch screen interface and ergonomic features, along with design and engineering innovations in the airflow, irradiance and control systems which have dramatically reduced variability in critical test parameters. As a result, the Ci4400 achieves new levels of temperature, humidity, and light exposure uniformity.

Atlas Material Testing
www.atlas-mts.com



Unbalance measuring plug-in

A new plug-in to Bachmann's Condition Monitoring System provides plant operators with regular updates on the balance condition of their wind turbines' blades and provides a measurement of unbalance without a lengthy and expensive process. In field tests, the calculated unbalance has shown excellent agreement with the weight actually fitted. The Blade Unbalance Calculator runs to provide an estimate of the mass unbalance in kgm, based upon a few structural parameters and the output from a tower sensor fitted at the centre of the nacelle. Not only does the output provide a direct measure of balance quality, it also distinguishes between aerodynamic and mechanical effects, ensuring plant operators prepare for the correct maintenance action. The implications of an undetected unbalance are severe: increased fatigue loads on the entire structure, including the tower and nacelle, as well as the drivetrain components. Providing a cost-effective estimate of the balance quality allows owners to target those wind turbines where balancing will make a significant improvement to the operational life. The impact of the Blade Unbalance Calculator on the cost reduction of offshore wind energy is currently being tested as part of the EU joint research project ROMEO.

Bachmann Monitoring GmbH
www.bachmann.info



Wind turbine blade management program

BladeEdge's Inspect wind turbine Blade Management Program (BMP) uses drone and sensor platforms to complete expertly piloted UAS (Unmanned Aerial Systems) blade inspections. BladeEdge's in-house flight team and regional partners throughout the U.S. are trained and certified to use the BladeEdge Capture Assistance Tool (BECAT) to capture a complete data set in the field. BECAT also packages the imagery for processing by BladeEdge, saving time and eliminating the opportunity for human error. Once the inspection is complete, the data is processed by BladeEdge's sophisticated image treatment process and deep learning algorithms. This gives their clients access to a complete, close-up image of their infrastructure highlighting areas of damage or concern. BladeEdge was designed with tolerance for sub-optimal weather conditions, and edge and anomaly detection capabilities can be used to analyze any type of composite blade. Each time data is collected, BladeEdge software further trains itself to recognize damage and wear. All the data available through the BladeEdge platform can be put to work. Complete, close-up imagery of all blades can inform asset management planning and inspection organization. In addition, historical inspection data can be compared with current imagery to track wear patterns on blades. Over time, BladeEdge's predictive modeling will provide the wind industry with a better understanding how blades age. This will allow owners and operators to develop proactive maintenance plans that will extend the life of infrastructure and increase annual energy production.

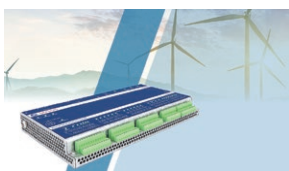
EdgeData | www.edgedata.net



Simple, intuitive interface setup

POSITAL's IXARC new magnetic absolute encoders with CANopen interfaces are now available with an optional "connection cap" that makes device configuration and troubleshooting simpler and more intuitive. The connection cap contains three rotary switches that enable the installer to define the node ID and baud-rate directly with a small screwdriver. There are also diagnostic LEDs on the backside that simplify setup and debugging by indicating device and network status. With eight screw terminals inside the cap, the user can easily install cables for power supply and bus-in/bus-out. A slide switch can activate a termination resistor when the device is located at the end of the network, reducing installation costs. IXARC magnetic absolute encoders with CANopen interfaces are a solution for motion control applications ranging from cranes and container ports to classic factory automation. Compared to optical encoders, they are almost 30% smaller and have higher resistance to shock and vibration loads. Available IP 66/67 protection makes these devices suitable for harsh environmental conditions. Single- and multi-turn models are available. For multi-turn versions, the rotation counter is self-powered, with no need for backup batteries and with a measurement range of four billion revolutions (32 bits). A variety of connection cap options are available, including cable glands for cables of various lengths and M12 connectors for use with pre-assembled cables. Connection caps with two or three connectors can be used to connect multiple devices in series (daisy chain) without T-couplers.

POSITAL | www.posita.com



Wind turbine monitoring system

The condition monitoring solution offered by B&K Vibro is based upon its Diagnostic Data Acquisition Unit (DDAU) hardware, companion VibroSuite software, and network of remote monitoring and surveillance centers strategically situated in North America, Europe, and Asia. These centers are staffed by highly experienced engineers providing both surveillance and root-cause diagnostic services. With the imminent release of their latest generation of DDAU hardware (DDAU3), they are extending the capabilities of their technology to deliver even more value to wind turbine operators, owners, and manufacturers.

Brüel & Kjær Vibro | www.bkvb.com

A Leading Terminal Operator

LOGISTEC provides high quality cargo-handling services to marine and industrial customers through a strong network of strategically located facilities in the Great Lakes, the St. Lawrence River, the U.S. Gulf, and on the Eastern Seaboard of North America.



At LOGISTEC, we know wind. Our highly-skilled team of experts work closely with our customers and partners providing unique and personalized solutions to move valuable wind components safely and effectively.

Visit us at www.logistec.com.



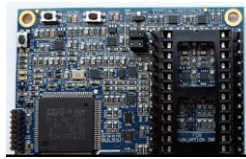
LOGISTEC



Intelligent industrial connector

Han-Modular CAN ID Module has 10MB of memory storage for retaining the revision status of drives and their parameters and other technical information. This helps ensure reliable operations, minimizes downtime during setup or maintenance, and can even form part of a predictive maintenance program. During servicing, drive configuration data stored in the module is easily accessed so individual machine elements can be swapped out or repaired faster. There is no need to search for hardcopies or electronic files on a server. Maintenance history per location is easily retrievable, even years later. There is no data loss in the event of a device exchange, and a correct connection is virtually assured with verification using the stored machine data. Markets well-suited for this module include wind energy, industrial building automation, machinery, and robotics.

HARTING USA | www.harting-usa.com



Professional MEMS development tool

The Profi MEMS Tool development platform by STMicroelectronics lets engineers visualize the behavior of ST's MEMS sensors, helping accelerate time to market and maximize the performance of new product designs. Featuring a high-performing STM32F401 microcontroller and flexible power management, the main Profi MEMS Tool board powers the sensors and gathers output data for forwarding to a developer GUI (Graphical User Interface) running on a host PC. Users are free to use ST's UNICO GUI, which can be downloaded from st.com, or a tool of their choice to analyze the MEMS sensor waveforms. Profi MEMS Tool goes beyond simply linking the sensors and GUI, by helping users explore all the operating modes and power settings and optimize performance and accuracy. The board's generous compute power handles complex datasets, such as OIS/EIS (optical or electronic image stabilization) from ST's advanced 6-axis inertial modules, as well as simple sensor readings like barometric pressure and accelerometer or gyroscope data. It also has ample capability for evaluating the latest generation of high-resolution MEMS sensors for industrial applications, such as the recently-launched IIS3DHH3 3-axis low-noise accelerometer, which features a 16-bit accelerometer output and 12-bit temperature output.

STMicroelectronics, Inc. | www.st.com



Minimally invasive video inspection camera

Extech Instruments' BR250-4 is an affordable and versatile wireless inspection borescope designed to get into openings as small as 4.5mm while providing bright clear images on its detachable, wireless display. By accessing smaller openings or requiring smaller holes to be drilled for access, the affordable BR250-4 is invaluable for simplifying diagnostics and documenting inspections while leaving minimal or no damage in the process. With the detachable, wireless 3.5" color display, users can position the borescope as needed and the monitor can be handheld or affixed to any metallic surface using its magnet mount. Alternately, for inspection sites near hazardous or moving components, the wireless monitor can be used to inspect conditions remotely up to 32ft (9.75m) away. Captured video (960 x 240 AVI) and images (640 x 480 JPEG) can be viewed on the unit's monitor, transferred to a computer via SD card, USB cable, or viewed on an external monitor via video-out connectivity. For instructors, live video from the camera can be received by the BRD10 wireless USB video receiver. The BR250-4 features a waterproof (IP67-rated) 4.5mm diameter BR-4CAM camera with a 63° viewing angle and bright, adjustable 4-LED lighting. The camera uses a 39" (1m) "semi-rigid" flexible gooseneck cable which easily retains a fixed shape. The BR250-4 is backed by a one-year warranty and comes in a hard carrying case including magnetic base stand, microSD memory card and adaptor, USB and video cables, AC adaptor, rechargeable display battery, and 4AA batteries.

Extech Instruments | www.extech.com

Vertical lifeline for protection against falls

ASAP VERTICAL LIFELINE is a temporary vertical lifeline designed to protect against falls from height. It is made up of an ASAP mobile fall arrester, an ASAP'SORBBER energy absorber, two steel OK TRIACT-LOCK connectors, and a RAY 12 mm static rope. It is ANSI compliant and available in 5 lengths; 25, 50, 75, 100, and 200ft.

Petzl | www.petzl.com



VDH/GSMI®

34.5 kV Vacuum Circuit Breaker and High Speed Grounding Switch for Wind and Solar Power Substations

Ema Electromechanics is the designer and manufacturer of model VDH/GSMI® combined 34.5 kV vacuum circuit breaker and high speed, mechanically interlocked grounding switch (aka "grounding breaker"), a unique and patented system specifically designed for switching and grounding of wind and solar feeder circuits.



16 Industrial Drive, Sweetwater, TX 79556
Tel: 325 235 8000
Email: contact@emaelectromechanics.com
www.emaelectromechanics.com



Powerful and dynamic control valves

The latest pilot-operated control valves from Bosch Rexroth are a solution for all moderate and high-dynamics application, including the most demanding tasks as well as position, speed, pressure, and force control. With high flow and a maximum pressure of 350 bar, they are designed for a wide range of practical applications. The latest from Rexroth are pilot-operated 4/3-way control valves with highly dynamic properties. Greatly improved product features allow them to master demanding control tasks with ease. With a high flow of up to 4,700 l/min and a maximum pressure of 350 bar, they guarantee fewer pressure drops, fast motion sequences, great power density, and increased stability and control quality. It offers increased energy efficiency, more productivity, and uses less space, with maximum control.

Bosch Rexroth Canada
www.boschrexroth.ca



AWEA OFFSHORE WINDPOWER CONFERENCE & EXHIBITION

October 16 - 17, 2018 | Washington, DC

Join us in the nation's capital for a timely educational program, recent advances in offshore technology, as well as top-notch networking with those leading the offshore segment into the 2020s.

PROGRAM CHAIRS



Thomas Brostrøm
President North America, ørsted



Stephanie McClellan
Director, Special Initiative on Offshore Wind, University of Delaware

KEYNOTE SPEAKER



The Honorable Terje Søviknes
Minister of Petroleum and Energy, Norway



Register at awea.org/offshore

Transportation & Logistics

With all of the equipment, carriers, size, and specialized handling requirements, getting all of the right turbine components to the right project sites for construction can be a challenge in the wind industry. Safety and efficiency are important keys to ensuring projects and timelines run smoothly. Here we focus on some of the top Transportation & Logistics companies in the industry that provide the specialized services required for getting all of those wind power parts, components, and machinery where they need to be for a successful wind farm.

SEE AD ON PAGE 57



PORT CORPUS CHRISTI

Port Corpus Christi

Services: Port of Corpus Christi provides services for the movement of heavy lift cargo. Facilities include 6 near dock laydown yards; highway and rail accessible; a 47' deep ship channel; dockside rail; three Class-1 rail carriers and a short line railroad; available labor force; open, covered and dockside storage; and security/safety operations.

Min/Max Loads/Tonnage: Port of Corpus Christi moves more than 100 million tons of cargo per year and has developed and implemented efficient transportation and logistics solutions for the renewable energy industry including wind energy.

Location/Logistics: Located on the Texas Gulf Coast, Port of Corpus Christi has a straight and uncongested ship channel; limited low visibility days, and provides access via three Class-1 railroads and Interstate highways to the US, Canada, and Mexico.



Qualifications: Port of Corpus Christi is a modern Port with diverse cargo handling capabilities and home to more than 50 industrial companies. The Port attracts major investments from the US and foreign direct investments for construction of manufacturing facilities. The Port maintains an Environmental Management System, ISO 14001 certification, and is Green Marine certified.

Key Features:

- The Port's Nueces River Rail Yard has eight tracks each 8500' long to accommodate 8-unit trains;
- Three Class-1 railroads directly connected to the Port's interchange yard and railroad system via short line railroad company;
- Dockside rail loading and truck transfer capability;
- Quick access to US 181 and Interstate 37;
- Home to the strongest open wharf on the Gulf of Mexico;
- A 47' deep channel, dredging to 54'.

portofcc.com

SEE AD ON PAGE 53

LOGISTEC



Logistec

Services: Logistec provides stevedoring and terminal operations to handle wind components.

Min/Max Loads/Tonnage: Able to accommodate a wide variety tonnages and dimensions at their ports.

Location/Logistics: Logistec operates 61 terminals in 37 ports across North America, from the Arctic down to the US Gulf coast.

Qualifications: Founded in 1952, and a member of Green Marine

Key Features:

- Provider of value-added cargo handling services for industrial customers in the renewable energy sectors;
- Utilizes the latest technologies throughout their network of strategically located facilities;
- Working closely with customers and supply chain partners to tailor cargo handling solutions to their needs.

www.logistec.com

TP & L

Management Solutions

Making Logistics Easy



By providing logistics management services through every step of the supply chain, TP&L ensures your shipments arrive at project sites economically, safely, on time and to the quality standards set by the manufacturer. We currently are storing and maintaining 17,881 components in our yards.



Services and Capabilities:

- Distribution Services
- Inventory Management
- Rail Logistics
- Trucking Logistics
- Indoor/Outdoor Storage
- Maintenance

Check out our distribution centers:

Casper, WY | Garden City, KS | Enid, OK | Grand Forks, ND | O'Neill, NE

tpandl.com • 307-262-6748



Port of Wilmington, Delaware

Services: Full service, deep water, wind project marine terminal

Min/Max Loads/Tonnage: 100 tons

Location/Logistics: Mid-Atlantic US

Qualifications: 360 Quality; C-TPAT; AWEA Membership

www.portofwilmington.com



Premier Truck Rental

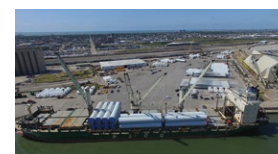
Services: Pickup truck rental, work truck rentals, UTV rentals, and trailer rentals

Min/Max Loads/Tonnage: 1/2 ton - 3 ton work trucks

Location/Logistics: Nationwide

Qualifications/Certifications: Non-CDL and CDL

www.rentptr.com



Metropolitan Stevedore Company

Services: Bulk, breakbulk, and project cargo stevedoring to include wind energy components. Full service terminal operations to include rail, truck, and barge.

Min/Max Loads/Tonnage: Crane capacity of approximately 200 tons

Location/Logistics: Servicing the wind industry on the USWC, USGC, and USEC

Qualifications/Certifications: More than 150 years' experience in vessel stevedoring and terminal operations

www.metroports.com

SEE AD ON PAGE 56



Transportation Partners & Logistics

Services: Logistic and transportation management for dimensional freight in North America

Location/Logistics: Kansas, North Dakota, Oklahoma, Wyoming, Colorado, Nebraska, and Texas

Key Features:

- Supporting rail, truck, crane, rigging and distribution centers, TP&L's team of in-house engineers are top-load certified and ready to take the lead when it comes to any logistical needs;
- From port to pad TP&L delivers economically, safely, and on time;
- Onsite services include: scheduled maintenance per OEM storage guidelines to maintain warranty, currently performing long term storage on over 800 complete turbines, additional shrink wrapping and product protection, storage of other windfarm related components such as cable reels, transformers, ladders, etc;
- Indoor storage available at all locations for element sensitive components such as DTA's, drivetrains, generators, and ship loose items.

www.tpandl.com

SEE AD ON PAGE 95



Port of Stockton
CALIFORNIA

Port of Stockton

Services: With 24/7 access to freight, the Port of Stockton is designed to quickly get cargo moving with flexible solutions for the renewable energy market. These include stevedoring, warehousing, inventory management, and transloading. Served by the UP and BNSF railways, the Port has 2.5 miles of on-dock rail with ample laydown area.

Min/Max Loads/Tonnage: The Port of Stockton has handled a wide variety of renewable energy shipments. It offers services for breakbulk and heavy lift shipments both large and small. With two mobile harbor cranes, around the clock security, and a 24/7 gate they offer unique and flexible results for critical logistical issues.

