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There are Expectations in Every Relationship

When is the last time you reevaluated your trade ally expectations?

Significant Growth on the Horizon for U.S. Offshore Wind

Taking Microgrids to the Extreme

How Much Power Do I Really Need?

The truth about sizing, depth of discharge, and surge capacity

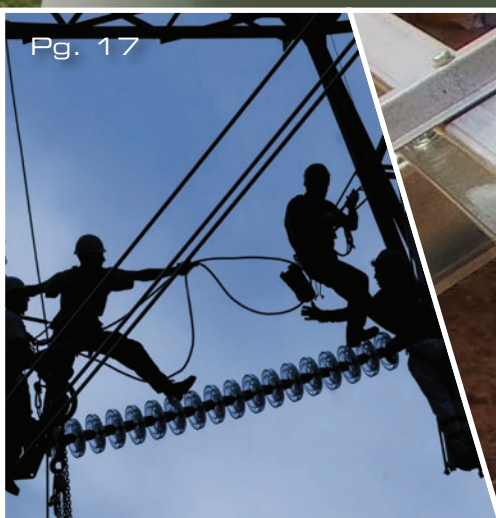
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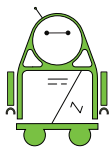
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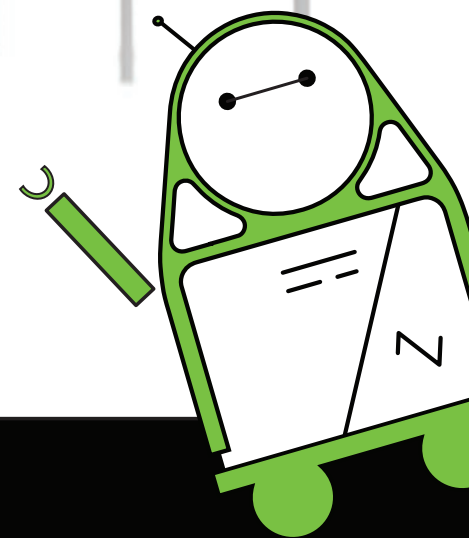
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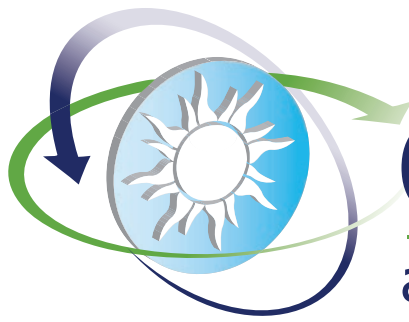


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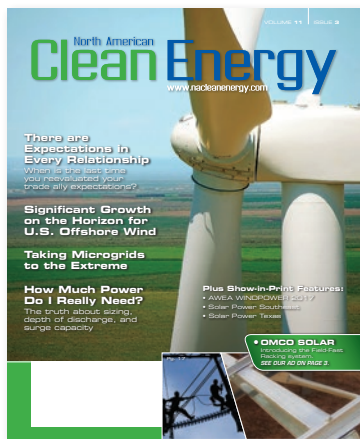
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On our cover...

Suzlon's S128-2.6MW rotor approaches the size of a cricket field. At 63m long, it employs carbon technology, allowing for lighter weight and stiffer blades. The strength of the carbon allows for thinner airfoils at the tip with high lift and low drag where rotor speed is 270km/hr.

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IT'S NEARLY IMPOSSIBLE TO READ THE NEWS WITHOUT SEEING AN ANNOUNCEMENT

about the latest advancement in solar, wind, and energy storage or energy efficiency. For those of you whose New Year resolutions are already a distant memory, this is just part of the daily routine of working in your industry. There remain a few stalwarts, however - those optimistic people resolved to strengthening their bond with Mother Earth, still hoping that this is the year they finally install solar panels or seriously budget for a plug-in car. What are they waiting for? We all know that you don't have to go the Ed Begley Jr. route to make a difference. In fact, taking small steps in adopting the latest renewable technology can not only give someone a sense of moral accomplishment, it's gotten to the point where it actually saves money.

Weather research engine WeatherDB compiled a list of the top 30 rainiest cities in the United States, based on several years of NOAA data. Corvallis, Oregon landed at number 6. Portland is less than 100 miles north of Corvallis, yet energysave.com ranked Portland number 1 in 2015 for top cities with a 20-year solar savings. Surprisingly, when it comes to saving money through solar, Portland beats out sunny Los Angeles. If Portlanders can do it with their weather, anyone can. It's not necessarily about throwing every last table scrap into a homemade composter or pedaling to work in a three-piece suit, but about taking small, manageable steps that seamlessly fit into your lifestyle. The website www.energy.gov even offers free downloadable guides that easily walk any neophyte through basic changes to save money, from adopting more conservative grid-connected systems to stand-alones, wind, solar, and even micropower systems.

Given that you probably already school your customers on the benefits of renewables, this information may seem old hat. If so, you may want to look up from your soon-to-be obsolete 2016 laptop and watch the horizon.

The newest generation of engineers is taking advantage of existing platforms to push the boundaries of technology. Scanning the daily press releases that flood our inboxes has become a game of seeking out the newest and craziest exploits. It feeds the desire to know the latest innovations and try to predict the future of these industries.

For those of you who secretly check out online live eagle cams to watch the cute newborns stumble around their nest, you might just rejoice at the newest wind catchers. These include bladeless turbines (eaglet-approved), as well as machines that capture wind energy without the wind. And when there's too much wind? Engadget.com reports that the world's first typhoon turbine was invented by Atsushi Shimizu to tap into the massive amounts of energy contained within storms common to his homeland of Japan. He estimates the energy stored in one typhoon could power the nation for 50 years, if only it could be harnessed. Shimizu's egg beater-like contraption is a vertical-axis Magnus wind power generator robust enough to withstand the high winds of a typhoon. Tests conducted using a scale model of the wind energy generator have been promising, and Shimizu is on a mission to connect with investors to help build larger practical versions in the hopes of one day feeding typhoon power into the nation's grid.

One of the best things about being part this industry is that renewables technology never seems to stand still. Engineers and visionaries are having so much fun competing with each other to create the next great thing; they seem perpetually on the verge of another technological breakthrough. As it turns out, the science of renewables is, itself, renewable.

Enjoy the read,

Meg

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Using the power of nature to keep the harbor clean

The Inner Harbor Water Wheel, or "Mr. Trash Wheel" to locals, combines old and new technology to harness the power of water and sunlight to collect litter and debris flowing down the Jones Falls River in Baltimore, MD. The river's current provides power to turn the water wheel, which lifts trash and debris from the water and deposits it into a dumpster barge. When there isn't enough water current, a solar panel array provides additional power to keep the machine running. When the dumpster is full, it's towed away by boat, and a new dumpster is put in place. Since 2014, Mr. Trash Wheel has removed more than 1,094,340lbs of garbage and debris from Baltimore's Inner Harbor.



Photovoltaic module for automobiles

Panasonic Corporation announced that it has recently developed the "HIT Photovoltaic Module for Automobile", which was adopted for the new Prius PHV released in February 2017 by Toyota Motor Corporation. Panasonic's solar cells have a unique structure that combines a crystalline silicon substrate and an amorphous silicon film, and feature high conversion efficiency and excellent temperature characteristics. Conventional automotive solar cells can output up to several tens of watts and have been used only for the auxiliary charging of 12V batteries and ventilation power sources for parked cars; however, the use of the features of Panasonic's solar cells allow a high output (approx.180W) in a limited area on a car's roof, enabling the charging of the drive lithium-ion batteries as well as 12V batteries, resulting in a possible extension of an EV's travel distance and increased in fuel economy. Furthermore, Panasonic has developed technologies to laminate three-dimensional curved glass to match the new Prius PHV's elegant body design, achieving the installation of modules on the roof without impairing the advanced design. This will eventually contribute to the improvement of the vehicle's environmental performance.