Location/Logistics: Located in the extended San Francisco Bay Area, the Port of Stockton provides instant access to less congested highways including I-5, CA-99, and CA-4, and is an hour away from I-80.

Qualifications/Certifications: The Port of Stockton has been in operation since 1933 and handles a variety of cargo for dozens of clients.

Key Features:

- Two 144 tonne Liebherr mobile harbor cranes;
- 15 multi-purpose berths available upon demand;
- Around the clock security;
- 24/7 access to freight;
- Dockside rail loading.

www.portofstockton.com



Port of Vancouver USA

Services: The Port of Vancouver USA specializes in handling wind energy cargo. It provides the equipment, facilities, space, and labor needed to safely and efficiently move projects of any size through the facility.

Min/Max loads/tonnage: The port's two Liebherr mobile harbor cranes can operate at any breakbulk berth and have a lifting capacity of 140 metric tons each; 210 metric tons together. Terminal 2 offers a Paceco crane with a 51-metric-ton capacity and a 115-foot outreach. Stevedoring equipment includes trailers and reach-stackers to efficiently move cargo. With over 100 acres of laydown space, the rail expansion project will triple capacity and reduce congestion by 40%.

Location/Logistics: The port is 106 river miles from the Pacific Ocean on the Columbia River. The BNSF Railway, Union Pacific Railroad, Canadian National Railroad, and Canadian Pacific Railroad have direct unit train access from mainline corridors. Primary freight arterials of the U.S. Interstate Highway network run north, east, and south.

Qualifications/certifications: Port of Vancouver USA has handled wind energy components for over 16 years. Long-term relationships with their customers have helped them develop the Port's facilities and make investments in the right equipment and training to respond to the modern challenges of moving all wind energy components.

www.portvanusa.com



Logisticus Group

Services: Transport & Project Management, Repower, Crane, Warehousing, Field Reps, WMS, and TMS

Min/Max Loads/Tonnage: Able to accommodate most, if not all, component sizes

Location/Logistics: North America

Qualifications/Certifications: MBE (Minority Business Enterprise)

www.logisticusgroup.com



Ports America

Services: Ports America provides terminal operations and stevedoring services in 42 ports and 80 locations throughout the USA.

Location/Logistics: Locations spanning the Pacific West Coast, the US Gulf Coast, and the East Coast.

www.portsamerica.com



ATS

Services: ATS is an asset-based carrier for wind energy transportation, having transported over 200,000 wind loads.

Location/Logistics: Headquartered in St. Cloud, MN and providing transportation services throughout North America.

www.atsinc.com



Yard Expansion & Rail Connectivity Underway at Port of Corpus Christi

The Port's new Rincon West Yard provides 25 acres of open space, with expansion and rail connectivity underway. Port of Corpus Christi provides more advantages for the transport of wind energy components such as rail loading and truck transfer, a 47' deep channel, and three Class 1 railroads.



PORT CORPUS CHRISTI®

portofcc.com

Maggie Iglesias-Turner 361-885-6156 maggie@pocca.com

SOLAR POWER INTERNATIONAL

September 24th-27th, 2018
Anaheim Convention Center — Anaheim, CA

Solar Power International (SPI) is powered by the Solar Energy Industries Association (SEIA) and Solar Electric Power Association (SEPA). SPI has been designed to serve and advance the solar energy industry by offering an annual forum to learn, explore, and bridge related products, knowledge, and opportunities. Bringing together more than 18,000 professionals in the field, this event focuses solely on creating an environment that fosters the exchange of ideas, information, and expertise for furthering solar energy developments.

www.solarpowerinternational.com

show in print

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



Heavy-duty, long-lasting batteries

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

Booth 3722



Solar wire management clip

Nine Fasteners highlights their newest solar wire management clip; NFI-1701 at SPI this year. The NFI-1701 was designed in conjunction with Enphase Energy for use with IQ series of microinverters. This clip is a rail mounted solution capable of securing one or two IQ cables to the rail. It is also capable of holding one or two standard gauge PV wires. The clip, as with Nine's entire product line, is manufactured right here in the U.S. Constructed out of .025" thick 301 1/2 hard stainless steel material and incorporating a rolled outer edge for maximum wire safety. The NFI-1701 is UL Listed for use within solar installations.

Nine Fasteners

www.ninefasteners.com

Booth 1954



Efficient solar inverter and energy storage solutions

Delta Electronics residential energy storage turnkey system, Delta E series, supports DC-coupled and AC-coupled battery systems for pure, or PV-combined storage systems. The Delta E series has built-in EMS and supports self-consumption, zero export, TOU, and off-grid modes with available back-up mode and dark start operation. With smart cloud technology, E series inverters support remote firmware upgrade, parameter modification, and one button RMA service and can also support Wi-Fi/Ethernet, cellular communication, and Bluetooth.

Delta Electronics (Americas) Ltd.

www.delta-americas.com

Booth 3420



Durable, safe, and long lasting energy storage systems

The Energport line of commercial and industrial energy storage systems is a portfolio of fully integrated, turnkey solutions to meet a wide variety of customer needs. Leveraging lithium iron phosphate batteries utilized in hundreds of thousands of electric vehicles, Energport's solution has high degrees of safety and reliability. An integrated inverter and energy management system provide for plug & play functionality, removing implementation burden, and reducing installation costs. Energport systems are available for immediate delivery, with financing options available as well.

Energport Energy Storage Systems

www.energport.com

Booth 4243

American Earth Anchors
The best screw you will have in the dirt™
46" Penetrator™
Field-tested to 9,000 lbs downward pressure
REPLACES CONCRETE FOOTINGS
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• No forms • No waiting
EASY LEVELING Screw down, screw up
2" Schedule 40 pipe fits over
Custom brackets for any pipe size
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Transformers & Reactors
for Solar applications
HPS has developed a reputation as one of the most capable manufacturers of standard and custom dry-type magnetics in the world. With multiple manufacturing facilities located throughout North America, Europe and Asia, HPS offers a broad range of products for many solar applications.
Our extensive and durable line of VPI and Cast Resin transformers and reactors provide you with a complete magnetic solution for all your solar energy needs.
www.hammondpowersolutions.com **HPS** Hammond Power Solutions

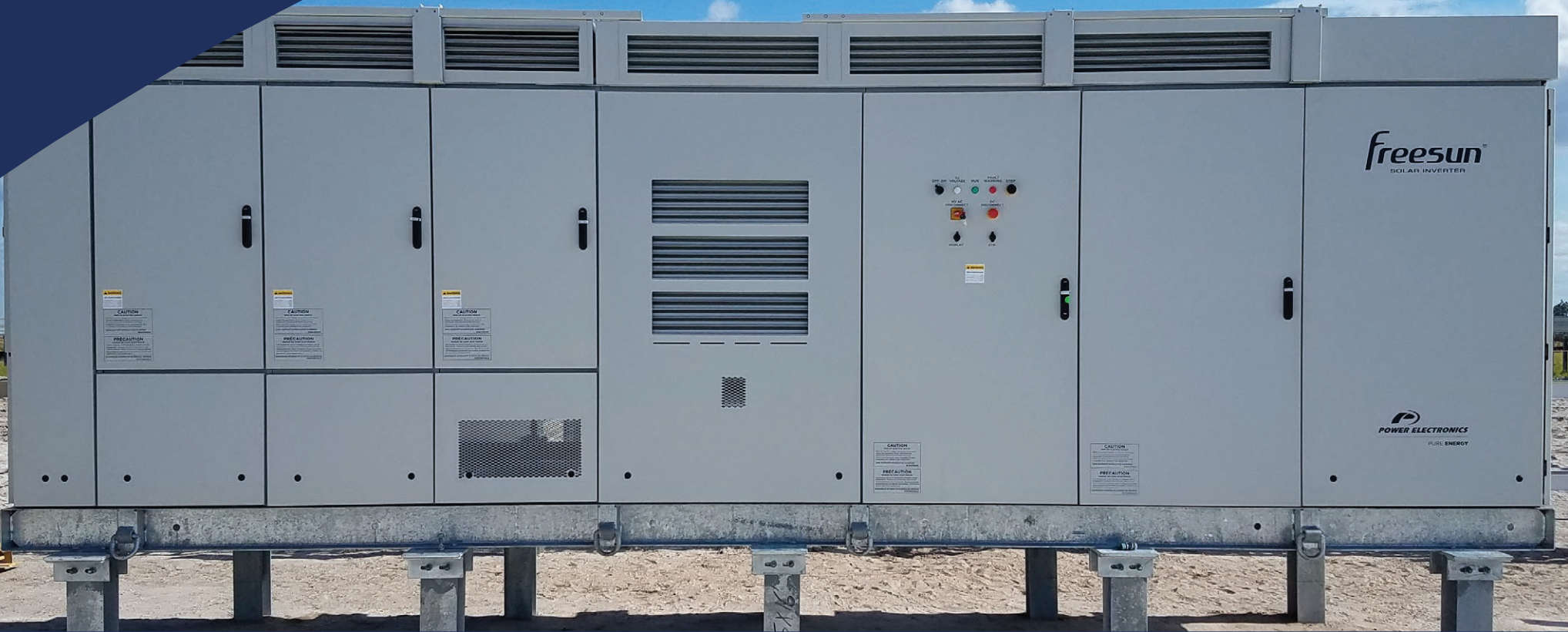


Advanced nano-carbon deep cycle battery

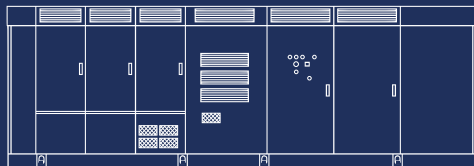
GS Battery newly developed their "SLR" Advanced Deep cycle VRLA battery with Nano-Carbon technology. It is designed for the high cycle life requirement of energy storage systems and manufactured in Japan according to rigorous Japanese quality control standards in order to deliver high performance and long service life. SLR500-2 was released on July 2018 and is designed for PV use. 2V, 500Ah/10hr, 5000 cycle@DOD70%, PSOC, 10-year limited warranty.





GS Battery | www.gsbattery.com

Booth 3828



HEM MEDIUM VOLTAGE INVERTER



-  **TURNKEY SOLUTION**
2.0 to 3.5 MVA, UL1741SA Certified MV Inverter
Integrated MV Transformer and Protection
-  **ROBUST DESIGN**
State of the Art Cyclone Air-Cooled System
NEMA-3R Protection without Filters
-  **MODULAR STRING CONCEPT**
Field Replaceable Power Modules
No Special Training for Module Replacement
-  **PROJECT AND GRID SUPPORT**
Configurable Grid Management Features
35kVA/480V + 5kVA/120V Aux. Power

FD0500 DC/DC CONVERTER



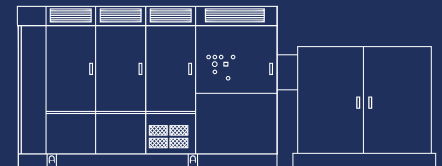
-  **DC COUPLED SOLUTION**
DC/DC Converter With BMS
Simplified Coupling and Controls
-  **Plug & Play DESIGN**
500kW to 3,000kW Output Power
Easy Integration with 3rd Party Equipment
-  **CLIPPING RECOVERY**
Maximizing Plant Revenue Potential
Operation with High DC/AC Ratios



BESS BATTERY MANAGEMENT SYSTEM

-  **RENEWABLE INTEGRATION**
Li-Ion Topology Based Containerized Solution
Up to 6.0MWh per Container

HEMK | PCSK SOLAR AND ENERGY STORAGE



-  **AC COUPLED SOLUTION**
Bi-directional Inverter with BMS
2.0 to 3.5MVA Design Options
-  **FOUR QUADRANT OPERATION**
0.5 Leading to 0.5 Lagging PF Support
P/Q On-Demand
-  **GRID STABILIZATION**
Load Leveling | Peak Shaving
Frequency Response



Pre-engineered solar support systems

Baja Carports established its trademark brand in 1981 and are now providing installations throughout the US, Mexico, and Canada. Baja's solar support systems are pre-fabricated, pre-engineered, and pre-galvanized. All structures can be painted on-site. Designed and engineered in-house to optimize kWh production with maximum coverage. Baja's carport components are delivered and assembled on-site by Baja construction crews; with the intention for no field engineering or welding. Each component is designed to be a direct attachment from modules to purlins, no additional racking or decking required. The result minimizes labor cost and reduces installation schedules. The solar advantage is Baja's in-house design and engineering services. Baja customers include Solar Integrators, Project Developers, State & Local Government, Multi-Family & Affordable Housing, Hospitals & Medical Centers, Schools & Colleges, Agriculture, Manufacturers, Transportation, and Fortune 500 Companies.

Baja Carports | www.bajacarports.com
Booth 2456 & 6011



Quick and simple solar racking solution

Sollega announces the introduction of their new universal slide on clamp. Designed to fit all framed modules, the slide on clamp ships on the FastRack 510 allowing quick and simple installation. Installation consists of positioning the module on the mounted clamps, pulling the clamp until it seats on the flange, and tightening the nut down. The no assembly FR510 is now even fewer parts, speeding up commercial flat roof installs.

Sollega, Inc. | www.sollega.com
Booth 2787



Medium voltage inverter solution

Ingeteam's Medium Voltage Inverter Station is a compact, customizable, and versatile plug & play solution that can be configured to suit each customer's requirements. This medium voltage solution integrates all the devices required for a multi-megawatt system, customized up to 5.4MVA. With high adaptability and power density of 5.2W/in³, not only does Ingeteam's Inverter Station offer low CAPEX, but also low OPEX, thanks to its long-lasting design, ease of access and serviceability, and maximum protection. The high-performance design uses electronic conversion topologies capable of achieving efficiency values of up to 98.9%. Its dual channel air cooling system makes it possible to increase the ambient operating temperature for maximum enhanced functionality, thus maximizing return on investment. The INGECON SUN PowerMax B Series is certified in compliance with UL 1741 SA and pairs well with INGECON SUN STORAGE PowerMax three-phase bidirectional battery inverters.

Ingeteam | www.ingeteam.com
Booth 2650

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Utility-scale DC-to-DC converter

With over 425MW of energy storage deployed worldwide, Dynapower offers 250kW and 375kW DC-DC converters as well as fully-integrated DC and AC-coupled energy storage systems for commercial and utility-scale solar plus storage. Up to 8 DC converters can be paralleled together. Dynapower's DPS-250 is the first commercially deployed DC-DC converter for utility-scale solar plus storage. Dynapower's DC-DC converters increase project economics and energy production for utility-scale solar plus storage installations.

Dynapower | www.dynapower.com
Booth 4145



Innovative Solar Systems

SPI Booth # 3938

WWW.INNOVATIVESOLARSYSTEMSLLC.COM



Innovative Solar Systems 34
50 MW AC

U.S. Developer

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- 3 Investment opportunities ranging from \$50MM - \$25B

IRR's Estimate at

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The Company

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Contact Patrick King

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Large diameter microflashing

SolarRoofHook debuts the expanded product line for their QuickBOLT with Microflashing (Patent # 8448407). Their new 4" Microflashing has a larger diameter than the original 3" design, giving it more coverage and allowing installers to cover extra holes in the installation area if they miss the rafter. They have also added the Quick Ratchet Conduit Clamp to the QuickBOLT line. Designed to be used with any of their QuickBOLT Mounting Kits, the new Conduit Clamp attaches directly to the QuickBOLT and provides a simple and affordable way for installers to run conduit on a roof. They have also upgraded their aluminum flashing to the new Galva Flashing for Curved and Flat Tile roof mounts. Galva Flashing is a durable, rust-resistant, and affordable way to flash tile installations.

SolarRoofHook | www.solarroofhook.com
Booth 286



Innovative racking designs

SolaRack, Inc is rolling out a whole new product line, which includes rails, mid clamps, end clamps, and more. These new products have been thoughtfully designed to not only keep costs low and effective, but also to be streamlined with other products currently in the racking industry.

SolaRack, Inc. | www.solarackusa.com
Booth 1238



Energy efficient, low voltage floor heating

Electro Plastics is the manufacturer of STEP Warmfloor, a low-voltage heater based on self-regulating PTC Nano Polycarbon technology. Because the heating element is self-regulating and acts as a floor sensor, it cannot overheat; as the material warms up, it consumes less electricity. The system is very energy efficient, operates on extra-low voltage, AC or DC, and can be connected directly to renewable energy, like solar or wind. Maintaining an even low temperature is more efficient than an on/off system and requires less solar panels, which makes this a solution for Net Zero Energy buildings. The installation is simple, and the thin and flat heaters can go under most flooring. Used for primary heating and floor warming; it is also available for snowmelt and roof deicing. All products are manufactured in USA with sustainable, non-hazardous and recyclable materials.