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Power island

Three European countries will press ahead on developing a large renewable European electricity system in the North Sea. The goal is to achieve a multi-party consortium which will realize the North Sea Wind Power Hub project. By developing the North Sea Wind Power Hub, TenneT and Energinet.dk want to make the energy transition both feasible and affordable. Central to the plan is the construction of one or more islands, so called Power Link Islands with interconnections to surrounding countries, in the middle of the North Sea (Dogger Bank): to which many wind farms can be connected (possibly 70,000 MW to 100,000 MW); from where the generated wind energy can be distributed and transmitted over direct current lines to the North Sea countries of the Netherlands, Denmark, Germany, Great Britain, Norway and Belgium; where transmission cables will simultaneously function as interconnectors between the energy markets of the aforementioned countries. Besides transmitting wind electricity to the connected countries, these 'wind connectors' will enable the countries to trade electricity; and where wind conditions are optimal.

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There Are Expectations in Every Relationship

When is the last time you reevaluated your trade ally expectations?

by Karen Germain

During a recent survey, trade allies voiced their concerns on a variety of issues, and how they view utility demand side management (DSM) programs.

Utilities know that trade allies are the foundation to driving increased participation in a DSM program. They give a DSM program access to the end customer and associated projects, and they may account for as much as 75 percent of the energy efficiency program projects submitted. The reach of their business development efforts can, when leveraged effectively, multiply the reach of an energy efficiency program, and allow utilities to tap into their intimate knowledge of the driving forces behind customer decision-making.

To illustrate the strength of that relationship, feedback from trade allies tells us that they understand the power of DSM incentives; many of them have built it into their sales approach. Because they have the front-line relationship with end-use customers, and significant insight into the motivations of those customers, they can tell a utility that incentive offers motivate customers.

That intimacy is valuable for both the trade ally and utility. It's these relationships with customers that provide the insight: The most effective selling point for energy efficiency is reduced maintenance costs – 65 percent of respondents surveyed selected reduced costs as the top seller of energy efficiency. This knowledge allows utilities to respond better to the needs of trade allies, and to more effectively use them to achieve program goals. A key strategy to increasing participation is to get behind trade allies as partners, and help them grow their business, with energy efficiency at the core.

Trade allies place value on several components in their relationships with the utilities – most of which focus on the concept of strengthening business development efforts, or the utility as a resource partner. They value the various utility-branded marketing materials provided. Rebate charts were valued highly by 73 percent, and technology fact sheets were found valuable by 60 percent. Trade allies place value on the materials that support them in building their case to their customers, as well as materials that allow them to complete their project application forms. And they place value on the tools and materials that are co-branded. They recognize that co-branding lends credibility to their efforts.

Resources such as case studies and fact sheets may be outside of the staffing capabilities or budget of most trade allies. By providing them, the utility is, in effect, extending the trade ally's operating capabilities. Not only does it provide operational support, it helps position the utility as a partner and trusted advisor.

The next level of that partnership is an outreach team that works closely and continually with the trade allies – a team which proactively nurtures relationships and supports the trade allies in growing their businesses. This facilitates a feedback loop between energy efficiency program and trade ally. Trade allies recognize the value of this outreach relationship; 62 percent of respondents met with an outreach professional and, of those, 40 percent met their outreach professional on a quarterly basis, and plan to continue the relationship.

The partnership between outreach professional and trade ally is crucial to accessing the value in your trade ally network. You can't just go through the motions – this relationship is about personalizing your program, understanding what you need and want out of the relationship with your trade allies, and equipping your outreach staff to deliver both. Outreach professionals can make the difference between simply achieving goals, and building a trade ally network that helps grow and strengthen your overall DSM program. The dynamic in this relationship is buoyed by the quality, relevance, and accessibility of the outreach professionals; along with the tools and materials they deliver to trade allies.

How do you best tap into the value of individual trade allies and of your trade ally network?

- 1. Have a long-term vision for your trade ally network** – You have a long-term vision for your utility and your DSM program. You also need one for your trade ally network. Understand what you want to get out of it, both near and long-term, and build a program that enables a partnership framework for you and the trade allies.
- 2. Evaluate regularly** – Build a comprehensive feedback loop and listen. There are several avenues available to achieve this. When leveraged regularly, this can allow you to keep ahead of the curve, and build a solid relationship with your trade allies.
- 3. Invest in your long-term vision** – Trade allies value the tools, marketing support, and training you provide them, and they value the support and access to the outreach professionals. This investment builds the framework begun when defining your long-term vision. Relevance and accessibility are key in any relationship, including DSM.
- 4. Buoy your trade allies** – Outreach professionals allow you the flexibility, agility, and access to trade allies; all of which are limited in a traditional utility structure. Outreach professionals that execute a well-planned, integrated strategy, utilizing segmentation and differentiation, will more effectively engage your trade allies.

Developing and maintaining good relationships with trade allies is much like maintaining any other relationship. The benefits of a strong trade ally relationship can be wide reaching for your program, for their business, and for the customers you both serve.



Karen Germain is a Business Direction Principal with Program Development and Implementation (PDI), Sustainable Energy Use (SUS). She is leading the Lead-to-Application process for PDI's energy efficiency program implementation teams. Ms. Germain has extensive leadership and management experience that includes multiple director-level positions, a strong international background, and full P&L responsibility for multimillion-dollar businesses. She has a proven, consistent record of revenue, profit, turnaround, and business growth achievements throughout her career. Ms. Germain has 10 years prior experience in corporate marketing and communications and has supported clients in sales development activities, including General Motors, Chrysler, Ford, Saab Sweden, Volvo Sweden, and various Tier 1 suppliers.

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Practical Solutions for In-Service Pitch Bearing Issues

by Becki Meadows and Jason Shapiro

Multiple wind turbine failure databases reveal that pitch bearings are one of the subassemblies with the highest failure rates, and largest contributors to overall downtime. The average life of a pitch bearing varies by manufacturer, turbine, and site operating conditions. Given the current design constraints, as the diameter of wind turbine rotors increase, and projects are placed in more turbulent sites, failure rates are expected to rise.

The pitch bearing allows for variable pitch position of the blades to maximize energy yield, and for load transmission from the blades to the hub. The most common pitch bearing arrangement used in wind turbines is the double row 4-point contact bearing, also known as an 8-point contact bearing. Similar to bearings found in the gearbox, the pitch bearing is comprised of outer and inner raceways, a cage, and rolling elements. Cage designs vary, and include individual plastic spacers, and single or multi piece split cages. The pitch bearing is equipped with two seals to contain the grease within the bearing, and prevent the ingress of foreign particles. (Figure 1).