Electro Plastics, Inc.
www.warmfloor.com
Booth 3672

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Environmental management

Ecology and Environment, Inc. (E & E) provides a suite of environmental services for the full life cycle of solar projects, from feasibility studies, project siting, and permitting, through pre-construction compliance, environmental monitoring, and operational auditing. E & E recognizes that renewable energy development is as much about building relationships as it is about building infrastructure. Their collaborative approach results in a level of trust with regulatory agencies and the public that provides added credibility during a project's critical early development stages. This approach helps to successfully negotiate realistic permit conditions and mitigation measures, prevents costly delays in the construction and monitoring stages, and helps clients adhere to aggressive schedules that meet critical in-service dates.

Ecology & Environment, Inc.
www.ene.com/markets/solar
Booth 880

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- Integrated grounding

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True deep-cycle AGM batteries

Trojan Battery will showcase the new SAGM 12 105, a Group 31 size battery recently added to Trojan's Solar AGM line. The Solar AGM line of maintenance-free, true deep-cycle absorbent glass mat (AGM) batteries offer a three-year warranty for stationary applications and are tested to an eight-year design life under IEC 61427 standard for solar batteries. The Trojan SAGM 12 105 is manufactured in the U.S. and is now available. It features a non-spillable design enabling installers to customize the use and position of the batteries in customer applications. The Trojan AGM Solar line was designed for maximum sustained performance and increased total energy output to meet demanding deep-cycling requirements in Trojan's wide range of market applications, including solar home, microgrid, inverter backup, and commercial.

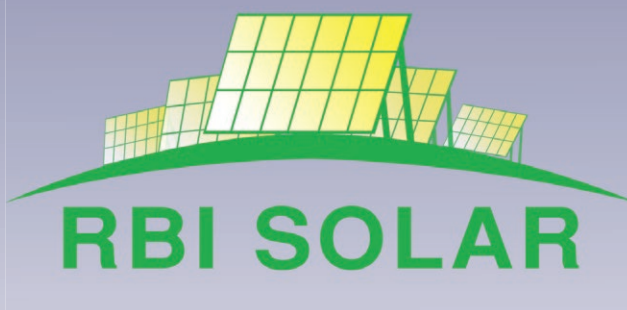
Trojan Battery Company
www.trojanbattery.com
Booth 3344



Reliable PV connectors

Stäubli Electrical Connectors, Inc.'s MC4 connector system is rated up to 1500V UL, 1500V TÜV safety class 0, and is available for 14 through 8 AWG cable configurations. Also available is their in-line fuse PV-K/ILF connector for very low energy loss and heat generation featuring a robust IP68 enclosure. Stäubli Electrical Connectors, Inc. offer custom solutions tailored to their customers' needs.

Stäubli Electrical Connectors, Inc. | www.staubli-alternative-energies.com
Booth 2814



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BOOTH #1220

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Solar clips and wire management

Heyco's SunRunner 4-2 and SunRunner 4-2U take the guesswork out of identifying the correct wire management solution for installers. Both clips work with either SolarEdge cable or Enphase Q cable and mount onto a variety of racking solutions. The SunRunner 4-2 mounts onto Everest, SnapNRack, and other similar racking profiles whereas the SunRunner 4-2U mounts onto Unirac, Ironridge, and other similar racking profiles. Both clips feature a unique retention tab which prevents side-to-side slipping of the cables once installed. Heyco also offers a number of clips that mount directly onto the PV module frame to meet a variety of installers' preferences.

Heyco | www.heyco.com
Booth 2891



Single piece solar mounting system

Introducing the new Patent-Pending PowerMount-7545S to be used with virtually any R-Panel Roof System. The single piece design simplifies installation and reduces cost. Use the PowerMount-S with any manufacturer's L-Foot or Solar Connections' Universal L-Foot to attach any rail system. Go railless and use the Solar Connection Kit with Patent-Pending GroundBonding Technology. The SCI Kit is UL 1703 and UL 2703 listed and approved.

Solar Connections International | www.solarconnections.com
Booth 452



Solar ground-mount earth anchors

American Earth Anchors manufactures earth anchors for commercial, military, and residential markets and are used across a variety of industries to secure and stabilize everything from tents, sheds, retaining walls, portable shelters, erosion control matting, and most recently ground mount solar arrays. Their PE46-Hex8 Penetrators have been field tested to 9000lbs of downward pressure and up to 14,000lbs of pullout strength, and was designed to fit a 2" schedule 40 pipe making it an option for solar panel ground mount racking. The Hex8 can save time and money by replacing concrete footings providing the advantage of no digging, no forms, no pouring, no waiting, and easy leveling by screwing up or down. AEA can also make custom brackets for any pipe size.

American Earth Anchors
www.americanea.com
Booth 2796

SOLAR CLIPS



NFI-1701
 Brand New rail mounted clip for use with Enphase IQ microinverters

NFI-1306-V90

90° oriented clip intended to secure two USE-2 wires or a single PV wire to standard module frame.



DCS-1306
 Designed to secure two USE-2 wires or a single PV wire to standard module frame.

DCS-1307

Designed to secure two PV wires, up to .30" diameter, to module frame.



NFI-1307-V90
 90° oriented clip intended to secure one or two PV wires to standard module frame.

NFI-1463

Clip designed to secure a single Enphase trunk cable to module frame.



DCX-2452A
 Designed to secure two Enphase trunk cables on to most rail/racking systems.

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Watertight, UV-resistant polycarbonate enclosure

The ARCA 2424 is a seamless replacement for metal or fiberglass enclosures. Built to last, the ARCA 2424 is one tough box. UL listed and rated NEMA 4x and 6P the ARCA - JIC series are manufactured to the Joint Industrial Council size standards, providing a straightforward path to upgrading any current designs' housing to today's robust polycarbonate with the ARCA 2424. This watertight, UV-resistant polycarbonate enclosure series provides high impact and corrosion resistance; meaning it won't dent, rust, or rot. The ARCA 2424 is also wifi friendly when needing to go wireless.

Fibox | www.fiboxusa.com
Booth 2690



Integrated power conversion station

HEM-US Power Station is the latest addition to Power Electronics product family. HEM-US combines advantages of both String and Central Inverter Topologies, while providing a complete Power Conversion Station including internally connected DC Disconnection, Inverter, MV Transformer, MV Switchgear, and Aux. Power in a single cabinet. HEM-US is UL1741SA certified and designed to meet NEC2017 Requirements for both PV and ESS applications. 2.0MW to 3.5MW Inverter is built on field replaceable 6 power modules. Filterless air cooled design with dry type transformer provides savings in O&M, while rated output at medium voltage provides protection and a reduced system cost.

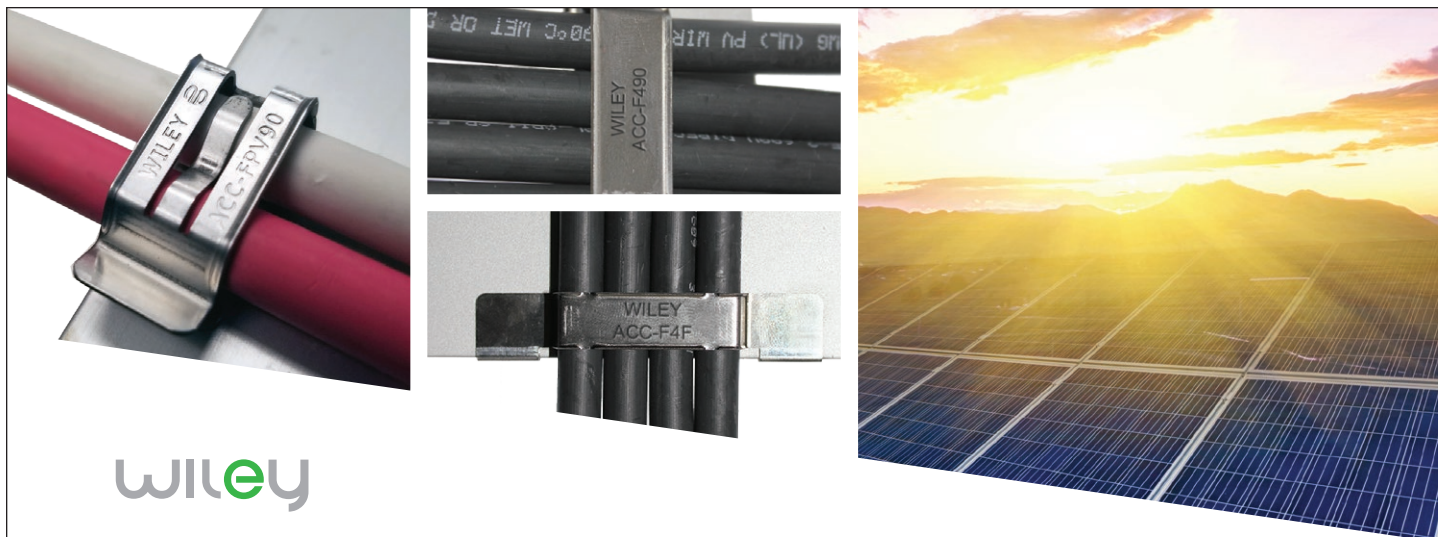
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Booth 2626



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U.S. Battery | www.usbattery.com
Booth 3232



WILEY

The Right Angle for Wire Management

Introducing three new additions to the Wiley 90 degree series for wire management. A perfect solution for keeping the PV installation neat, clean and free from ground faults. Easy to install and slides 90 degrees onto module frames of various thickness.

- Accommodates cables up to 8mm in diameter
- Compatible on modules/purlins with a flange thickness range of 1.0-3.5mm
- Considerable lead-in for installation without tools
- Snake tongue tabs securely anchor clips to module frames or purlins
- Corrosion resistant 304 stainless steel for durability in all environments
- Rolled edges protect cable insulation from damage

- RoHS Compliant
- UL1565 Listed
- Environmentally Tested – UL2703 & ATSMB117
- New Additions
 - ACC-FPV90 holds up to two PV wires
 - ACC-F490 holds up to four PV wires
 - ACC-F4F holds up to four PV wires and has two securement attachments which makes this clip a perfect solution for trackers and high vibration or wind scenarios



Ask your local BURNDY Sales Representative about the entire Wiley line of wire management products.



Ground mount solution

Polar Racking's PRU ground mount system includes a variety of foundation types and is best for the 200kW to 10MW ground mount market. Due to thicker gauges of material, the PRU uses 60% fewer connecting brackets and 50% fewer fasteners than industry standards. With less time needed for installation and lower labour costs, the PRU provides quality assurance and affordability hand in hand. The Polar Racking team supplies continuous product development, on-site technical support, and logistics coordination for on-time delivery. Polar maintains a four-week delivery time for complete foundation and racking orders.

Polar Racking
www.polarracking.com
Booth 814

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Safe and effective enclosure and equipment sealant

Polywater InstaGrout Sealant is a two-part urethane foam that seals out pad-mounted equipment openings to prevent outages and service disruptions. Safe and effective to use, InstaGrout will not collapse during change-outs and adheres to various pad-mounted materials. Keep snakes, rodents, and insects out of critical electrical equipment and increase electrical reliability.

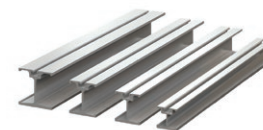
American Polywater Corporation | www.polywater.com
Booth 1790



Maintenance-free AGM batteries

Crown Battery's maintenance-free AGM batteries are designed from the ground up for renewable energy. Built using robotic assembly, the industry's heaviest plates, and more active materials, they deliver enhanced performance and lifespan. Crown1 batteries are optimized for energy storage in off-grid applications and for uninterrupted power supply for grid-connected users, offering a wide array of configuration options, improved temperature management, and more. To ensure quality, Crown1 batteries are manufactured at the company's Fremont, Ohio headquarters. The plant includes environmentally-friendly, roof-mounted solar and wind arrays, and every battery incorporates recycled lead and plastic to help protect the environment. Proprietary cast-on-strap systems allow for 100X the precision of manual welding -- for improved battery life, reliability, and performance. Heat-sealing equipment, automated testing, and vision systems streamline production and ensure maximum precision, uniformity, and power.

Crown Battery | www.crownbattery.com
Booth 3204



Commercial solar mounting system

Preformed Line Products' POWER RAIL commercial mounting system is engineered for long span and cantilever distances for rooftop or open-structure applications. Designed with the professional PV solar installer in mind, both the XD/UD and LD/MD rails feature single-tool assembly and a patented RAD Lock-in-Place bolt for fast and secure module clamping. The high-strength aluminum mounting rails also include an integral wiring channel that secures cables and provides a clean, professional appearance.

Preformed Line Products | www.preformed.com
Booth 1676



Innovative tracker design

FTC Solar's Voyager single-axis tracker features minimized steel content, simple installation requiring no special tools, and the SunMaster smart controller that manages each row on a site to maximize energy yield. The Voyager tracker is a single-row, self-powered system that includes 3 days of backup autonomy and is compatible with all module types. With its 2P configuration, optimized module rails and post heights, and integrated wire management to minimize shading, Voyager is a solution for bi-facial module performance.

FTC Solar, Inc. | www.ftcsolar.com
Booth 132



Versatile ground mount system

APA is a turnkey manufacturer and installer of versatile fixed tilt ground-mount racking. With a dual post design, foundations include shallow helical anchors or ground screws for utility-scale to residential projects. APA's Geoballast is a concrete-free system designed for installation speed. The Pre-Engineered Kit is a solution for residential and small-scale projects offering no concrete and a fast install. APA solutions allow versatility with soil issues, including soft soils, high water tables, shallow bedrock, deep frost lines, rolling topography, and rocky terrain.

AP Alternatives
www.apalternatives.com
Booth 804



Solar cable management

CAB Solar Cable Management is a unique solution to cable management in large-scale projects. The system uses patented designs to carry all types of cables and includes multi-carrier hangers for DC feeders, string wiring, data/comm, and power. The new, patent-pending, CAB Integrated Grounding System uses a copper composite messenger wire to both provide cable management and act as the EGC and GEC for the system. The Cambria County Association for the Blind and Handicapped, located in Western PA, is the manufacturer of all CAB Products. These products provide employment and rehabilitation opportunities for persons with physical and intellectual disabilities.

CAB Solar | www.cabproducts.com
Booth 1854

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DC/DC power converter for photovoltaic applications

Phoenix Contact's new UNO Solar DC-to-DC power converter connects directly to a solar array. The UNO Solar converts high voltages from DC strings to 24VDC, eliminating the costs and hassle of trenching for combiner, re-combiner, and inverter control for anti-islanding applications. The UNO Solar accepts the 300 to 1000VDC input generated by the array and converts it to electrically isolated 24VDC/2.5A output voltage. For higher current applications, the UNO Solar can be wired in parallel with the use of a decoupling diode. The UNO Solar has a compact housing and high efficiency of more than 90%, so it can also be used in small control boxes. The LED monitoring simplifies startup. It is the power supply powered by the solar array, certified to UL 1741, facilitating the approval of the overall system.

Phoenix Contact
www.phoenixcontact.com/unosolar
Booth 1876



High performance pyranometer

With increased requirements of accuracy and reliability, the MS-80 pyranometer from EKO Instruments is a spectrally flat and sub second (<0.5 s) pyranometer. When combined with the MV-01 heated ventilator, the sensor is suitable to be deployed globally while meeting a "Class A" accuracy level for PV monitoring under IEC 61724-1. Each MS-80 has individual cosine and temperature response characterizations as part of the standard accredited ISO 17025 calibration procedure.

EKO Instruments USA, Inc.
www.eko-usa.com
Booth 2790



Diaphragms for module laminators

Smartech International will display Steinbach's silicone diaphragm materials. Steinbach diaphragms have a reputation for quality and consistency. Their EVA-resistant Lamibrans Diaphragm and three different types of solid silicone are made in Germany in widths up to 3200mm as well as a variety of thicknesses and surface treatments, all backed by Smartech's made-in-USA service.

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/ **Fronius Symo Shade Cover** - Ensure maximum lifetime while keeping the inverter's temperature low and performance high. With rooftop inverter placement eliminate the need for Rapid Shutdown hardware, minimizing system design.