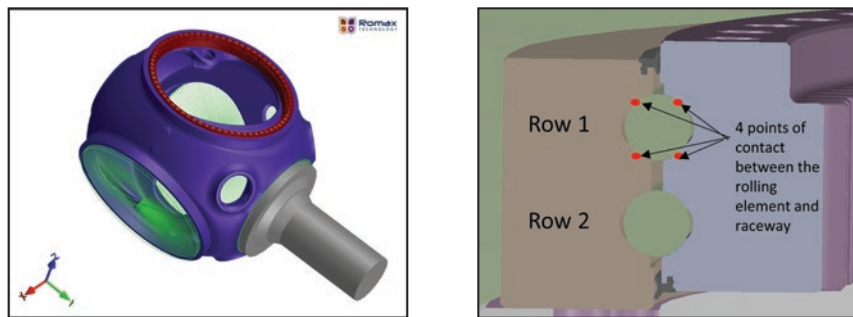


Figure 1: The pitch bearing connects the blade to the hub and allows for variable pitch position of the blades. The most common pitch bearing arrangement utilized in wind turbines is the double row 4-point contact bearing, also known as an 8-point contact bearing.

Common Failure Modes

In service, the pitch bearings rotate in short intermittent sweeps, and can spend extended time with little to no rotation. Due to slow rotational speeds, pitch bearings operate in boundary lubrication, which can result in more rapid accumulation of surface damages compared to bearings that operate with sufficient film thickness. Extensive root cause analysis work identified common causes of failures, including ellipse truncation, cage wear and surface fatigue cracks originating at stress concentrations, and quality issues from poor induction hardening (summarized in Table 1).

The cause of ellipse truncation is typically due to deflections in the bearing raceway, due to insufficient stiffness under normal operating conditions, or extreme loading events. This results in high loads at the edge of the raceway, which leads to macropitting.

Another common failure mode is outer ring cracking, usually located in the vicinity of a stress riser such as a through hole, or other feature. This cracking failure mode is normally isolated to a specific bearing design or supplier. If allowed to continue operating, the crack can eventually progress into the hub and cause other system failures.

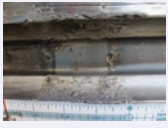
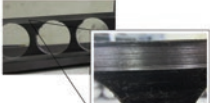


FAILURE MODE NAME	FAILURE MODE DESCRIPTION	POTENTIAL ROOT CAUSES
Soft Zone Damage – Bearing Inner Ring		Manufacturing quality or improper positioning of the soft zone within the bearing load zone
Cage Damage		Abnormal loading of the cage and high contact pressure with the hardened raceway
Outer Ring Cracks		Finite element analysis of the system showed high stresses within the outer ring, which led to crack growth from the lifting hole
Macropitting – Outer Ring Raceway Edge		Damage isolated at the edge of the raceway indicates high contact stresses due to ellipse truncation

Table 1: Summary of common pitch bearing failure modes as identified by numerous root cause analysis investigations.

Failure Detection

The turbine controller alarm system and grease analysis are the current industry standards for detecting pitch bearing issues. The turbine control system alarms when the failure has progressed to a state of catastrophic or functional failure. Grease analysis can provide more advanced warning by allowing the reliability engineer to investigate the size, shape, and type of wear particles present in the grease. With this information, an assessment of the bearing health, and severity of damage can be determined. However, it is difficult to ensure that the sample collected from the bearing is representative of the entire bearing; there are no hard and fast guidelines to easily interpret test results.

Some wind farm owners and operators have successfully detected pitch bearing damage through analyzing SCADA parameters, such as pitch motor current, pitch ram pressure, and pitch tracking errors. This is more complex, since anomalies can be due to the pitch adjustment mechanism, rather than the actual bearing.

Additional techniques for pitch bearing health monitoring are under development, and in the early stages of adoption within the industry. These include vibration assessment and

borescope inspection. Portable vibration equipment can be used to capture data on the pitch bearing during constant speed pitch from 0 to 90 degrees. This data is analyzed for the presence of pitch bearing fault frequencies. This method has the potential to provide owners and operators with more advanced warning than current industry methods.

Depending on the bearing design, a borescope inspection may be possible through the grease zerks, or other ports located on the pitch bearing. Typically, a 4mm borescope is recommended for the inspection, due to the small port size and limited space within the pitch bearing. Borescope inspection has the benefit of visual damage confirmation, allowing for a more proactive approach to replacement, as opposed to the strategy of replacing upon functional failure.

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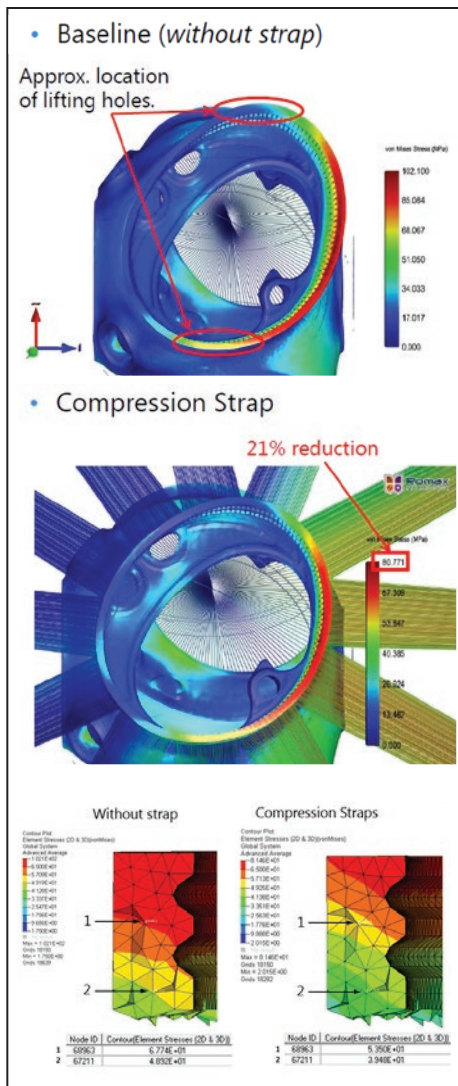


Figure 2: Innovative pitch bearing field retrofit solution that can be installed uptower on an in-situ bearing. The outcome is a pitch bearing that operates at a reduced stress, thus extending its life.

Practical Field Solutions

Changing the grease type, re-lubrication quantity, and frequency can be performed on pitch bearings to address wear related failure modes. However, failure modes such as macropitting from ellipse truncation or outer ring cracks require a different corrective action.

Innovative solutions are now coming to market to help extend the life of in-service pitch bearings. Applying a compressive stress to the outer ring can eliminate the formation and propagation of cracks in the pitch bearing. FEA analysis of the hub and pitch bearing can identify the levels of stress that contribute to crack propagation. Then the amount of outer ring compressive stress required to reduce the von Mises stress at the crack initiation point can be determined. Figure 2 shows a pitch bearing field retrofit that resulted in a 21 percent stress reduction. This corrective action hardware can be installed uptower on an in-situ bearing. It is recommended to preform field verification testing utilizing strain gauges to measure the strain before and after compression hardware installation, as well as during turbine operation. The measured values need to correlate with the predicted strain values. The outcome is a pitch bearing that operates at a reduced stress, thus extending its life.



Becki Meadows is a consulting engineer with Romax InSight. She graduated from the University of Michigan with a degree in mechanical engineering and went directly to work as a field engineer for General Electric's Power Generation division, inspecting and repairing steam turbines and generators at small/medium power plants across the country. During her five years with GE, she was trained in statistics and process management, which led to a career as an independent consultant/trainer and co-author of a book on how to use statistics to effectively manage business. Prior to working at Romax, she worked as a senior engineer at the National Renewable Energy Laboratory (NREL) completing wind resource assessments for the federal wind program and cost of energy modeling for distributed energy and offshore wind projects.