/ Learn more at www.fronius.us/pv Contact us at (219) 734-5500 or pv-sales-usa@fronius.com



Solar project developer

ISS develops utility-scale solar farm projects located in over 30 states, with an existing pipeline of 15GW. All ISS projects are between 20 and 200MW in size. ISS has sold over 2.5GW of projects and adds 3 or 4GW of projects to their pipeline annually. ISS is a fully customized developer services provider matching their offerings to the needs of the investor. Depending upon the entry and exit timing for the investor, returns can be achieved up to 500%. ISS will deliver projects to investors at any stage from mid-development to COD.

Innovative Solar Systems, LLC (ISS) | www.innovativesolarsystemsllc.com
Booth 3938



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OMCO Solar | www.omcosolar.com
Booth 126



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Fully integrated utility-scale inverters

Solar Ware Samurai Series utility-scale inverters offers power classes from 2500kW to 3360kW at 1500Vdc. The inverters offer reliability; with over 3GW installed base in North America, their fleet availability is 98.7%. Manufactured in Houston, TX, the series offers grid support functionality across all U.S. grid systems. A wide MPPT range allows operation in any environment, and a fully-integrated skid solution simplifies installation. The Solar Ware Samurai Series inverters are outdoor NEMA 3R/4R rated and conform to all standards: UL1741, UL1741-SA, IEEE 1547, IEEE1547.1, Canada CSA 22.2 107.1. TMEIC also provides advanced grid integration, a bi-directional Energy Storage PCS, and PV monitoring solutions.

TMEIC | www.tmeic.com
Booth 1112

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Booth #1358

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Strong, universal commercial mounting anchor

OMG Roofing Products has introduced PowerGrip Universal for mounting solar racking systems on all commercial roofs. PowerGrip Universal is designed to reduce or eliminate ballast, so there's less weight, material handling, and labor on the roof. PowerGrip Universal is designed with performance in mind, offering 3300 lbf. of tensile strength, 2500 lbf. of shear strength, and 2000 lbf. of compressive strength. Made of heavy-duty cast aluminum, PowerGrip Universal is easy to install, saving time and labor. The system transfers the load to the structural roof deck, and does not require any membrane welding.

OMG Roofing Products
www.outofthestoneage.com
Booth 1972



Reliable and robust fasteners

Huck fasteners have been engineered to provide quick installation speed and vibration resistance, making them a joining system solution for a wide range of solar applications. These fasteners are engineered to be installed in 1 to 2 seconds and battery powered tooling adds even more flexibility to installations. In addition, self-grounding Huck fasteners are now being used to replace conventional multi-part, grounding assemblies, saving both inventory and labor cost. Huck fasteners also have the strength to support the connection of the solar panels to their frames, providing a level vibration resistance that allows them to withstand winds exceeding 100 mph. Finally, these fasteners are designed to be tamper proof, providing an additional measure of security for valuable PV panels.

Arconic | www.afshuck.net/solar
Booth 2390



3MW electrolyzer stack

Hydrogenics' 3MW electrolyzer stack is a power-dense stack, capable of producing enough hydrogen to fuel over 300 fuel cell electric vehicles every day. Its' compact design enables easy scale up for multi-MW plants, delivering reduced plant size, and costs while improving deployment flexibility for energy storage and grid balancing services.

Hydrogenics | www.hydrogenics.com
Booth 4356



Calibrating to a higher standard

Solar Radiometer Calibration Services

ISO-CAL provides fast, reliable, ISO/IEC 17025 and ANSI/NCSL Z540 accredited solar radiometer calibration services: WRR, WISG and/or NIST traceable.

Equipped to calibrate any pyranometer or pyr heliometer model type, ISO-CAL offers both indoor and outdoor Primary or Secondary reference calibration services in accordance with all ISO and ASTM calibration standards.

Supported sensor types:

- ✓ Pyranometers
- ✓ Net Radiometers
- ✓ Pyr heliometers
- ✓ PAR Sensors
- ✓ Pyrgeometers
- ✓ LUX Sensors
- ✓ UV Sensors
- ✓ Spectroradiometers



480-336-8133

info@isocalnorthamerica.com
www.isocalnorthamerica.com

SR30 | Digital Secondary Standard Pyranometer

Join the evolution...



ev·o·lu·tion
/ ,evə'looSH(ə)n/

noun

The gradual development of something, especially from a simple to a more complex form.

When it comes to superior performance, even Darwin would agree the latest SR30 pyranometer from Hukseflux is the natural selection.

SR30 pyranometer employs an internal, low power, maintenance-free ventilation system with heating, rendering larger higher power/ high-maintenance external ventilators obsolete. The SR30 is locally supported in the U.S. and backed by a 5-year warranty.

- Superior measurement accuracy
- Highest data availability
- Low cost of ownership
- Most value added features standard
- Performance validated (test data included)
- Compliant with latest ASTM & IEC standards



Low-power internal ventilation with heating via digital control over RS485 / Modbus (patent pending)

Internal ventilation port
Easy-view bubble level

HuksefluxUSATM

631-251-6963

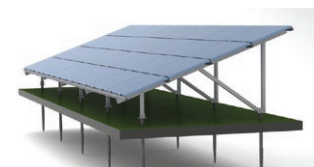
info@HuksefluxUSA.com | www.Hukseflux.com



Integrated PV solution for harsh conditions

GP JOULE is a global renewable energy company developing, engineering, constructing, operating, and financing commercial and utility-scale renewable projects. Globally, GP JOULE has installed over 550MWs of PV projects and manages 600MWs of assets across Europe and North America. Their full range of PV products and services is focused on delivering low installed cost in tough environments. Combining turnkey EPC expertise with its proprietary PHLEGON single axis tracker, GP JOULE offers a bankable solution with engineering, installation, and commissioning services. Designed specifically for harsh climates and challenging sites, the PHLEGON tracker uses heavy-duty linear actuators that intelligently integrate German-engineered control systems. This technology contends with heavy snow and high winds to ensure production 365 days a year. Cost-effective PHLEGON utilizes up to 50% fewer piles, has a low fastener count, and offers easy ground maintenance access.

GP JOULE | www.gp-joule.com
Booth 2284



Foundations for a variety of applications

American Ground Screw provides a foundation system which minimizes the hassle, expense, and environmental impact of foundation work. With their ground screw products and easy-to-use tools, structural, load-ready foundations can be installed in just a few minutes. Simply mark the location, drive the screw, and start building, with no digging, re-grading, removing soil, or waiting to pour and then cure concrete, which ultimately reduces the cost of labor and materials. American Ground Screw's solution is reusable and removable, virtually eliminating environmental damage to meet building needs and sustainability goals.

American Ground Screw
www.americangroundscrew.com
Booth 1886



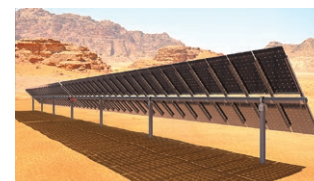
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Bifacial single-axis tracker

SF7 Bifacial collects energy on both the front and rear sides, capturing reflected irradiance from the ground surface under and around the tracker and from other modules. Depending on site conditions, bifacial yield-gain can reach +30%. SF7 standard features provide for drop-in bifacial compatibility with high mounting height, shadow-free backside, and wide-aisle reflecting surfaces. In addition to intrinsically optimizing bifacial gain, the standard features enable other economic and performance benefits including the elimination of torque-tube shading. Soltec trackers count with a high and dry location of the motor, electronics, and cabling, and result in few piles-per-MW. The cabling management solution DC Harness StringRunner and the absence of dampers not only eliminate bifacial backside shading but also provide high-grade cabling protection against environmental conditions, requiring zero maintenance.

Soltec | www.soltec.com
Booth 1450

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When you're going off-grid you become the power plant.

And when you need a battery to provide your power needs, depend on the best: **Crown Battery**. Thick energy-dense plates. Heavy-duty construction. More active lead materials. Proven low-maintenance performance. It all adds up to one **World Class Battery. Crown.**

CONTACT US FOR DETAILS: +1.419.334.7181 / commercial@crownbattery.com / www.crownbattery.com



Low cost ground mount system

Nuance Energy's patent-pending Osprey PowerPlatform ground mount system employs a unique earth anchor and modular design to achieve peak profitability through low installation costs for ground mounted systems.

Nuance Energy | www.nuanceenergy.com
Booth 7420



Flexible, versatile tracker technology

The DuraTrack HZ v3 offers revolutionary features, including a single-bolt per module clamp and flexibly linked architecture. The single-axis tracker delivers a variety of efficiencies allowing for quick installation, zero scheduled maintenance, and quick uptime to deliver the best levelized cost of electricity (LCOE).

Array Technologies, Inc. | arraytechinc.com
Booth 1104



Non-penetrating roof mount

EkonoRack 2.0 is a simple, non-penetrating solar mounting solution for commercial flat rooftops. The system's ETL Certification attests to its high standard of safety and robust design, allowing it to be grounded with only one grounding lug per array. EkonoRack 2.0's innovative design is composed of only one major component, acting as a ballast tray windshield mount and multiple panel support. The system's pre-attached roof mats save time on installation and provide maximum protection for the roof.

KB Racking | www.kbracking.com
Booth 2270



Renewable energy fuses

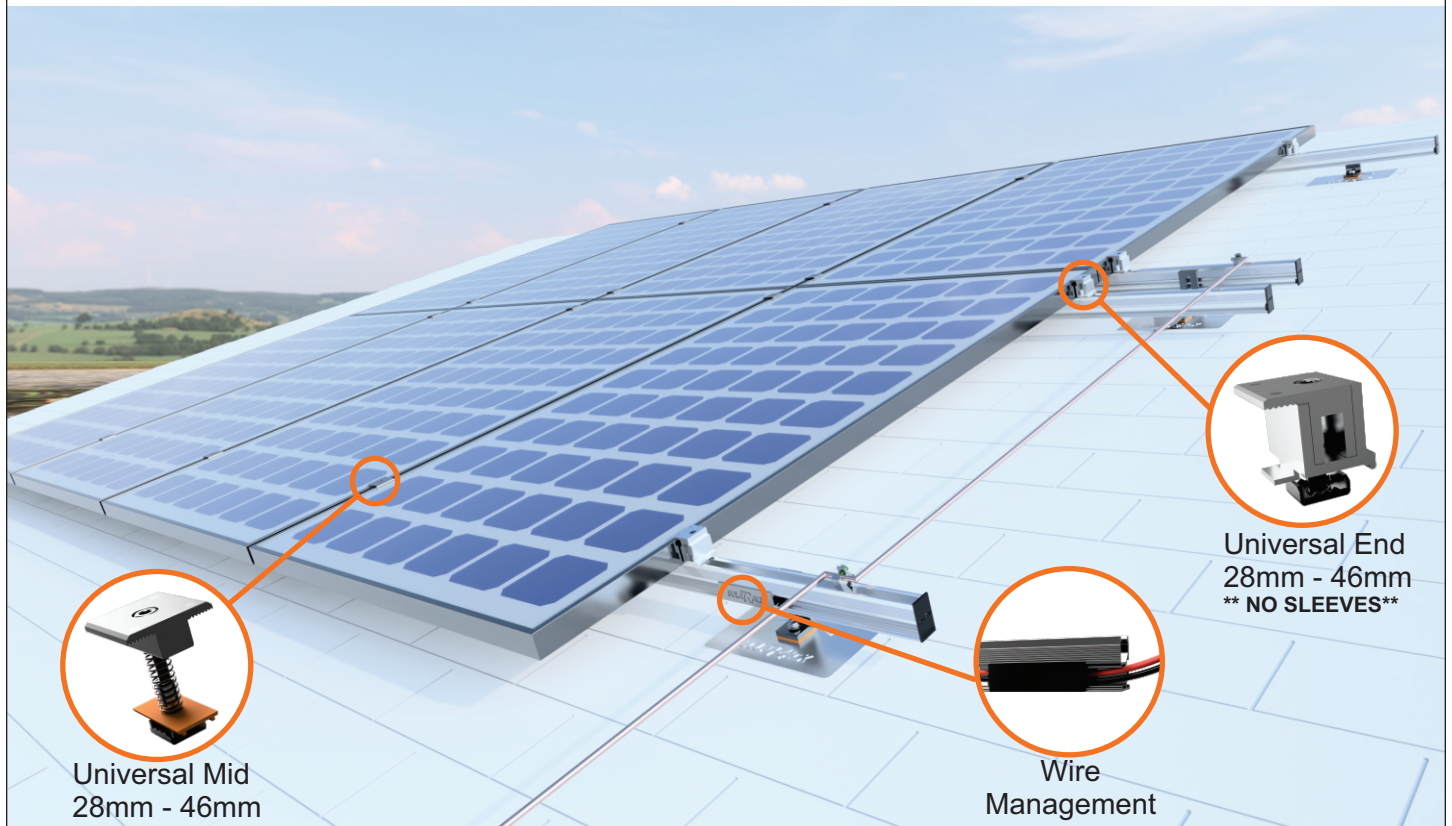
SIBA Fuses are available for protection of PV panels, sub-arrays, arrays, energy storage (ES) systems, inverters, filters, and transformers and switchgear tied to the grid. Fuses for DC side of the inverter are available in the voltage range from 400VDC through to 1500VDC and current ratings from 1A through to 2500A. Fuses developed for energy storage (ES) have high current breaking capacity and low L/R. On the AC side of the inverter SIBA is capable of meeting voltage applications up to 40.5kV with for bus protection, capacitor filters, PT transformers step-up transformers (SSK fuses specific for wind, solar, and energy storage application) and switchgear with medium/high voltage fuses.

SIBA FUSES | www.siba-fuses.us
Booth 1752

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JUST MAKES CENTS PER WATT

- Fully Anodized Products
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- Integrated Grounding
- Universal Mid & End Clamps
- Cost Effective



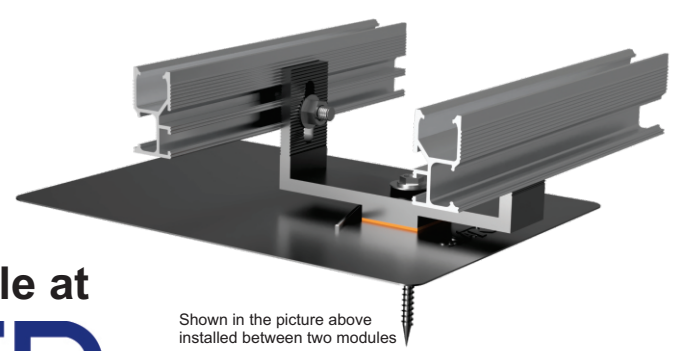
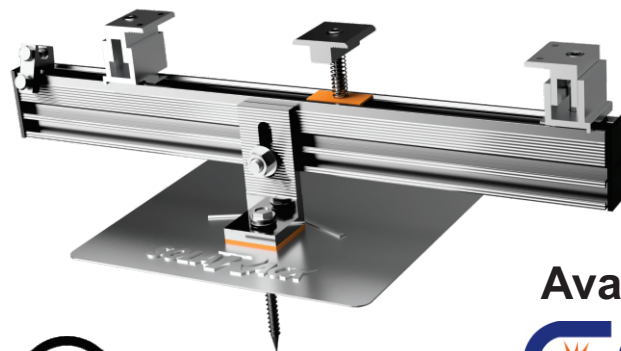
Universal Mid
28mm - 46mm

Universal End
28mm - 46mm
** NO SLEEVES**

Wire
Management

Our proprietary Racking Solutions are designed for the following roof applications:

Composition • Flat Tile • Curved Tile • Rolled Comp • Stone Coated Metal



Shown in the picture above
installed between two modules



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Energy storage solutions

Fullriver Battery's energy storage portfolio includes its flagship AGM lines, LiFePO4 storage solutions with high cycling capability, and their SunVault line of Lithium storage products. The newest member of the SV family is the SVL16. A drop-in replacement for any L16 format storage bank. With the SVL16 users can recharge faster, discharge deeper, and cycle longer.

Fullriver Battery USA | www.fullriverbattery.com
Booth 3930



Hybrid lead-acid battery

MK Battery's Deka Solar line includes sealed lead acid GEL and AGM batteries and select flooded products. The new UltraBattery is a hybrid device – a chemical combination of a lead-acid battery and an ultracapacitor, achieving higher-rate, partial-state-of-charge operation with extended longevity and high efficiency. Its unique chemistry not only increases power handling but vastly reduces hard sulfation, facilitating excellent longevity, and allowing it to run for long durations between refresh charges. The UltraBattery is a solution for low voltage home and commercial use, as well as high-voltage grid applications. It's extremely efficient; up to 90-95% of every unit of energy stored is available for re-use when used in partial-state-of-charge. Like all batteries in the lead-acid family, UltraBattery is fully sustainable with its closed loop recycling.

MK Battery - Deka Solar
www.mkbattery.com
Booth 3224



Power delivery engineering services

Electrical Consultants Inc. (ECI) was incorporated in 1985. For over 30 years, their in-house portfolio of services, including overhead and underground transmission engineering, substation and switchyard design, industrial power systems design, land survey and construction staking, right-of-way services, environmental planning, project management, construction management, and procurement services have provided a key resource for hundreds of utilities. ECI brings extensive experience in power delivery services through 500kV to their clients.

Electrical Consultants, Inc. (ECI)
www.electricalconsultantsinc.com
Booth 2778

HEYCO® Wire Management Solutions for Solar Installers & Integrators...

Heyco® Solar Products Warranty

Visit www.heyco.com for information about Heyco's **20 Year Limited Warranty** on our solar products.

Helios UVX Clip

The Helios UVX clip installs into a .260" (6,6 mm) mounting hole and holds up to 2 cables between .230-.315" (5,8-8,0 mm) each. Molded from our robust UVX nylon 6/6 with extended UV capabilities, for our Solar 20 Year Warranty.



Heyco®-Tite Cordgrips for Enphase Q Cable

Two new cordgrips now accommodate the Enphase Q Cable. The 1/2" version provides liquid tight entry for one Enphase Q Cable; .24x.38" (6,1x9,7 mm). The 3/4" version provides liquid tight entry for up to two Enphase Q Cables; .24x.38" (6,1x9,7 mm) and an additional .130" (3,3 mm) dia. hole for a #8 solid grounding cable.



Heyco® HEYClip™ SunRunner® 4-2 & 4-2U

SunRunner 4-2 & 4-2U clips are compatible with the Enphase Q cable. SunRunner 4-2 works with Everest, SnapNRack, Solar Mount & similar rack profiles. SunRunner 4-2U works with Unirac, Ironridge & similar rack profiles.



Heyco® HEYClip™ SunRunner®

Double-compression design holds from (1) 12 gauge USE-2 to (2) 8 AWG cables up to 8,3 mm OD.



Heyco® HEYClip™

SunRunner® 90, 90-2 & 90-4

Double-compression, right angle design for use with PV modules mounted in "landscape" mode.



Heyco® SunBundler®

Stainless Steel Wire Cable Ties

Aircraft grade 302/304 stainless wire w/UV protected vinyl jacket and stainless steel crimp sleeve, 8" (203 mm) to 20" (508 mm) lengths—Special lengths available upon request.



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Fully assembled energy meters in NEMA enclosure

The WattNode Meter Enclosure from Continental Control Systems is a UL 508A NEMA 4 enclosure for the WattNode meter. It is available with a three-phase circuit breaker, a fuse block, or no circuit protection. Any model of the WattNode; the revenue-grade meter or standard accuracy meter comes preinstalled when ordered with the enclosure. WattNode communication protocols include BACnet, Modbus, and LonWorks, or as pulse outputs, and are available fully assembled in one easy to install enclosure. Designed for indoor and outdoor installations, the enclosure complies to UL 508A Type 3R, 4, 12, and 13.

Continental Control Systems

www.ccontrols.com
Booth 3769



Modular solar carport system

Patriot Solar Group's solar carport system is comprised of minimal components and "slide-in" purlin assembly, which is a solution for commercial and utility-scale projects. Each system is prefabricated designed for quick installation; easy bolt together design requires no on-site alignment or welding. The modular design also allows for multiple configurations dependent on field layout necessary. Their standard universal mounting rails are designed to fit any commercially available photovoltaic panel. PSG carports can withstand the site's necessary wind (up to 125mph) and snow load (up to 40psf) conditions. Patriot's carports offer a robust solution for parking lots, top-level parking garages, and shading structures at a low price. Patriot also can supply all equipment, integration, installation, and EPC services.

Patriot Solar Group

www.patriotsolargroup.com
Booth 3747



End-to-end solutions for PV/CSP solar actuation

Parker Hannifin's advanced solutions include megawatt scale solar inverters and hydraulic motion systems for both PV and CSP, as well as engineered sealing solutions, thermal management solutions, and a complete line of fluid connectors. In addition, they offer established manufacturing and supply chain expertise and custom capability to support large projects like solar fields.

Parker Hannifin | www.parker.com
Booth 3174



Sealant free asphalt shingle flashing solution

With simple and easy installation, the EJOT flashing is designed to be used on three tab asphalt shingle roofs. With triple layer sealing, it provides watertight seals on top of the flashing, top of the shingle, and bottom of the shingle. The kit includes a flashing and an EJOT Solar Fastener JA3-SB-8.0 x 80/70 E22 for wood substructures. The fastener has a 5/16" lag screw on the bottom and can be used with L-feet or other Hanger Bolt Clamps to support the rails. For the installation preparation in the shingle and wood substructure use the EJOT Click&Drill Hole Saw.

EJOT Fastening Systems L.P.

www.ejot-usa.com

Booth 372

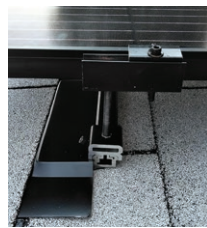


Mechanical pin adaptors

BURNDY is pleased to introduce a family of mechanical pin adaptors, which provide customers with an alternative means of terminating conductor into mechanical connectors typically found in switch gear, breakers, and other electrical equipment. The KAP / KAPO type connectors are a supplement to the AYP / AYPO aluminum compression adaptors. Consisting of three range taking sizes that accommodate a wire range from #6 to 750 kcmil, each size is offered in a center pin and off-centered pin design. Off-centered pins can be rotated to prevent interference when installing conductors side-by-side in limited space applications. Insulated covers are provided with each connector to prevent contact between it and uninsulated live parts of opposite polarity or grounded metal. The KAP / KAPO type mechanical pin adaptors are UL Listed for use with Flex (fine stranded) conductor.

BURNDY LLC | www.burndy.com

Booth 2278



Roof studless attachment

Spider-Rax was developed to give all of the benefits of a rail-less solar mounting system with the convenience of a railed system. This Spider-Rax solution is rail-less and studless with post install height adjustment. It comes fully assembled with only one part number to order. The comp mount fits all module frames with its patented mid clamp and provides 8" of east to west adjustment and 1.5" of vertical adjustment. The 5kW fits in an 8" x 8" x 18" box.

Spider-Rax | www.spiderrax.com

Booth 3917



Introducing the Gen 4 Solar Tracker



Gen 4 Key Advancements



Tracker Monitoring

Expanded communication options: Tracker is now WiFi, cellular and SD card enabled to check the power generation and mode status with ease.



Self Powered

The dual-axis tracker will keep following the sun, even when the grid is down: The tracker efficiently uses energy from the panels so it will always be in the correct mode.



Improved Accessibility

The inverter can now be mounted lower on the mast of the tracker, or separated from the structure. Making wiring and maintenance a breeze!



Maximized Net Metering

The most energy produced for AC watts installed. Maximize your net metering production and value.

Learn more at SPI booth #1471 or online at allearthrenewables.com/spi



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PV wire meeting safety standards

Service Wire's ServiceSolar brand of PV wire meets current UL 4703 requirements. ServiceSolar can be used in both grounded and ungrounded Solar arrays and is designed to withstand heat, cold, and moisture, meeting or exceeding both US and Canadian standards for safety. Service Wire manufactures and stocks ServiceSolar in 600/1kV XLP/USE-2 or RHH/RHW-2, and in 600V with EnviroPlus (LSZH) Jackets in all industry colors.

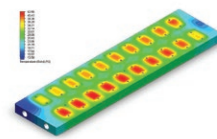
Service Wire | www.servicewire.com
Booth 894



Inversion technology with design flexibility

The Fronius SnapINverter line offers integrated Wi-Fi and SunSpec Modbus interfaces, NEMA 4X rating, wide voltage windows, multiple MPP trackers, and easy installation in 15 minutes or less. With the identical look and feel, the Fronius SnapINverters reduce cost for training and servicing. Power classes range from 1.5 to 24.0kW. Additionally, the unique O&M solution of the Fronius Solutions Provider program eliminates the need for inverter exchanges, providing a fast service solution.

Fronius | www.fronius-usa.com
Booth 1538



Liquid cooled cold plates for high performance heat transfer

Baknor designs a compact liquid cold plate which provides up to 5kw of heat dissipation in a modular format. With a reduction of 23% in size, 20% in weight, and 18% in cost, battery pack efficiency and life cycle is increased. When faced with high watt densities and air-cooled heat sinks are inadequate, liquid-cooled cold plates offer a high-performance heat transfer solution alternative. Baknor has developed various solutions to improve performance essential for effective operation in all climates. Their knowledge of cooling systems weighs various tradeoffs and factors such as functionality, volume, mass, cost, packaging, manufacturability, efficiency, and the reliability and safety of heat dissipation components. This includes power electronics and battery packs as an integrated or modular system. Products and designs include: Heat Sinks, Liquid Cold Plates, Phase Change Cooling, Forced Convection, and Graphene Film Heat Sinks.

Baknor | www.baknor.com
Booth 4016



Hydrogen solutions for energy storage

Dedicated to delivering solutions for producing, storing, and distributing hydrogen worldwide, Nel Hydrogen has provided more than 3,500 reliable, cost efficient Alkaline and Proton Exchange Membrane (PEM) water electrolyzers to the renewable energy, industrial, and transportation sectors. In the renewable energy market, they help utilities convert curtailed power to cash, balance the grid, and store excess energy. Their industrial scale electrolyzers provide high purity hydrogen for a host of manufacturing processes. In the transportation sector, Nel Hydrogen is a UL listed manufacturer of hydrogen fueling stations.

Nel Hydrogen | www.nelhydrogen.com
Booth 4369



Penetration seal system simplifies solar installations

Chem Link, formulator and manufacturer of high-performance adhesives, sealants, coatings, and related products for application throughout the building envelope, announces the new 5" E-Curb penetration seal system, the newest size offering in the full E-Curb line of products. This new size allows contractors flexibility to create a durable, waterproof rubber seal around penetrations and extends Chem Link's current E-Curb offering for both steep and low slope roofs. Designed to better fit contractor needs, light-weight E-Curbs feature interlocking "slip-fit technology," which allows for quick assembly and easy installation. E-Curbs are designed for use on granulated modified bitumen, asphalt and coal tar built-up roofing applications, as well as PVC, PIB, and TPO single-ply roofing membranes.

Chem Link | www.chemlink.com
Booth 2295



Online platform to buy and sell solar equipment

EnergyBin.com is a B2B, members-only online community and marketplace where solar providers gain access to competitively priced components, including panels, inverters, racking, and batteries. EnergyBin facilitates the brokering, movement, and commerce of new, excess, used, refurbished, and legacy solar equipment and provides critical supply-chain intelligence. As a U.S. Department of Energy SunShot Initiative awardee, EnergyBin has lowered residential and commercial project capital costs by 20-70% on equipment.

EnergyBin | www.energybin.com
Booth 2977

- **Worlds Most Efficient Hybrid Inverter**
- **Batteries are optional**
- **Engineered, Assembled, and Tested in USA**
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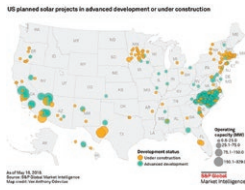
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www.spglobal.com/marketintelligence
Booth 7430



Integrating storage into solar installations

SimpliPhi's plug-and-play, all-in-one AccESS residential energy storage system streamlines equipment and costs by integrating power storage into new/existing on/off grid solar installations. AccESS combines SimpliPhi's cobalt-free, non-toxic LFP batteries with inverter charge controllers, power electronics, and system management in a NEMA 3R outdoor-rated box. Available with 14kWh of storage, AccESS can scale up for additional power output and capacity and be safely installed indoors or outside in temperatures from -4°F to 122°F with no risk of thermal runaway or fire. AccESS can be charged with solar, grid, or generator power and comes pre-wired and programmed.

SimpliPhi Power
www.simpliphipower.com
Booth 3220



Solar field wiring

The BLA (Big Lead Assembly) takes all the guesswork out of wiring a solar field. Using Shoals' latest in-line fuse and wire manufacturing technology, they offer a site free of DC string combiners. The entire load is combined into a single pair of aluminum conductors running from the string combiner to the inverter. There's no need to trench for DC feeders or hang string combiner boxes. And when terminated with the BAC connector, the whole array is plug-&-play. Plug in the panel strings, plug into the inverter, and just walk away.

Shoals Technologies Group | www.shoals.com
Booth 1304

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Solar Power International & Energy Storage International 2018
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YOUR RELIABLE OFF-GRID SOLUTION.

PREMIUM DEEP CYCLE FLOODED AND MAINTENANCE-FREE AGM & GEL

ROLLSBATTERY.COM





Asset optimization

EDF Renewables ensures ongoing profitability for solar project owners and investors by providing a full range of asset optimization services and expertise. These include: total project operations/balance of plant (BoP); asset management; warranty inspections; as well as engineering support and analysis. The company's Operations Technology Department provides a full suite of standard and advanced services, including 24/7 remote monitoring, project performance evaluation, NERC compliance services, SCADA support, and remote resets and technician dispatch.


EDF Renewables | www.edf-rs.com/ao
Booth 2438



Renewable energy consulting services

DNV GL is a global provider of independent renewables and energy advice. They work with investors, project developers, owners, and equipment manufacturers to help manage risk throughout the project life cycle to ensure the performance and safety of systems from residential solar rooftops to multi-megawatt power plants. DNV GL's services include: energy management and sustainability, grid integration, energy assessment; independent engineering; owner's engineering; technology reviews; pre-construction engineering, environmental, and permitting; asset management; solar grid integration; solar storage applications; certification testing; and PV module and inverter testing.

DNV GL | www.dnvgl.com/solar
Booth 1660




ENERGY STORAGE SYSTEMS

C&I 30kW/60kWh systems in stock

Starting at \$32,000

FEATURES:

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- CE/UL compliant



Energport


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Custom fabrication of steel, aluminum, and alloys

RPM Rollformed Metal Products is a Canadian owned and operated custom fabricator of steel, aluminum, and alloys. RPM has been supporting North American requirements with quality products and client support for 30 years. RPM's product offerings are focused on galvanized structural steel members for various structural applications. All materials are sourced from Canadian or US Steel Mills and adhere to strict traceability. RPM is ISO9001:2015 CERTIFIED. RPM's depth of experience in custom roll forming includes Solar Racking, Industrial Racking, Pallet Conveyors, Heavy Transport, and many other industries. With 3 Facilities located in Southern Ontario, RPM can assist clients with custom roll forming, coordinating to site shipment and assembly.


RPM Rollformed Metal Products
www.rpmroll.com
Booth 1293




BOOTH : 3446

C&I BES & Micro-grid


Driven By **Sinexcel**




Outdoor Capable




Easy to Configure




Multiple Battery String Tech



Flexible Power & Capacity




Non-Walk-in Maintained




Battery Type Compatibility

Energy storage & Micro-Grid solutions

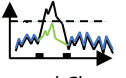
The semi-integrated BES system includes all local components except the EMS controller and Battery system. With standard MODBUS MESA compatible protocol, different kind of battery could be easily integrated and be used as a plug-&-play BESS.



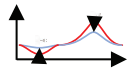
Up to 30kW + 60kWh
 A small foot print energy storage solution for Demand Charge Management, Back-up and PV Self Supply




Up to 150~500 kW + 2MWh
 A containerized energy storage solution for Demand Charge Management, Back-up, PV Self Supply and Micro- Grid



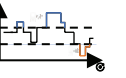
Demand Charge Management




Peak Shaving



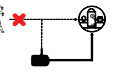
Frequency Regulation



Spot Market



Micro-Grid



Backup power

Sinexcel Inc.

<http://www.sinexcel.us>

henry@sinexcel.us



Ground mount, ballasted, roof mount, and canopy solutions

RBI Solar is a turn-key solar mounting solutions supplier for ground mount, ballasted landfills, roof mounts, and canopy/carport structures. As a single-source provider for commercial and utility-scale PV projects, all responsibility for the design, engineering, manufacturing, and installation of efficient PV racking systems is completed in-house by the RBI Solar Team. Committed to providing value from conception to completion, RBI Solar's customers receive a cost-effective and durable racking solution for each project site to aide in reducing the overall project costs.