Jason Shapiro is the engineering manager for the Romax InSight field team. He started his career in the wind industry in 2008 working for a major turbine manufacturer as a drivetrain engineering specialist. His expertise includes bearing and gear failure analysis, reliability engineering, lubrication analysis, supplier audits, and fieldwork. Jason has a mechanical engineering degree from the University of Colorado and lives in Boulder, Colorado.

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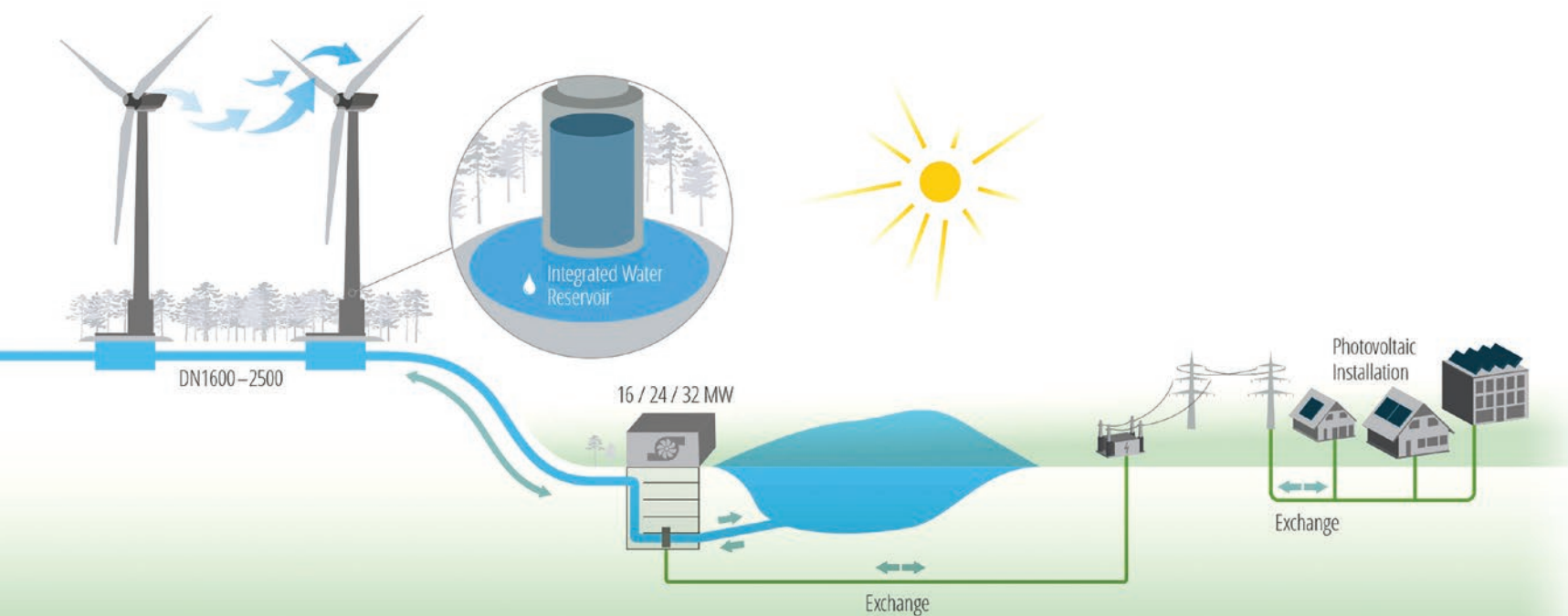
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It's Time to Talk About Virtual Net Demand

by Jürgen Joos

WITH EVERY ADDITIONAL METER OF HUB HEIGHT ADDED TO A WIND TURBINE, the annual energy yield increases by 0.5 to 1 percent. Reduced wind turbulence resulting in significantly better wind yield speaks in favor of hub heights over 130 meters, especially at inland locations with weak wind. This delivers a faster return on investment (ROI) for the entire project. With new hybrid towers, hub heights of up to 180 meters can be realized economically. This is possible thanks to a unique combination of precast concrete parts and steel elements. They even can be manufactured locally in a mobile factory. A pilot plant, combining wind turbines and pumped storage, is breaking new ground to further increase the efficiency and yield of wind turbines.

Last year, the world's tallest wind turbine, with a hub height of 165 meters and an overall height of 230 meters, was built in Germany. The facility in Bickenbach demonstrates what is possible at great heights. Here, a new hybrid tower system was used. Hybrid towers deliver greater yield and high efficiency, especially inland. As far as the heights of wind turbines are concerned, there is great potential, particularly in North America.

The tower consists of a concrete foundation poured in place, with 60 to 100 meter concrete elements assembled on top, using modular construction. The concrete elements can be combined to create towers of different heights and shapes according to a modular system. Individual tower types are designed to precisely match the static-dynamic and customer requirements of the systems.

A special segment geometry and cylindrical rings as spacers make these great heights possible, as well as the customization to suit project-specific conditions. During production, the concrete elements are machined to one tenth of a millimeter using a CNC milling machine. This makes it possible to then stack the rings precisely on top of each other – using dry joints, i.e. without mortar or other compensating layer. The steel tube is finally added for the tip at a height of 120 to 180 meters.

Using hybrid construction, it becomes possible to find the economic optimum for the required tower heights. The concrete component is completely maintenance-free and especially durable. In addition, with the strong concrete section and more flexible steel tip, the hybrid system ensures improved structural stability over pure concrete or steel towers. The modular design and simple "stacking" of the rings allow fast construction in one week, under any weather conditions.

"Local content" thanks to mobile production

For international projects, a modified hybrid tower system and mobile on-site manufacturing can be worthwhile. Here, the CNC-machined concrete segments are smaller. At the wind turbine site, a mobile manufacturing plant is set up, which assumes production of the concrete elements, using local workers and local materials. This creates added value on site, increases "local content," and significantly reduces the number of heavy transports. The high quality standards of factory manufacturing are also maintained in the mobile factory; it was only necessary to adapt the equipment and processes based on seven years of experience in the production of the concrete segments. Because of the smaller segments, it is possible to serve several wind farms at the same time, or locate the mobile factory between several wind farms, which increases the "local content".

Future-oriented symbiosis of wind power and pumped storage

Currently, a power plant combination in Gaildorf, with a new and unusual design and usage, is being launched. It complements the hybrid tower system with an energy storage option. A pilot plant connects four wind turbines with pumped storage tanks, whereby the turbine foundations serve as water storage tanks. Pipelines connect them with a hydroelectric power station and a corresponding lower basin 200 meters below, in the valley. The idea is that, where large concrete foundations are already being erected on a mountain, these can be extended to include water basins. This reduces the need for conventional pumped storage (for which the largely-unspoiled landscapes traditionally undergo massive transformation).

If wind turbines are unable to produce electricity because the wind is weak, but the grid requires electricity, water flows from the reservoirs into the lower basin and drives a turbine that produces electricity with a generator. If the plants supply more

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DuPont introduced Nomex in woven and nonwoven forms in 1967. Nomex grew out of fundamental research and development (R&D) work conducted by Paul Morgan and Stephanie Kwolek. The impetus for discovery of this inherently flame-resistant fiber was the deaths of numerous race car drivers in fiery crashes. Building on the work of his colleagues, Wilfred Sweeny, found a way to make a high molecular weight product that could be spun into a tough crystallizable fiber (later named Nomex) that possessed outstanding thermal- and flame-resistant properties. Fittingly, Nomex was first tested in racing suits in 1966 before being commercialized the following year. In 2002, Sweeny was recognized for his contributions with a Lavoisier Medal, the highest honor of science excellence awarded by DuPont. DuPont Nomex helps protect firefighters, industrial workers, and race car drivers, as well as mass transit and wind energy systems.

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power than they can feed into the grid (for instance, during strong winds), water is pumped back into the reservoirs using the excess energy. The storage system can function independently, as well as flexibly, to store externally generated excess power.

Each of the four wind turbines has two water tanks, one in the pedestals with a diameter of 16.8 meters, and one at a height of up to 40 meters. With this modular design, the extended tower footing is used for water storage. As with a standard system, the foundation for the wind turbine is installed on the base and then the tower is installed. This increases the height of the existing system by up to 40 meters, increasing the hub height accordingly. After completion, the pilot system will be the tallest wind turbine in the world, with a total height of 243.5 meters and a hub height of 175 meters.

When the water storage is needed to deliver power, the base storage is emptied first. Additionally, there are four large open basins, with a diameter of 63 meters and a water level of up to 15 meters. These accommodate the bulk of the water volume, and are used after the base storage. Each reservoir has a volume of 40,000 cubic meters. The plant is expected to supply around 2,200 full load hours and 40GWh per year. The pilot plant will reach a storage capacity of 70MWh. Seventy percent of the performance can be activated within thirty seconds. The modular construction concept enables the linking of a different number of systems, and the ability to equip the power station in the valley with three performance classes of 16, 24 or 32MW.

The potential for harnessing wind power is far from exhausted, both in hub heights and extended utilization forms.

Jürgen Joos is commercial manager at Max Bögl Wind AG, one of the largest construction, technology and service companies in the German construction industry.

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Significant Growth on the Horizon for US Offshore Wind

by R.V. Ahilan

After a slow start, development of the US's significant offshore wind resources is now truly up and running, with twelve projects in advanced stages of development nationwide. Indeed, with the National Renewable Energy Laboratory estimating its offshore wind potential at over 4,000GW, there is much to be optimistic about as the industry gets up to speed. While the recent change of administration and its desire to restore investment in fossil fuels are causes for concern, the states of Massachusetts and New York have both made commitments to offshore renewable energy that are legally binding, and separate from the federal budget.

The epicenter for this activity continues to be the East Coast, with the 290-million-dollar Block Island wind farm commissioned in late 2016. While the wind farm, located 6km off the eponymous Block Island, directly to the south of Rhode Island, consists of a modest five turbines and 30MW capacity, its significance as the US's first offshore wind farm is far greater.

Doubtless, the project has gained from the experience the industry acquired following the demise of the Cape Wind project. This 468MW wind farm seemed to signal the extent of the US's ambitions when it comes to offshore wind. The loss of state and financial backing, however, in addition to legal wrangling, saw the project scrapped – at least for the time being. The East Coast will likely remain the focus for offshore wind in the US for the foreseeable future, due to the abundant weather resource, shallow water, and ease of landfall. It is expected that once the technology for floating wind turbines matures, the West Coast will develop its own offshore wind energy industry.

However, the growth of US offshore wind remains very much in its infancy. By contrast, across the Atlantic, Europe commissioned its first offshore wind farm in 1991, securing its position as a world leader in the sector, easily outpacing other regions. This discrepancy has much to do with the respective legal and regulatory incentives in place; while EU nations have long been setting targets in terms of the amount of electricity they generate from renewable sources, the US has only recently begun to adopt similar measures. The state of New York, for instance, is now seeking to secure 50 percent of its power from renewable sources by 2030. Additionally, a bipartisan bill proposes establishing offshore wind farms in New York waters, which will generate fifty times the power output of the Block Island facility.

The delay in the development of US offshore off its east coast, relative to that of Europe, does have some advantages. Foremost is the opportunity to learn from companies who have been operating in European markets for decades, allowing newcomers to avoid many of the teething problems these markets experienced at the outset. Of course, this



is complicated by the Jones Act, which requires all vessels operating in US waters to be constructed in the US, and owned and crewed by American citizens.

The Block Island wind farm was built using turbines sourced in Europe. With the sizeable onshore wind energy industry in the US, this supply chain may be able to contribute significant support to offshore wind in the future. Even though lessons can be learned from the European experience, it is important to keep in mind the differences between US and European operations. Currently, there is limited local supply of sufficiently large monopoles to follow the European model for wind farms. This may lead to alternatives, such as jackets, being manufactured domestically because of the Gulf of Mexico energy industry.

Partnering with firms that are major service providers in the European offshore wind market will be an advantage – as long as they can also demonstrate an understanding of the local supply chain, and provide strong support for contractors and developers at the early stages of investment. This can help unlock the significant resource potential in the US, and introduce efficiencies and best practices that will reduce project costs. This, in turn, will further accelerate the market's growth.

As it looks to the future and continues to mature, the industry's ability to control costs will continue to be key to developing bankable US offshore wind projects. To do so will require sufficient mitigation of, and responsiveness to, the risks in maritime and offshore projects, as the equipment costs involved will be significantly greater when compared with onshore wind.

As turbines continue to grow ever larger, so does the potential for bigger energy yields. With this growth comes a greater need to ensure that necessary infrastructure and logistical considerations are in place. A failure to adequately protect against these risks, and ensure the safe transportation and lifting into place of these turbines, can jeopardize a project's ability to meet production targets.

While there is much to learn from Europe's experience in offshore wind, the development of the US sector presents its own challenges, the majority of which will have little to do with the current incumbent to the presidency. Offshore wind in the US has now reached the point where the potential for employment, plummeting prices, and considerable scope for state-level autonomy, promise clear seas for the industry. Nevertheless, an ability and willingness to draw on relevant expertise – particularly with respect to the technological challenges and risks outlined above – will be essential to US offshore wind achieving its full potential.



Dr. R.V. Ahilan is Group Director, Renewables Advisory & Energy Technology. He is a Chartered Engineer and Fellow of both IMarEST and RINA. He holds a BSc (Leeds) and MS (Caltech) in Civil Engineering, a PhD (Cantab) in Engineering Fluid Mechanics and an MBA (Imperial). He is a well-known and highly respected technology and business leader, with over three decades of industry experience, more than 15 years of which has been at board level. Prior to LOC, Ahilan was EVP of the Renewables Advisory Division of DNV GL, with strategic and operational responsibility for the world's largest technical advisory firm in renewable energy, formed by the merger of GL Garrad Hassan (of which he was President) and the renewables business of DNV.

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Yaw brake lifting and installation tool

Svendborg Brakes has released its yaw brake lifting and installation tool, which aims to improve safety and reduce the time taken to maintain the yaw brake systems on wind turbines. This latest innovation uses a simple carriage assembly to position, raise, and lower brakes to ensure maintenance engineers minimize any heavy lifting and complete their tasks more efficiently. The LBS 120 yaw brake lifting and installation tool has been designed to work on brake assemblies with a maximum width of 502 mm and with a brake disc thickness of 40 mm. The tool incorporates a winch mechanism that is used to raise and lower the brake to floor level, with a maximum lifting height of 2,000 mm. Created to improve safety and productivity of the engineers, the tool is easy to transport and assemble on site. Once the lifting tool has been installed, the original brake can be released, allowing it to rest on a sliding carriage which is used to position the brake below the winch mechanism used to lower it to the floor. The process is reversed to install the new brake, after which the tool can be repositioned to work on the next brake. The new service tool significantly reduces the time required to maintain yaw brakes which reduces the downtime of the turbine and minimizes running costs.

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How Well Do You Really Know Your Safety?

by K.D. Aiardo

WHEN IT COMES TO SAFETY, ARE YOU ON THE CUSP of epic greatness, or on a one-way electrical highway to disaster? We challenge you to take the following quiz to determine your safety knowledge.