RBI Solar | www.rbisolar.com
Booth 1220



Hybrid solar collectors and systems

SunDrum Solar is a supplier of hybrid (PVT) solar collectors and systems. Their collectors are designed to maximize the energy collection from a commercially available PV panel, with a simple attachment. By harnessing a PV panels' thermal energy they also cool the panel for increased electricity production. Their performance is demonstrated by holding the record for solar efficiency at 86% since 2013. Their patented technology, in addition to provide excellent heating solutions, commercial DHW, pool, space heating, also provides solar cooling. A recent system in Washington, DC is a 2017 AEE International award winner. The system provided 100% of the homes' space cooling and 92% of its total space, pool, and DHW heating needs. Since 2008, their systems have been used in a variety of commercial and residential applications, ranging from 2MW to a few kW.

SunDrum Solar
www.sundrumsolar.com
Booth 4140



Turnkey solar tracker

TDP 2.0 Solar Tracker offers solar design engineers a unique, high performance Solar FlexRack Tracker option, increasing their arsenal of solar mounting solutions to maximize their system's energy yield, whatever the site requirements. Designed with BalanceTrac technology for easy, safe installation and longevity, TDP 2.0 Tracker can be installed with 1000 or 1500V thin film or crystalline modules. With up to 90 modules per row, the ability to install shorter piles and low per-unit fixed costs for balance of system, TDP 2.0 reduces project installation costs.

Solar FlexRack | www.solarflexrack.com
Booth 1212

The Future of Versatility Never Looked Brighter

The Huck® Range Force™ Battery Tool

Introducing the next-generation of installation tools for dozens of different structural blind rivets and HuckBolts. A simple one-finger electronic control quickly adjusts and locks the pull force from 0 to 4500 lbs, delivering the precise force for the fastener you need. The 18V 5Ah battery-powered Huck® Range Force™ by Makita® promises you a bright future in portability, reliability and versatility.

See the Future of Versatility at SPI Booth #2390

afshuck.net/solar




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Touchless, hydraulic snow removal

Buffalo Turbine has been manufacturing turbine style blowers since 1945, which are made using high-precision machined components, resulting in long-lasting dependable products. These turbine units are being used worldwide in a variety of applications. The diverse product line provides its customers with the ability to choose a product that best suits their application and various budgets. The newest of all the applications is touchless snow removal with its stacked hydraulic unit that quick attaches to most skid steers.

Buffalo Turbine | www.buffaloturbine.com
Booth 3765



Corrosion resistant fasteners

A distributor of innovative solar hardware, Mudge Fasteners will be showcasing the DURA-CON Power Lag 2.0 at SPI 2018. The Power Lag 2.0 features a 2.5" thread length instead of the traditional 2" thread length of generic lag screws, resulting in a 25% higher pullout strength. Like all DURA-CON fasteners, the Power Lag 2.0 exhibits resistance to environmental corrosion equal to that of stainless steel fasteners when tested in aluminum solar panel racking, but is much more cost effective. DURA-CON Corrosion Resistant Fasteners are specifically tested for use in aluminum solar racking materials.


Mudge Fasteners | www.mudgefasteners.com
Booth 2283



Balance-of-systems


Hammond Power Solutions (HPS) offers a standard line of HPS Centurion R Reactors which provides a blend of performance and reliability while reducing the products footprint. HPS Centurion R can be used in a wide variety of power quality and solar applications. HPS can design custom solutions for applications requiring a reactor designed to handle different frequencies, or low losses, or even integrated into an assembly with a step-up distribution transformer.

Hammond Power Solutions
www.hammondpowersolutions.com
Booth 472



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 Booth Number: 2496

SunSource Energy, a proven solar design & engineering firm with global presence provides engineering services from preliminary proposal stage to detailed construction drawings. We are present in the United States, Philippines, Singapore, Vietnam, Africa and in India.

In the US, we have delivered 1GW+ of designs across Residential, Commercial & Industrial and Utility segments. We have also delivered design with PV+ Storage or Hybrid options.

Our key to success is our delivery model that we operate on, our turnaround time utilizing multiple time zones across our multiple offices and our relationships with various third parties that we work with, backed by the efficient professional team, all help us deliver effectively.

Please reach out to us for any technical help!



Deep cycle VRLA battery

Leoch's new LDC6-400-L16 (BCI GROUP 903) is a true deep cycle VRLA battery using advanced Absorbed Glass Mat (AGM) technology. The LDC Series incorporates primary lead grids alloyed with specific materials to achieve optimum performance in heavy-cycling renewable energy applications. Their proprietary paste formula and highly refined silica (gel) have been designed to extend the service life of the battery by improving charge acceptance leading to high energy efficiency. Leoch manufactures its own AGM separator. To ensure optimal performance, their high porosity AGM separators have been double wrapped to lower internal resistance and prevent acid stratification.

LEOCH BATTERY CORPORATION
www.leoch.us
Booth 3822



Rugged, industrial enclosures

The new Ensto PolyBox enclosures are rugged industrial polycarbonate enclosures with unique features, such as the integral nonmetallic latch and a corner elevator mounting system for adjustable hinged front kits and back panels. Their integral nonmetallic latch is a robust padlockable latch with only one moving part, providing durability and security. Ensto's corner elevator system uses a slotted shelf technology providing solid hinged front surfaces that are easy to install, align, and keep level. This system also allows for a back panel to be raised off the back of the enclosure.

Ensto USA, LLC | www.ensto.com/us
Booth 3666

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Parker advanced solutions include megawatt scale solar inverters and hydraulic motion systems for both PV and CSP, as well as engineered sealing solutions, thermal management solutions, and the most complete line of fluid connectors in the world. In addition, we offer established manufacturing and supply chain expertise and custom capability to support large projects like solar fields

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solutions.parker.com/SPI2018



Transformer solution provider

WEG Transformers USA, formerly CG Power Systems USA, provides transformer products, services, and integrated solutions serving the North American T&D, commercial & industrial, and renewable markets for more than 35 years from four North American manufacturing plants. Their product offerings include distribution, substation and power transformers, multi-winding (3, 4, or 6) step-up transformers for solar applications, shunt reactors, mobile substations, generator step-up, auto, voltage regulating, and arc furnace transformers. WEG Transformers USA has an installed base of more than 12,000 transformers (24MW) and provides consistent quality and on-time delivery.

WEG Transformers USA | www.weg.net
Booth 786



Fast installing standing seam solar clamps

AceClamp by PMC Industries, Inc. is a US-based manufacturer of snow retention and solar attachment clamps and systems. The AceClamp Solar Attachment Kit is precision engineered, providing fast installing standing seam solar clamps. As a rackless-type hold down, the AceClamp A2, along with the Solar Kit offers a low-cost alternative to secure PV panels to standing seam metal roofs (SSMRs). Plus, their patented, non-penetrating sliding-pin design helps preserve the panel warranty. The AceClamp can also be used with an L-Foot bracket design for the attachment of rail systems used in other types of PV installations.

AceClamp | www.aceclamp.com
Booth 2784



UL Listed wire, cable, and hose clamp

HellermannTyton's extreme-duty Ratchet P-Clamp has successfully passed validation tests at Underwriter's Laboratory and now carries the UL Listed designation. The unique adjustable wire, cable and hose clamp offers end users a one-of-a-kind solution to route and fasten in a broad range of applications. HellermannTyton offers the fastener with a standard zinc-plated steel base and an upgraded version with a stainless-steel base plate. All versions of the Ratchet P-Clamp withstand extreme weather and harsh chemicals. Their one-piece hinge allows the clamp to open without prying. The clamp closes with an interlocking ratchet-style mechanism to custom fit the bundle. Four product sizes accommodate any bundle from 1/4" to 2" in diameter. If removal of the bundle is ever required, the Ratchet P-Clamp can be opened by inserting a small, flat-blade screwdriver without disassembling the clamp from the work surface.

HellermannTyton
www.hellermann.tyton.com
Booth 2850



High power producing solar tracker systems

GameChange Solar's single axis Genius Tracker provides high power production and low O&M cost. Additional Owner offerings include the technologically advanced WeatherSmart and PowerBoost. Installers will benefit from advanced design innovations with SpeedClamp, QuikClamp, and pre-assembled components. GameChange Solar also offers fixed tilt pile driven, ballasted ground and roof solar racking.


GameChange Solar | www.gamechangesolar.com
Booth 1338

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Solar soiling monitoring system

Soiling measurements give PV plant operators the information they need to maximize power output and save money on cleaning costs. The new DustIQ sensor makes accurate, cost effective, and continuous soiling measurements and does not require manual cleaning or moving parts or liquids. The DustIQ monitors the loss of light transmission caused by dust on the PV panels using the novel Optical Soiling Measurement (OSM) technology. The soiling ratio data can be used to know when and where to clean, preventing unnecessary cleaning visits and helping schedule cleaning after sudden soiling events.

Kipp & Zonen | www.kippzonen.com/energy
Booth 420



High density racking system

Ecolibrium Solar will show advancements for EcoX pitched-roof and EcoFoot flat-roof racking solutions. For pitched roofs, new EcoX Universal Rail-Less Racking fits any module thickness from 32mm to 46mm using a single size for each core component. One racking SKU streamlines shipping and storing, and minimizes job site interruptions. Go from 1 job a day to 2 with 33% fewer penetrations and the elimination of awkward rails. For EcoFoot2+ 10-Degree and EcoFoot5D High Density Ballasted Racking, explore expanded applications and installation on lighter weight roofs enabled through optimized array design and optional Smart Attachment System. Universal Clamps for EcoX and EcoFoot fit any frame and every roof on agricultural, industrial, commercial, and residential buildings.

Ecolibrium Solar | www.ecolibriumsolar.com
Booth 2248

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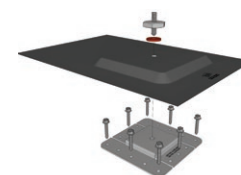
www.kineticsolar.com



Easy and efficient grass cutting in solar farms

The Perfect swing arm mowers RF series have been developed to make mowing between solar panels easier and more efficient whilst avoiding damage to the panels. The parallelogram headstock with manual, or hydraulic offset adjustment allows for a very large offset of the rotary mower. Because of its large offset possibility in combination with the swing arm, the RF models are a solution for mowing the grass between and underneath solar panels in solar farms or solar parks, and to cut grass under board fences, along wire or rock fences, and around fence posts.

Superb Horticulture
www.superbhorticulture.com
Booth 893



Solar mounting sheathing attachment

Zilla's patented Double Stud XL Flashing Assembly attaches directly to sheathing while also providing the option for structural members if necessary. Without having to locate structure, the Zilla Double Stud XL eliminates the need for installation prep work, standardizes design and installation processes, achieves greater speed and flexibility in the field, and makes it possible to complete more projects in less time at less cost. Zilla Double Stud XL is compatible with Zilla flush mount systems or any solar mounting system to help drive better bottom line results.

Zilla Corporation | www.zillarac.com
Booth 2964

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A cleaning system to generate maximum yield

Uncleaned solar systems exhibit yield losses between 15-35%, and heavy soiling can be expected on systems installed on agricultural buildings with livestock, industrial plants, and on roads with heavy traffic. These systems generate less electricity, and therefore less remuneration for feed-in. The Sola-Tecs Solar Cleaning System is now available to the U.S. market from ProSolarClean, LLC. Sola-Tecs brushes are light, mobile, effective, and suitable for all system types, from residential roof mounts to large commercial ground mounts.

ProSolarClean, LLC
www.prosolarclean.com
Booth 493



ISO-17025 accredited pyranometer calibration services

ISO-CAL North America LLC is a full service ISO-17025 accredited calibration laboratory, specialized in solar radiometer (sensor) calibration service. Based in Phoenix AZ, services include indoor and outdoor WRR traceable pyranometer and pyrhemometer calibration in accordance with the latest ASTM and ISO calibration standards. The ASTM G207-11 indoor secondary transfer calibration process employed by ISO-CAL North America replicates the OEM production calibration of the leading pyranometer manufacturers, assuring continuity in sensitivity scale from one calibration interval to the next. In addition to instrument sensitivity, each ISO-CAL North America calibration report states the expanded calibration uncertainty ($k = 2$) on the reported sensitivity result. Calibration turnaround times are 1 to 2 weeks typical. Expedited calibration services are also available on request. ISO-CAL North America supports numerous utility scale O&M services providers throughout the solar energy industry, while also tracking the calibration due dates for any sensors returned for routine calibration.

ISO-CAL North America, LLC
www.isocalnorthamerica.com
Booth 2391



Aerial intelligence to optimize energy production

Measure is an aerial intelligence company specialized in collecting, analyzing, and delivering information that transforms how solar owners and operators keep assets at peak performance. Through thousands of commercial drone flights, a specialized data engineering team, and a portfolio of inspection solutions, they deliver the benefits of drone technology to clients across the energy sector. Save time, reduce costs, and optimize energy production with turnkey drone services or an in-house drone program toolkit from Measure UAS.

Measure UAS, Inc. | www.measure.com
Booth 692

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Avoid main panel upgrades

QF Energy helps customers avoid main service panel upgrades with the B3 Bypass. The NEC 120% rule limits the amount of power production sources (PV, batteries, generators) that can be connected to a main panel. The B3 Bypass is a UL certified over current device that doesn't connect to the load center busbar, so the NEC 120% rule doesn't apply. The B3 Bypass allows the interconnection of PV, ESS, and EV chargers without the need to upgrade main service panels (load centers).

QF Energy | www.qfe002.com
Booth 3320



Commercial and industrial battery energy storage solutions

Sinexcel Inc., located in CA, US, provides various semi-integrated energy storage systems including storage inverters, outdoor cabinets/containers, distribution systems, and optional HVAC and fire extinguishing systems, but without EMS and Battery. The products are used for residential community, commercial, and industrial applications. The products are based on the ETL/CPUC/HECOgy listed PCS with a power range from 30kW to 500kW per unit. They have both grid-forming and grid-following features, and could be used for either storage-only or solar+storage hybrid applications. With a standard MODBUS MESA compatible protocol, different kinds of batteries could be easily integrated and be used as a plug-&-play BESS.

Sinexcel, Inc. | www.sinexcel.us
Booth 3446



All new ISO-9060 pyranometer lineup (Class-A, B, and C)

The latest feature packed line of pyranometers from Hukseflux delivers value and performance. Low-power internal ventilation, onboard dome heating, and real time tilt reporting are just a few of the value-added features offered standard depending on model type and ISO-9060 class. In addition to offering both analogue and digital sensor models, the latest pyranometer line from Hukseflux fully complies with the current IEC 61724-1 PV system performance monitoring standard, as well as the latest revision of the ISO-9060 pyranometer standard for Class-A, B, and C (formerly Secondary Standard, First Class, and Second Class). An affordable range of sensor mounts and leveling accessories are also available for each model type.

Hukseflux USA | www.hukseflux.com
Booth 2391

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Booth #493

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Booth #2787

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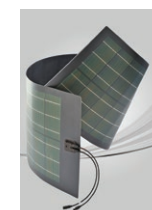
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Delivering tomorrow's energy transformation today

Rhombus Energy Solutions provides next generation energy management for electrification, smart grids, and renewable distributed energy assets. Rhombus' solutions are deployed into several markets such as high power, bi-directional, fast charging systems for heavy duty vehicle fleets, microgrid and energy storage systems for commercial applications, regenerative test systems for battery cycling and dynamic load testing, Internet of Energy "IoE" software platform for microgrid management, and contracted engineering innovation, helping their customers deploy their next generation products.

Rhombus Energy Solutions
www.rhombusenergy.com
Booth 3768



Thin film solar panels to win more projects

Hanergy Thin Film Flex Panels are a solution for flat roofs which cannot bear the weight of conventional crystalline solar panels without expensive roof structure reinforcement, allowing solar installers to win commercial roof projects they may have had to walk away from in the past. Hanergy Flex Panels without frames and racking are lightweight and securely mounted with advanced "peel and stick" adhesive technology, providing no roof penetrations that could void roof warranties and cause leaks. They perform well in hot, humid, or shady conditions. With Hanergy Flex Panels, the benefits of solar can be added on boats, RVs, drones, light poles, or anything else with an irregular shaped surface.

Hanergy Thin Film Power America
www.hanergyamerica.com
Booth 1638



Dual-axis tracker

The AllEarth Solar Tracker is a dual-axis solar tracker which uses GPS and wireless technology to follow the sun throughout the day, producing up to 45% more energy than rooftop solar. With its ease-of-use features, high energy performance, and small footprint, the AllEarth Solar Tracker is a ground-mount solution giving energy independence and a high return on investment. The tracker is American-engineered and American-made, with rigorous lifecycle and wear testing to make sure the details are done right, guaranteeing that the system will have a long, reliable life. Key features include a wind rating of up to 120 mph with automatic high-wind protection settings, advanced snow-shedding capabilities, and a durable design which ensures the tracker can withstand any climate, from desert heat to severe winter conditions.

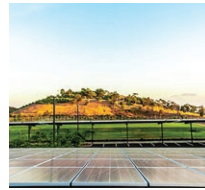
AllEarth Renewables
allearthrenewables.com
Booth 1471



Powering a cleaner grid

Coronal Energy, powered by Panasonic, is an independent power producer focused on utility-scale solar and storage projects. The firm provides turnkey solar energy solutions tailored for diverse enterprise customers across North America, including utilities, corporations, and the public sector. Uniting 3GW of completed project experience with the financial strength of a Fortune Global 500 company (#110), Coronal Energy, powered by Panasonic, owns and manages a 333MW operating portfolio and a multi-gigawatt development pipeline in more than 20 US states.

Coronal Energy
www.coronalenergy.com
Booth 1556



Solar structures

M Bar C Construction designs and constructs solar carports, ground mounts, and shade structures. In 2017, they built over 81MW of solar structures averaging 5.1 million square feet of steel structures. M Bar C was developed to serve the increasing demands of schools (DSA), commercial, government, and industrial customers with a variety of services including fabric, steel, and solar shade structures. If it's made of steel and it covers from the sun, M Bar C Construction can build it, meeting the most demanding specifications for utility, durability, and cost-effectiveness.

M Bar C Construction, Inc.
www.mbarconline.com
Booth 2379



Solar PV mounting system provider

TerraGen Solar is a solar PV mounting system solutions provider with a focus on upfront engineering, ease of construction, and quality manufacturing. TerraGen offers a variety of mounting systems including, but not limited to, flush mount racking systems, tilted pitched roof systems (south facing modules on an east/west pitched roof), flat roof ballasted systems, and ground mount systems. In addition to their standard product offerings, they provide solutions for engineering and construction challenges relating to solar PV systems.

TerraGen Solar | www.terragen.com
Booth 2982



Seasonally adjustable ground mount

Kinetic Solar's new seasonally adjustable ground mount brings versatility and strength while being economical and fast to install. Each module section is balanced in order to make seasonal adjustments with 60- or 72-cell modules simple and easy, no heavy lifting required. Seasonal adjustment can offer a yearly increase of in production of up to 14%, without the added cost of a tracking system. Standard tilt angles include 20°, 45°, and 60°. It is engineered to withstand 1kPa of wind and 2.5kPa of snow, making it suitable for use in nearly any location in North America. It's innovative design tilts flat for fast and easy construction. Available with optional string inverter mount, micro inverter mount, and rear cable shielding panels. The structures sturdy steel construction and hot dip galvanized coating stands up to even the most hostile environmental conditions.

Kinetic Solar | www.kineticsolar.com
Booth 4145

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Solar design and engineering

SunSource Energy, a solar design and engineering firm with global presence provides engineering services from preliminary proposal stage to detailed construction drawings. They are present in the United States, Philippines, Singapore, Vietnam, Africa, and India. In the US, they have delivered 1GW+ of designs across residential, commercial, industrial, and utility segments. They have also delivered designs with PV + Storage or Hybrid options. Their delivery model provides turnaround time utilizing multiple time zones, across multiple offices and relationships with various third parties, backed by an efficient team, which helps them deliver effectively.

SunSource Energy Americas, Inc. | www.sunsource-energy.com/us
Booth 2496



Next generation efficiency for battery-based multi-mode inverter

Sol-Ark 8K DC transformerless storage string inverter is 97% efficient on grid and 95.5% off grid. They lowered the cost by over 25%, combining 2 string MPPT's, battery inverter, and user wiring area into one unit. Low cost 48V batteries are an option to keep costs down. It can run loads off PV power for smaller battery bank. Sol-Ark has a touchscreen GUI interface as easy to use as a smart phone. 8KW/20KW peak power for starting big motors. As a military vendor, it was EMP Hardened to >100KV/m so system, panels, and appliances survive. Designed by an in-house team of engineers, this system has all the on-grid/off-grid features in one simple package to allow easy install.

Sol-Ark | www.sol-ark.com
Booth 3417




Solar inverter solutions

Growatt's 33-40k TL3-US model is an inverter with excellent performance and high reliability. It's dual independent MPPT with wide input voltage range ensure energy harvesting. With string monitoring, comprehensive protection, and remote upgrading, Growatt 40k TL3-US offer a low operating and maintenance cost. Wide MPPT range, max DC/AC ratio of 1.5, and plug and play wiring box provide a flexible design and installation. This new three-phase inverter from Growatt is a global solution for commercial and industrial PV systems.





Growatt New Energy Technologies
www.growatt-america.com
Booth 2820

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SunDrum Solar has changed the paradigm for solar energy harvesting. Our Hybrid PV/Thermal system is capable of capturing energy on cloudy/rainy days and even in the dark of night. We supply solar heating and A/C cooling as well as setting the industry standard for residential and commercial energy capture since 2008. SunDrum Solar's world record stands today after our PV/Thermal system delivered 86% of solar energy collected on a roof top to the house. SunDrum Solar redefines harvesting of solar energy providing comfortable conditions for you and cooling the planet at the same time. Find out how SunDrum Solar can change your world.

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Crimp tool for MC4/Tlian/Twinsel/Jinko solar contacts

For 30 years Rennsteig has been manufacturing specifically engineered tools for the wires and terminals used in the solar industry. Rennsteig has the knowledge, skill, and capacity to meet any customer specifications and is specialized in meeting customer requirements. Rennsteig now offers a new Crimp Die Set and Locator for MC4/Tlian/Twinsel/Jinko solar contacts. They also offer many other Crimp Die Sets for terminals by all major manufacturers. With stock in NJ, Rennsteig can respond quickly to installer needs.

Rennsteig Tools, Inc.
www.rennsteig.us
Booth 2764



TÜV-certified photovoltaic cable



Nexans AmerCable's AmerSol H-1Z2Z-K is a TÜV-certified BS EN 50618 photovoltaic (PV) cable manufactured in North America. AmerSol H-1Z2Z-K is currently available with a black or red jacket in sizes from 1.5sqmm to 16sqmm. It offers flexible tinned copper metric stranding protected by a two-layer construction and features a low smoke halogen-free, flame retardant, and sunlight resistant cross-linked compound outer layer and halogen-free thermoset polyolefin inner layer. The cable carries a voltage rating of 1500VDC and 1000VAC rating and is RoHS compliant.

Nexans | www.nexansamericable.com
Booth 672

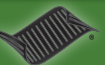
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Solar Power Midwest is bringing the latest in solar and green architecture to the Midwest this November alongside Greenbuild International Conference and Expo. Together, the co-located shows will bring together a community of professionals dedicated to improving, researching, and growing the market for a sustainable future.

- **Over 18,000 attendees** ready to network and display the newest innovations in solar and sustainable development.
- **700+ exhibitors in various industry sectors including:** Engineering & Design, Manufacturing, Government & Utilities, Research Consulting Firms, Contractors & Builders.
- **Regional Specific Education:** The effect of the Future Energy Jobs Act, the future impact of the Illinois Power Agency's Long-Term Renewable Resources Procurement Plan, and the potential implications of the Adjustable Block Program.
- **2018 Highlights:** SEIA's Women Empowerment Summit and the Smart Energy Microgrid Pavilion.

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The Automobile REVolution

by Preston Roper

IT'S A RARE OPPORTUNITY TO SEE A TECHNOLOGY INFLECTION POINT

as it's occurring. With electric vehicles, many would say we are at the bend in the proverbial hockey stick. In the U.S. alone, the EV year-to-date sales increased 59 percent in April 2018. That month also marked the 31st consecutive month of year-over-year sales increases for EVs, making it the 5th most successful month in US EV sales history, and the second best month ever for EV sales globally.

Acknowledging this shift in transportation, OEMs are making commitments to the EV market. Toyota announced its plans to electrify its entire lineup by 2025, and General Motors announced plans for 20 new EVs two years sooner, by 2023. Meanwhile, Ford said they are investing \$4.5 billion into 13 new EVs. Even Jeep is getting into the mix by announcing its plans to release a plug-in Wrangler in 2020. However, Volvo may have made the largest commitment to the rEVolution of transportation, by committing that all models introduced after 2019, will be either hybrids or all electric.

In terms of charging stations to support this growing segment, last November brought us the opening of Tesla's largest supercharger station in North America, located about halfway between Los Angeles and San Francisco - a mix between airline waiting lounge and coffee shop. Meanwhile, Volkswagen announced its plans to install 2,800 charging stations in 17 of the largest U.S. cities by June 2019, mostly in workplaces and multifamily dwellings such as apartment buildings and condos (a part of its Dieselgate reparations). In Europe, Shell released its plans to charge EVs in just eight minutes, with 80 high-power charging stations throughout the continent.

In the past year, the EV charging market saw several notable acquisitions by multinational energy companies. Engie started things off in March, with the purchase of EV-Box, a Dutch electric-vehicle charging management startup. Then, the international power and clean energy company Enel bought smart-grid EV charging company eMotorWerks. The more than 30,000 charging stations they have deployed to date, can aggregate vehicle charging load. This gives energy providers an easier method of balancing the grid, and gives drivers the chance to optimize their charging (for renewables or the lowest electricity price). Another acquisition in the charging space was Shell, which bought NewMotion. The company manages charging points for electric vehicles in Western Europe, and will operate alongside Shell's program of rolling out fast charging points at its stations.

These investments by major car OEMs, and acquisitions by power companies, indicate that more energy players are taking action on the necessity of establishing a foothold in EV charging infrastructure. It also shows how these players are preparing for the load balancing challenges that can be expected when the inflection point hits, without building new fossil fuel generation plants.

That brings us to our next question: What to expect in 2018 and beyond?

1. More EV Models and Continued Sales Growth

The sheer number of automotive OEMs announcing new electric vehicle models, or electric versions of their existing models, illustrates how the industry is embracing the "Evolution" of transportation. Expect to see more Tesla Model 3s, and new, longer-range models from Nissan, Jaguar, Honda, Audi, Kia, BYD, Hyundai, and more.

2. Utilities Leveraging EVs as Grid Assets

Thousands of EVs - all charging at the same time - hold the potential to either cripple the reliability of local utility grids, or prove to be a windfall in electricity sales. It all depends on the willingness of these organizations to embrace new technologies that will allow them to aggregate charging load over the course of a day, while still making sure cars are charged up when their drivers need them. These solutions can provide a variety of services beyond grid balancing, such as optimizing charging loads for times of the day when demand is low, renewables are abundant, or prices are at their lowest. Additionally, existing software rewards drivers (or charging equipment providers) for allowing their systems to act as virtual power plants, and bid into Demand Response (DR) programs. Expect forward-thinking utilities to rollout this smart-grid charging technology throughout the next year. The goal is to leverage it in order to avoid unnecessary grid infrastructure upgrades to meet demand, reduce dependence on peaker plants, and enable vehicle-to-grid integration.

3. Shifting Service and Dealership Business Models

As most innovations go, the electrification of consumer cars is going to unsettle existing business models built around ICE vehicles. With their fewer parts and lower maintenance requirements, EVs are expected to reduce demand for part supplies and mechanics. We can even expect dealerships, which bank on service as a recurring revenue generator, to begin to

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make adjustments to their business models in the face of the pending EV boom.

4. More bans on ICE vehicles

Norway by 2025, India and China by 2030, and the U.K and France by 2040, are the targets these countries set to ban ICE vehicles in favor of electric ones. California is also contemplating something similar as a way to meet greenhouse gas emissions goals. Democratic Assemblymember Phil Ting proposed a bill that would require all new passenger vehicles sold in the state to be battery-electric or hydrogen fuel cell cars. Considering that several other states follow California's lead on vehicle emission regulations, such a decree could have sweeping implications for the United States automobile industry. In 2018 and beyond, expect these bold goals to be backed up with implementation plans - and keep an eye on California.

5. More Utility Programs to Support EV Adoption

According to the Rocky Mountain Institute, 2.9 million EVs on the road by 2022, could add over 11,000 GWh of electricity demand on the world's grids. Utilities are under pressure to meet this demand without building new fossil fuel generation plants. As utilities often work on 25-year planning horizons, expect forward-thinking power suppliers to get into the deployment of charging infrastructure. Look for deployments and customer rebates from energy providers in the U.S. and Europe for smart-grid charging systems, which allow them to remotely manage and aggregate the charging loads of EVs over time, limit the need of additional fossil fuel plants, and optimize renewable energy when it is abundant on the grid. Additionally, expect energy providers to target expansion into the current vacuum of DC fast-charging, as it requires extensive new utility infrastructure to deliver (and they don't have to grant interconnection agreements to themselves).

6. The Volkswagen 'Dieselgate' Windfall

As a part of a \$14.7 billion settlement reached by Volkswagen and the United States government, Volkswagen is now infusing \$2 billion into the nation's zero-emission vehicle (ZEV) infrastructure

over the next ten years. In total, 44 states from Ohio to Texas, and North Carolina to California, are currently planning how to spend these funds to reduce emissions in their communities. Early plans include funding electric vehicle charging stations and infrastructure, to replace aging diesel school buses with electric or cleaner burning ICE models. Meanwhile, in California, the plan is to install 600 DC fast charging stations, and 1,500 charging stations at workplaces and multi-unit dwellings.

Preston Roper is the Chief Marketing and Operations Officer at eMotorWerks. He has more than two decades of experience leading innovative marketing and operations teams at companies including Honeywell, NetDynamics (acquired by Sun Microsystems/Oracle) and Synopsys (IPO), Stem, Cogenra (acquired by Sunpower) and Tioga Energy.

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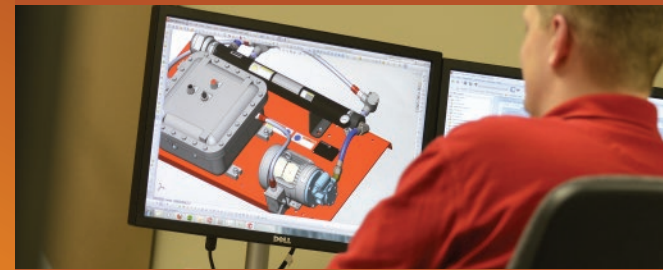
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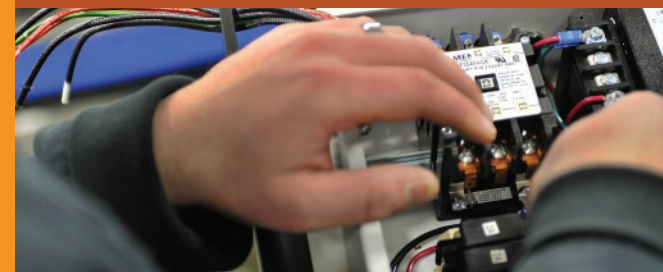
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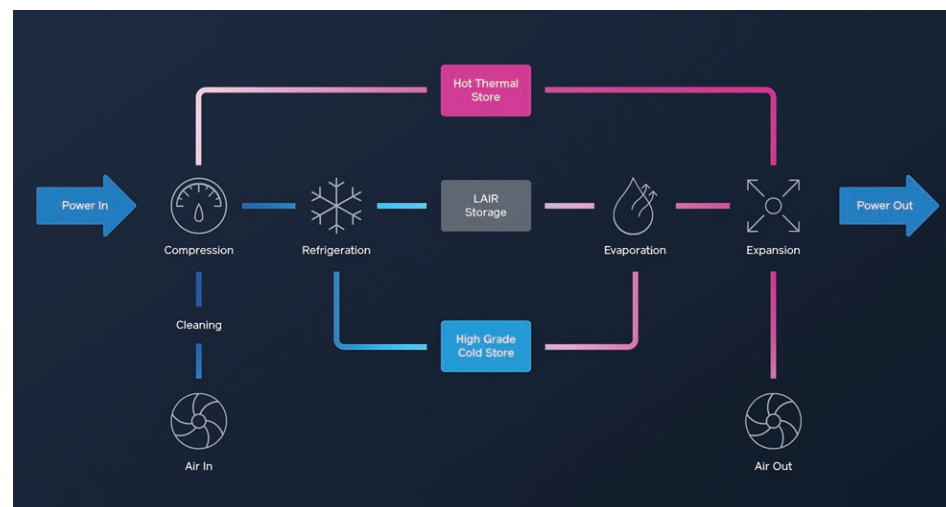


DELIVER



The Case for Long Duration Energy Storage

by Carl Sheldon



Energy storage devices are rapidly being deployed, as independent power producers (IPPs) and utilities look for ways to improve power generation economics, balance the grid, and increase reliability. As more wind and solar generation is added to the grid, the need for cost-effective, environmentally friendly, long duration energy storage (over four hours) is increasing.