1. You remove your rubber gloves from a sealed, plastic bag. That means they are perfect and you can skip the visual inspection.
 - a. True – They're fine.
 - b. False – A sealed bag does not protect them from damage such as improper storage or climate wear; even new goods sometimes have imperfections from the manufacturing process. ASTM also states visual inspections are required prior to every use (ASTM F496-08, F479-06, F478-06).
2. The best way to prolong the life of rubber goods and prevent further damage is:
 - a. Storing goods in canvas bags, totes, or tubes
 - b. Cleaning with mild soap and water
 - c. Wearing leather protectors
 - d. All of the above
3. ASTM previously known for:
 - a. American Safety Training Measurement
 - b. A Stitch in Time Management
 - c. American Society for Testing and Materials
 - d. None of these
4. Fiberglass live line tools should be removed from service every _____ years for full recertification, even if no damage is suspected.
 - a. 1
 - b. 2
 - c. 3
 - d. 4
5. Per OSHA, the use of a fall-arrest system is required any time there is a risk of fall from an elevated position of:
 - a. 3 feet or more
 - b. 6 feet or more
 - c. 3 stories or more
 - d. Currently OSHA does not have fall protection guidelines.
6. Arc-Tested materials are designed to:
 - a. Protect in the event of an arc-related incident
 - b. Be used only as a fashion accessory
 - c. Prevent additional injury in the event of an arc-related incident
 - d. Allow additional time to escape an incident
7. Grounding equipment should be removed from use if:
 - a. Clamps are broken or pieces are missing
 - b. Copper fibers are broken
 - c. Cuts or kinking are present in the cabling
 - d. A and B only
 - e. All of the above
8. As long as rubber goods are brand new, straight out of the box, and removed from sealed plastic packaging, they do not require a date stamp inclusive of testing facility, tested voltage, max use voltage, and either the date of the most recent test or expiration date of the goods.
 - a. True
 - b. False
9. FR Clothing can still be used if there is a small pin hole (less than 1mm x 1mm) is present.
 - a. True
 - b. False
10. Visual inspections should occur before every use of:
 - a. Rubber Goods
 - b. Grounds/Jumpers
 - c. Fiberglass Tools
 - d. Arc Flash Equipment
 - e. Fall Protection
 - f. All of the above
11. Fall Protection should be removed from the field if:
 - a. Buckles are bent or damaged
 - b. Ropes are frayed or cut
 - c. Belt rivets are bent
 - d. Cracking is present on belts or parts
 - e. All of the above
12. Rubber Goods may be used up to one month beyond their expiration date per OSHA and ASTM.
 - a. True
 - b. False

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How did you do? If you scored...

12/12: Congrats! You are a safety god. Your goal is to ensure, "Everyone makes it home safe at the end of the day." We hope that you spread your knowledge and encourage others to reach the same deity-like status.

10-11: You're almost perfect. With a little bit more practice, you might actually earn the bragging rights of a true safety professional. (We take some of the credit, because we're awesome.)

7-10: OK, you occasionally believe in proper safety. Try to avoid complacency and keep learning because you're teetering right on the cusp of awesomeness.

5-7: Hmm, looks like you're a bit of a risk taker (that's an understatement) and you just might survive a typical day in the field. For your sake, we highly recommend that you brush up on your Safety Guidelines before you're fined or fried... no, really...why are you still just sitting there...?

0-5: Wow. Okay. How are you still kicking? Go out and buy yourself a lotto ticket because you must be drenched in pure luck-dust. In all seriousness, we urge you closely review your safety procedures for the well being of you and your team. After all, we're all accident-free....until we're not.



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Answer Key

1. B
2. D
3. C
4. B [per OSHA1910.269(j)(2)(ii)]
5. B [(OSHA 1926.959)]
6. D [Arc Rated products are geared to providing actual protection, whereas arc-tested goods are only designed to be non-contributors in the event of an incident. For example, an arc-tested fall protection device does not protect the wearer from burns in an invent, but has been tested to resist burning and melting up to a certain point.]
7. E
8. B [Per ASTM D-120, OSHA 1910.137 standards, rubber goods must be acceptance tested (also known as proof-tested) before their first use. Therefore, a rubber goods testing lab that performs a full visual inspection in addition to an electrical test, as a part of the initial acceptance process, will rule out initial quality issues with new goods, while also certifying them for use with a fresh date stamp. On average of 12-15% of new goods fail the initial out-of-the-box testing standards; imported rubber goods are often 3-4 times higher.]
9. B [Before use, arc flash clothing should be inspected for any signs of wear, including holes, tears, or wear spots. Any damage should result in the PPE being removed from use.]
10. F
11. E
12. B [per ASTM F496]

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

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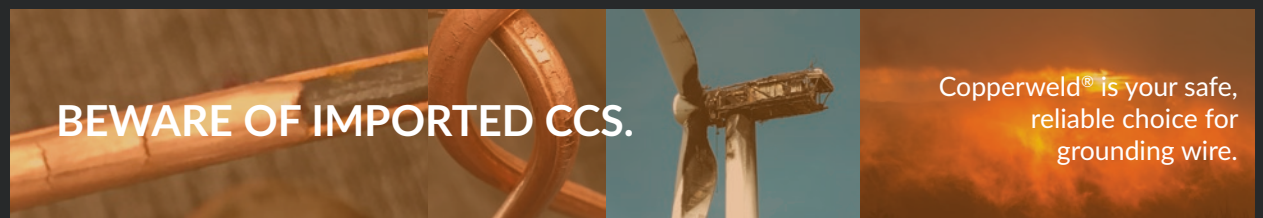
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Keeping Pandora's Box Closed

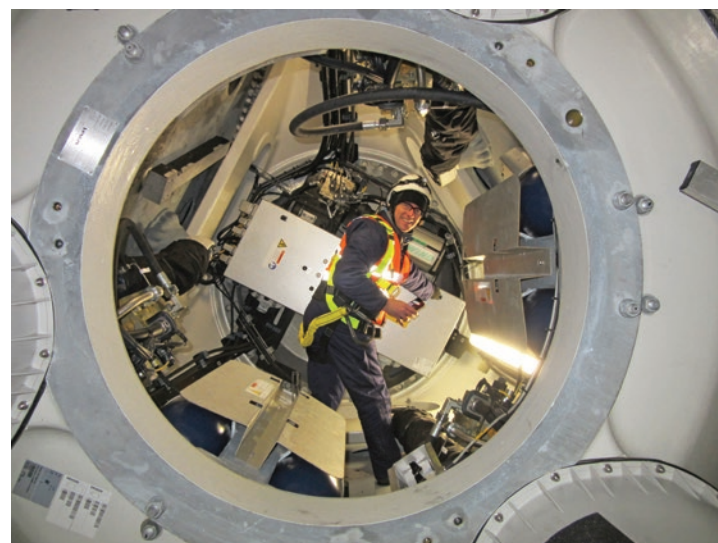
by Julius Carter

RENEWABLE ENERGY ASSET OWNERS ARE FRUSTRATED WITH THE PERCEIVED lack of control, flexibility, and transparency they receive from an original equipment manufacturer (OEM) provided operations and maintenance (O&M) service solution. Owners are also faced with the challenge of lowering operational costs while maintaining or improving performance. As a result, it is quite common for most owners to begin an arduous journey evaluating other O&M service options. Unfortunately, this often results in more questions than answers and, consequently, no change. There are opportunities and challenges associated with transitioning from an OEM service strategy, to an independent service provider (ISP) or internal service strategy, and guidance to be gained from those who have been there before. Taking a thoughtful and organized approach, and utilizing the lessons here, will keep Pandora's box closed.