A recent forecast by the U.S. Energy Information Administration highlights the need for more storage. From 2020 to 2050, the EIA predicts that utility-scale wind capacity will grow by 20 gigawatts (GW) and utility-scale solar photovoltaic capacity will grow by 127 GW, in the United States alone. The only way for all of this new, but intermittent, generation to be optimally integrated into our electrical grid, is alongside large scale and long duration energy storage.

What Long Duration Storage Options are Available Now?

Many energy storage technologies are already in use, but each presents its own challenges for grid scale, long discharge storage.

Pumped hydro and cavern-based compressed air storage have been used effectively for very large-scale energy storage projects, but both have siting constraints. Pumped hydro requires close proximity

to two large bodies of water, with hundreds of feet of drop between them; compressed air storage calls for injecting compressed air into air-tight geologically stable structures, such as caverns, or depleted oil or gas fields, which can be difficult to find.

Lithium-ion batteries have been used for stationary energy storage applications, due to their high energy density, and relatively low upfront cost. However, the longer the discharge period for a given capacity, the more batteries you need. At the hundreds of megawatts scale, the economics for two or more hours of discharge is a challenge. Lithium-ion batteries are also tough on the environment; after a relatively short life, their components are difficult to recycle. They can also pose a fire risk if not properly managed, and they rely on diminishing metal resources (like cobalt) which come with mining risks.

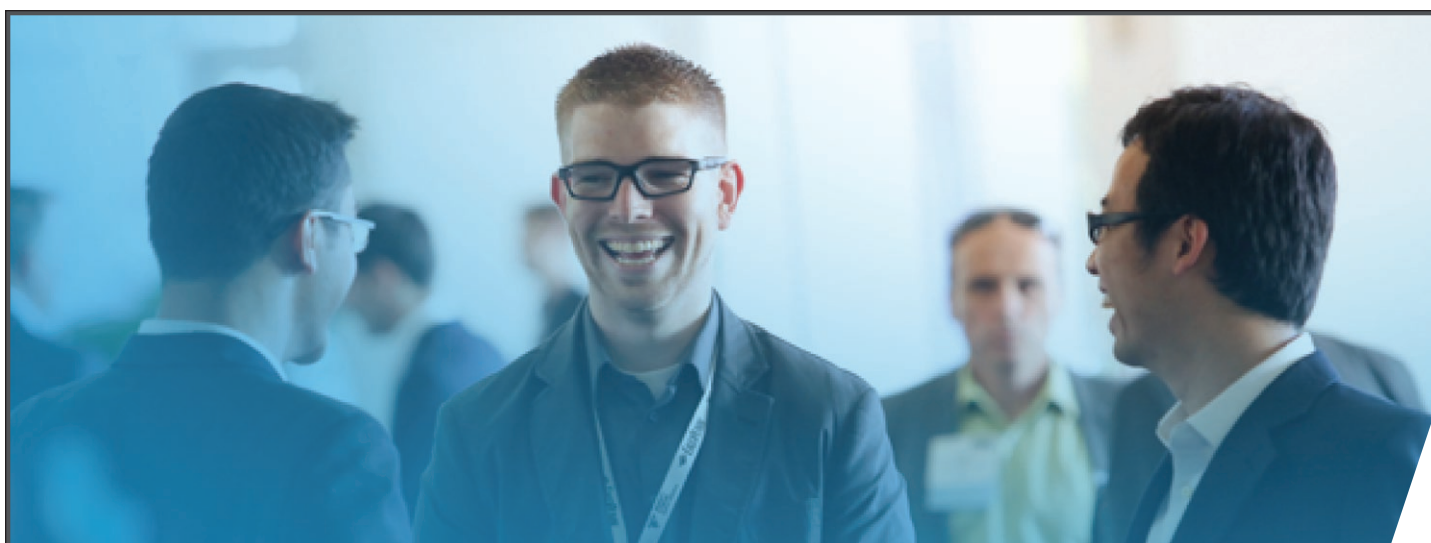
Flow batteries may be more economic than lithium-ion, and they don't degrade as quickly. However, there is a cost to scaling to higher power capacities. Like all batteries, they are limited in their ability to reliably provide the synchronous inertia and voltage control in the way that is possible for traditional power plants with spinning generators. This means that, as more and more solar and wind power is added to the grid, battery storage is limited in its ability to respond to large imbalances between electricity supply and demand, and keep frequency and voltage stable.

A Versatile, Environmentally Friendly Option Emerges

One emerging, long-duration energy storage option, with the potential to mitigate many of the constraints posed by other systems, is Liquid Air Energy Storage (LAES).

LAES is based on the storage of atmospheric gases in liquid form. The technology uses liquid air as the storage medium by cooling ambient air (using conventional industrial refrigeration) to lower than -270°F (-170°C), which results in a 700-fold contraction in its volume from gas to liquid. The process is similar to that used to liquefy natural gas, but because LAES uses only air, the entire charge/discharge cycle is completely free of carbon emissions.

The liquid air is stored in conventional insulated tanks at low pressure (such as those used for liquid oxygen or nitrogen storage, at facilities such as hospitals). When energy is needed, the liquid is warmed and pumped to pressure,



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then expanded back to gas, with a 700-fold increase in volume. The expansion takes place through a standard expansion turbine connected to a generator to generate electricity, thus releasing the stored energy. There is no combustion - the only thing released into the atmosphere is fresh air!

Facilitating Wind Power in Texas

Long duration energy storage could prove to be particularly useful in states like Texas, where more than 20,000 megawatts (enough to power 5 million homes)¹ of wind generation capacity has been built in rural areas, far from demand centers. Power lines are expensive to build, especially when dealing with the hundreds of miles between the best wind in West Texas, and large population centers in Dallas, Houston, Austin, and El Paso. Long-duration energy storage could reduce the requirement for additional (or replacement) transmission lines. It would provide services cables can't, such as load shifting, frequency regulation, and also reduce constraint on existing transmission lines

LAES is better suited to provide grid scale storage than pumped hydro-power or compressed air, because it is a freely locatable system that can be sited just about anywhere. LAES plants don't take up much space and don't use any hazardous materials, have no associated fire risk, and can easily meet strict urban building codes.

An Energy Storage Empire in New York State?

Long-duration storage also has potential applications in the state of New York, which set itself some very ambitious targets for both additional renewable generation and energy storage. New York already has an established capacity market - LAES would add valuable capacity close to the electrical load, with no toxic emissions. The only prerequisite for providers to participate in the day-ahead capacity market, is that they be able to provide at least

four hours of energy at rated power. Long duration storage is also useful in other applications such as grid reinforcement; ConEdison recently released a request for proposal calling for storage with a longer than eight-hour discharge period, underscoring the trend towards long duration use cases.

Today, most new energy storage capacity is provided by lithium-ion batteries. But these degrade over time, which forces providers to significantly overbuild capacity, and be prepared to replace all the batteries as often as every five years. This adversely affects the economics of a project, and can be a major problem in dense urban areas like New York City, where fire risk is a concern. LAES plants are freely locatable, are environmentally benign, do not degrade over time, and have an economic useful life of more than 30 years.



Support for a Safer Future

A recent study by Navigant Research found that the market for utility-scale energy storage is growing rapidly, and is on track to be worth \$3.6 billion by 2025. As demand grows, and utilities come to better understand the benefits of long duration energy storage, there's a high possibility that something as simple as liquid air could soon be powering your home.



Carl Sheldon joined Highview Power at the end of 2017, as president of its U.S. subsidiary. Previously, he was CEO of the Abu

Dhabi National Energy Company PJSC (TAQA) and was Managing Partner of Allen & Overy LLP's Frankfurt and New York offices, during his 25 years with the firm. He received his B.A. from Cambridge University, and is a Solicitor of the Supreme Court of England & Wales as well as a licensed attorney in the State of New York.

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¹ <https://www.houstonchronicle.com/business/article/How-Texas-blew-to-the-top-in-wind-power-12529917.php>



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Saving Water One Drop at a Time with IoT

by T.J. Rodgers

IoT is gaining strides in utility applications. More recently, it's found an innovative use in agriculture, as farmers work to more precisely gauge irrigation needs and conserve water resources. Smarter irrigation is essential because farming uses 80 percent of the nation's water (even more in many Western states) and is also responsible for the majority of its waste, according to the US Department of Agriculture.

Bowles Farming, located in the Central Valley of California, is illustrative of how IoT is helping farmers do a much more efficient, and smart, job of delivering water at the right time, which is critical to the success of a crop. Bowles' crops, which include cotton and processing tomatoes, are drip irrigated from a canal system. Solar-powered sensors enable the company to set water delivery according to each crop's needs, and by the variability of the fields themselves; this will effectively create a 'live canal'.

Set right in the field, the sensors collect data and let Bowles Farming see - in real time - when water levels have been achieved. Rather than over-watering, which wastes resources and increases irrigation expense, the sensors give farmers a level of data intelligence and precision that simply didn't exist before.

IoT in the Field

In areas where land is relatively consistent, farmers can make use of fewer sensors, as few as one per 100-acre-block. Terrain with more variation may need a sensor for every 3-acre-block. By creating "microblock" target areas, farmers can easily assess soil conditions and water needs based on live data.

The system uses a hub-and-spoke model; one gateway acts as the hub, and each carbon node acts as a spoke. The nodes feed into a single gateway that can cover more than 1000 acres. Data is stored in the cloud, easily accessed anytime by PC or mobile device.

Using remote sensors also conserves labor hours. Instead of sending a team of irrigators to go around turning valves on and off in the field, a wireless autonomous valve control lets farmers operate the valves remotely.

The Internet of Plants

For almond growers with water-related issues like yield variability within blocks, and the goal of optimizing the life of the tree, the technology prevents over or under watering. This allows every microblock within an orchard, to produce

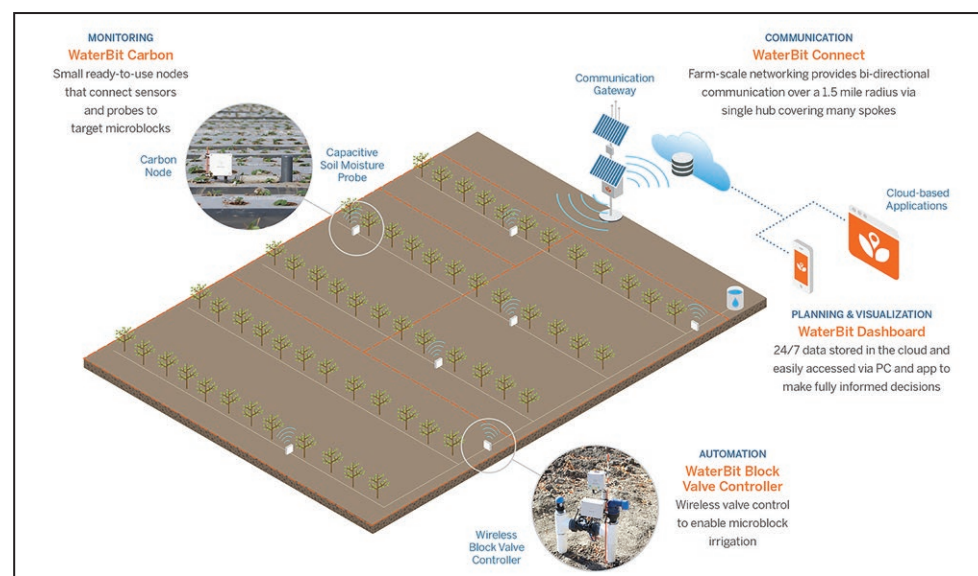
at its peak. It also means that trees stay healthier, for a longer, and more valuable production life. Recently, almond growers have faced scrutiny about water use. Smart irrigation allows them to keep precise records of their sustainable water use, while monitoring for leaks 24/7.

Farming in the Future

IoT is helping farmers work more efficiently, produce better crop yields, and save water. Using technology like soil moisture probes, farmers can now identify areas that are waterlogged or overly dry, either of which could impair yield. IoT-powered smart irrigation eliminates extremes, preserving balance by turning on the right valves, in the right microblocks, for the right amounts of time. IoT means farms will have healthier crops, minimal water waste, increased production, and bigger profits.

T.J. Rodgers is chairman of the board of WaterBit, a company developing farming applications using IoT technology. Prior to WaterBit, T.J. co-founded Cypress Semiconductor in 1982, and served as Cypress's CEO for 34 years until stepping down in 2016. He is the former chairman of the Semiconductor Industry Association and SunPower Corporation.

WaterBit | www.waterbit.com

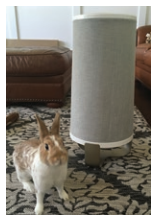




Compact noise suppression filters for LED lighting

TDK Corporation has expanded the MAF series of noise suppression filters with the new MAF2520ASS600C type that is designed especially for LED lighting systems. The new multilayer filter has compact dimensions of just 2.5mm x 2.0mm x 0.85mm and features a suppression of spurious noise between 20MHz and 100MHz that is equivalent with that of larger wire-wound components. In addition, the new MAF2520ASS600C filter satisfies CISPR 15 standards for LED lighting.

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New York, NY; www.awea.org
- 05 **Wind Energy Finance & Investment - West**
San Francisco, CA; www.awea.org
- 10-11 **Horizon18**
Boston Convention and Exhibition Center – Boston, MA; www.awea.org
- 14-17 **GRC Annual Meeting & Expo**
Reno, NV; www.geothermal.org/meet-new.html
- 16-17 **5th Annual Demand Response & Distributed Energy World Forum**
Costa Mesa, CA; www.drworldforum.com
- 16-17 **Offshore WINDPOWER Conference**
Hyatt Regency Washington on Capitol Hill – Washington, DC; www.awea.org

NOVEMBER

- 06-08 **ESNA 2018**
Pasadena, CA; www.esnaexpo.com
- 08 **Renewable Energy Grid Forum**
Grand Hyatt – San Francisco, CA; www.renewablegridforum.com
- 13-15 **Wind Energy Fall Symposium**
Colorado Springs, CO; www.awea.org
- 14-16 **Greenbuild 2018**
McCormick Place – Chicago, IL, CO; www.greenbuildexpo.com
- 28-29 **Companies vs Climate Change**
Adrienne Arsht Center – Miami, FL; www.solveclimatechange.com

JANUARY 2019

- 23-24 **The Energy Expo**
Miami Airport Convention Center (MACC) – Miami, FL; www.theenergyexpo.com

FEBRUARY 2019

- 27-28 **GLOBE Capital 2019**
Four Seasons – Toronto, ON; www.globeseries.com

MAY 2019

- 20-23 **AWEA WINDPOWER 2019 Conference & Exhibition**
Houston, TX; www.awea.org

JULY 2019

- 09-11 **Intersolar North America**
Moscone Center – San Francisco, CA; www.intersolar.us

SEPTEMBER 2019

- 23-26 **Solar Power International 2019**
Salt Lake City, UT; www.solarpowerinternational.com

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44	Abaris	www.abaris.com
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46	AIMCO Corporation	www.aimco-global.com
73	AllEarth Renewables	allearthrenewables.com
58	American Earth Anchors	americanearthanchors.com
64	American Polywater Corporation	www.polywater.com/solarpanelwash.html
30	Analytic Systems	www.analyticsystems.com/product/smp-100
77	Arconic	www.afshuck.net/solar
55	AWEA	www.awea.org/offshore
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3	Baker Electric	www.baker-electric.com/commercialsolar
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12	Continental Control Systems	www.ctsys.com
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6	CyboEnergy	www.cyboenergy.com
19	Dynapower	www.dynapower.com/dc-dc
68	EDF Renewable Energy	www.edf-re.com/ao
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