Let's start by addressing the opportunities in making a change. Usually, an ISP's core business is the focus of your service need. An OEM's core business is designing, engineering, and selling its wind turbine equipment. Aligning yourself with a business that targets O&M service will naturally bring synergies that create a win-win environment and promote success. ISPs can also enact changes and provide flexibility in service offerings. It is much harder for an OEM to react to the specific needs of its customers; in large OEM organizations capable of manufacturing wind turbines, the existing bureaucracy tends to make them organically inflexible.

Further, you can enjoy more transparency from an ISP. Largely unburdened by financial consequences from turbine component warranties or serial defect issues, a responsible ISP will strive to communicate openly on turbine challenges, and advise on how to improve turbine performance at the site. This attention and partnership leads to a high level of customer service that is difficult to achieve with an OEM service strategy in place.

Arguably, the most important opportunity when evaluating a service strategy change, is lowering the operating cost at the project. An ISP typically has much lower overheads and risk to mitigate when proposing a service solution for a project. The result can be significant long-term, direct cost savings for the project.



If all this sounds too good to be true, it is. There are risks to an ISP or internal service approach that need to be considered and mitigated in order to take advantage of the opportunities just described. This is where the journey can get ugly. Knowing which hazards to look for will significantly increase your chances of realizing success.

First, be prepared to define the scope of service that you need. Unfortunately, simply stating that you need O&M service isn't enough. O&M service means different things to different providers. Ask yourself these key questions:

- What does success look like? The answer should create the backbone of the strategy you need.
- Do I need spare parts procurement and an inventory management solution?
- Do I have the technical documentation for my wind turbines? You probably wouldn't buy a home appliance without this information, so make sure you have it for your multi-million-dollar project.
- Do I have all the tools I need to operate and troubleshoot my turbines? Many tools and software programs utilized by an OEM are considered proprietary, and may require a special support agreement or license with the OEM. An ISP will request access to these tools from the owner in order to properly provide service.
- Do I have enough time? Time is not on your side when preparing for a new service strategy. Review the notification deadlines in existing contracts, query ISP's on lead time requirements, and evaluate your internal lead times to give yourself adequate time to put a new service in place.

Once you have been able to gather answers to these questions, make sure value still exists. Do not fall into the trap of, "I've gone this far so I better keep going". Often, but not always, the pros still outweigh the cons.

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At this point down the path, it's time to evaluate ISPs and their capabilities and value propositions. Not all are the same, and it is vitally important to understand the differences. Each has its own idea of what is important and valuable when executing O&M service. Finding an ISP that aligns with your needs is crucial. Be sure to analyze the following key areas:

- Safety performance – does the ISP have a solid safety record and systems in place to promote a safe working environment?
- Environmental performance – is the environment important to the ISP? How will they treat an oil spill?
- Quality management system – does the ISP utilize a system that conforms to ISO standards? Is quality a priority for them?
- Experience and knowledge base – will the ISP be capable of executing the services to the standards you expect? Does the team have the knowledge of the required turbine models?
- Cost – while a high cost may disqualify an ISP, be careful of low bids. Both may be a sign that the ISP is not evaluating your project and your needs correctly. It is important to make an apples-to-apples comparison between ISPs submitting proposals.

Though pondering an O&M service change might risk opening a Pandora's box, the benefits of change can also lead to lower operating costs with improved project performance. Ask yourself what success looks like, and take the time to address your concerns. Finally, set yourself up for positive results by performing a thoughtful and penetrating evaluation of potential ISPs. If that ISP happens to be yourself, be realistic, and make sure you have calculated the internal costs correctly.



Julius Carter is the Head of Operations & Asset Management, North America for Natural Power. He has worked in O&M as an asset owner, as an OEM O&M service provider, and as an ISP in the power generation industry for over 15 years.

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55-ton extendable trailer

Talbert Manufacturing introduces its 55SA-TELE heavy-haul trailer, featuring a deck length of 54' when open. Operators can retract the trailer to 32' 6" which shortens the overall trailer length to 53', eliminating the need for permits. Talbert designed the 55SA-TELE with a 90" swing radius that can be extended to 114" with the use of a gooseneck extension. Users can set up the trailer as a four-axle close coupled, 2 + 2 spread axle or 3 + 1 spread axle configuration. The third and fourth axles can be flipped or removed, plus a 24" pinned and hinged gooseneck extension can also be flipped. The unit features a 29' wood deck in the front and a 3' Apitong platform in the rear with beams stretching between. The trailer expands and locks in 4' increments. The 55SA-TELE also is equipped with Talbert's ENitro nitrogen assisted dampening system. ENitro provides a safe and stable platform that virtually eliminates bridging of the spreader. The system's nitrogen accumulator oscillates around a central self-tracking pivot point to provide proportional weight distribution in each axle grouping. It sets the axle load capacity and keeps it there as the system equalizes up and down articulation. The trailer also features low deck heights of 20", which optimizes headspace for taller equipment. The trailer has an air ride suspension and can be equipped with optional Dura-Bright aluminum wheels, strobe lights at each axle, and a battery backup that powers the lighting package when the trailer is disconnected from the truck power. The trailer is built with 100,000-psi minimum yield steel, giving it the durability to withstand harsh day-to-day environments.

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www.enerpac.com

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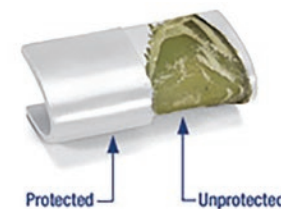
• MPP-141480-CB Cross Bonding Pedestal



• Box Pads for Grounding Transformers



• Chuted Box Pads in various sizes accommodate a variety of Pad-Mount Transformers



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www.3m.com/Wind



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SEE AD ON PAGE 13



SIEMENS

Siemens Wind Power, Inc.

Product: 2.625-120 Siemens Wind Turbine

Capacity: 2.625MW

Blade length: 59m (~ 193ft)

Hub height: 85.1m (279ft)

Swept area: 11,310m²

Nominal power: 2,625kW

Cut-out wind speed: 22 m/s

Key Features:

- Longer blades and internal refinements for increased capacity factor;
- Specifically designed nacelles allow easy access to the moving parts of the geared turbines, lowering service costs and reducing work time;

- A reliable machine optimized for the American grid and site conditions for American needs;
- The high capacity factor can be used in medium wind sites for a dramatic improvement in the cost of energy;
- Robust and flexible aeroelastic tailored blade, designed in Boulder, Colorado;
- Environmental agility features allow this turbine to adapt to most outdoor conditions;
- Diagnostics services enable the early detection of anomalies, and prevent potential failures.

www.siemens.com/wind

SEE AD ON PAGE 19



Nordex/Acciona Windpower

Product: AW125/3000

Capacity: 3000kW

Blade length: 61.2m (200.78ft)

Hub height: 87.5m to 120m (287ft to 393.7ft)

Swept area: 12,305m²

Rotor speed: 86.5 m/s

Nominal power: 3000kW

Cut-in wind speed: 3.5 m/s

Nominal wind speed: 10.5 m/s

Cut-out wind speed: 25 m/s

Key Features:

- Ideal for higher wind projects in the Central Plains and Texas;
- Optimized design for the US market;
- Financed by top lenders.

www.nordex-online.com



LEITNER

Product: LTW77

Capacity: 1.5MW

Blade length: 37.3m (122.38ft)

Hub height: 65m (213.25ft)

Swept area: 4,608m²

Rotor speed: 17.8 rpm

Nominal power: 1.5MW

Cut-in wind speed: 3 m/s

Nominal wind speed: 14 m/s

Cut-out wind speed: 25 m/s

www.leitwind.com



ENERCON

Product: E-141 EP4

Capacity: 4.2MW

Blade length: 66.7m (219ft)

Hub height: 99/129/135/159m (324/423/443/522ft)

Swept area: 15,614.5m²

Rotor speed: 4 to 11 rpm

Nominal power: 4.2MWh

Cut-in wind speed: 2.5 m/s

Cut-out wind speed: 34 m/s

www.enercon.de



Vestas - American Wind Technology, Inc.

Product: V116

Capacity: 2.0MW

Blade length: 57m (187ft)

Hub height: 120m to 135m (394ft to 443ft)

Swept area: 10,568m²

Nominal power: 2000kW

Cut-in wind speed: 3 m/s

Nominal wind speed: IEC IIB (medium to low wind)

Cut-out wind speed: 20 m/s

www.vestas.com



Goldwind Americas

Product: GW 140/3.0MW(S)

Capacity: Scalable: 3.0MW to 3.4MW

Rotor diameter: 140m (459ft)

Hub height: 100m and 120m (328ft or 394ft)

Swept area: 14,712m²

Rated power: 3000 to 3400kW

Cut-in wind speed: 2.5 m/s

Rated wind speed: 10.5 to 11 m/s (based on site conditions)

Cut-out wind speed: ≥20 m/s

www.goldwindamericas.com



Suzlon Wind Energy Corporation

Product: S128
Capacity: 2700kW
Blade length: 64m (210ft)
Hub height: 86m to 120m (282ft to 394ft)
Swept area: 13,000m²
Rotor speed: 7.3 to 12.1 rpm
Nominal power: 2700kw
Cut-in wind speed: 3 m/s
Nominal wind speed: 9.5 m/s
Cut-out wind speed: 20 m/s
www.suzlon.com



Senvion

Product: 2.3M124
Capacity: 2.33MW
Blade length: 60.7m (199ft)
Hub height: 90m to 110m (295ft to 361ft)
Swept area: 12,076m²
Rotor speed: 7.3 - 13.3 1/min (+12%)
Nominal power: 2330kW (MV side) (60Hz)
Cut-in wind speed: 3 m/s
Nominal wind speed: 12 m/s
Cut-out wind speed: 18 m/s
www.senvion.com



Siemens Gamesa Renewable Energy

Product: Gamesa G132-3.465 MW
Hub height: site specific
Wind class: IIA
Swept area: 13,685m²
Capacity: 3.465MW
Power density: 253.20 W/m²
Blade length: 64.5m (212ft)
www.gamesacorp.com/en

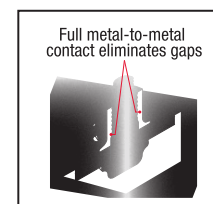
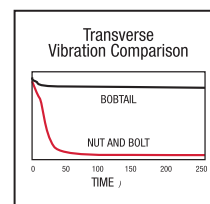


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Deploying Solar Trackers in Harsh Environments

by John Williamson

The implementation of solar tracking technology at utility-scale solar sites has grown exponentially over the past few years. In a recent report, Greentech Media has estimated that over 70 percent of all U.S. ground-mount projects are now being installed with trackers. This number has grown in large part due to the economic benefits tracking provides over fixed-tilt systems. For example, solar trackers typically account for 10 percent or less of the total cost of a utility-scale project, and in return, will produce an average increase of 20 percent in power production. This once-optional technology has now become a centerpiece for many utility-scale installations.

There are multiple solar tracker options available on the market today. In order for utility sites to maximize the benefits of trackers, solar asset developers, owners, and EPCs must be able to identify the best tracker for the job. As the new solar frontier pushes into less-than-ideal sites, this includes looking at reliability and durability, as well as the ability to affront unique terrain and environmental challenges. Keeping these key considerations in mind will help ensure the right tracker is selected to meet the needs of a project.

Considerations When Selecting a Tracking Vendor for Harsh Environments

For obvious reasons, reliability is the most important feature to consider when selecting a solar tracker. To fully reap the benefits of tracking, and reduce operational risk, it's critical to maximize system uptime, and minimize the amount of potential failure episodes. Trackers will face harsh environmental conditions repeatedly throughout their 30-year lifespan, and must be designed to operate normally, even under exceptional circumstances.

Structural integrity and a tracker's design approach to wind loading is another critical consideration. Some trackers are designed to withstand the specified site wind speeds at any tilt angle, while most other trackers are designed to withstand high winds only in a horizontal stow position. Horizontal stow design approaches include many assumptions that require careful analysis in order to safely design for the dynamic movement of the tracker in the wind. Critical assumptions include wind turbulence, wind attack angle, structural stiffness, structure damping, and other factors. If these elements are not carefully considered,

it could lead to immediate structural problems. It's important to request documentation on the tracker's structural and aerodynamic analysis and wind tunnel studies, to ensure these elements have been considered.

Lastly, it's imperative that solar trackers have the ability to accommodate diverse terrain conditions. Optimal solar sites are typically flat, and located in mild regions that experience little wind. Unfortunately, due to the recent growth of the industry, most of these ideal locations are already in use. It's becoming increasingly common to develop sites at higher latitudes, with reduced footprints, and terrain challenges. To meet these standards, solar asset owners will benefit from trackers that have high density and terrain-following capabilities, so as to maximize the use of land, and avoid site grading altogether.

Sorting Through the Crowded Landscape

While all trackers are manufactured to accomplish the same goal – tracking the sun from east to west to maximize productivity and power generation from PV panels – the design architecture, electrical and electromechanical components, as well as load relief approaches, can vary greatly. Consequently, their suitability for deployment in harsh environmental conditions will also vary.

One of the biggest differences between tracker architectures is the amount of electrical and electromechanical components required to operate the system. Centrally linked trackers employ streamlined designs that minimize the number of components, and thus potential failure points, per megawatt. Decentralized trackers rely on 167 times more components per



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megawatt to operate properly. The number of components is a key contributor to assessing reliability, risk of failure episodes, and operational longevity.

Another key difference is the tracker's structural design approach to loads. Innovative tracker solutions are designed to automatically handle forces on the system on a row-per-row basis, and allow each row to rotate to a variable "safe-position" naturally. This automatic process is mechanically based and does not require the use of sensitive componentry to function properly. Other trackers rely on an active stow strategy – a horizontal defensive position – in order to survive high wind speeds. Active stow design approaches require multiple control system components, including wind detection, control and communication, and drive systems to all function flawlessly, in order to ensure the ability to assume the horizontal stow position when required. The potential for failure of any one of these components during storms – which is when they are most needed – is high. Stowing at a flat position can also subject single-axis trackers to torsional instability phenomenon, which could damage modules or the tracker system itself, as previously mentioned.

Case in Point

A 200MW utility-scale solar tracking project was recently commissioned in Kern County, California. While the climate of Kern County provides ideal solar production conditions, this specific site presents many environmental obstacles. In the Californian desert, seasonal temperature fluctuations swing wildly; record temperatures range from 3°F to 113°F (-16.1°C to 45°C). In addition, high wind speeds are a common issue at the site. It's typical for winds to approach 60 miles per hour, and form hazardous sand dunes.

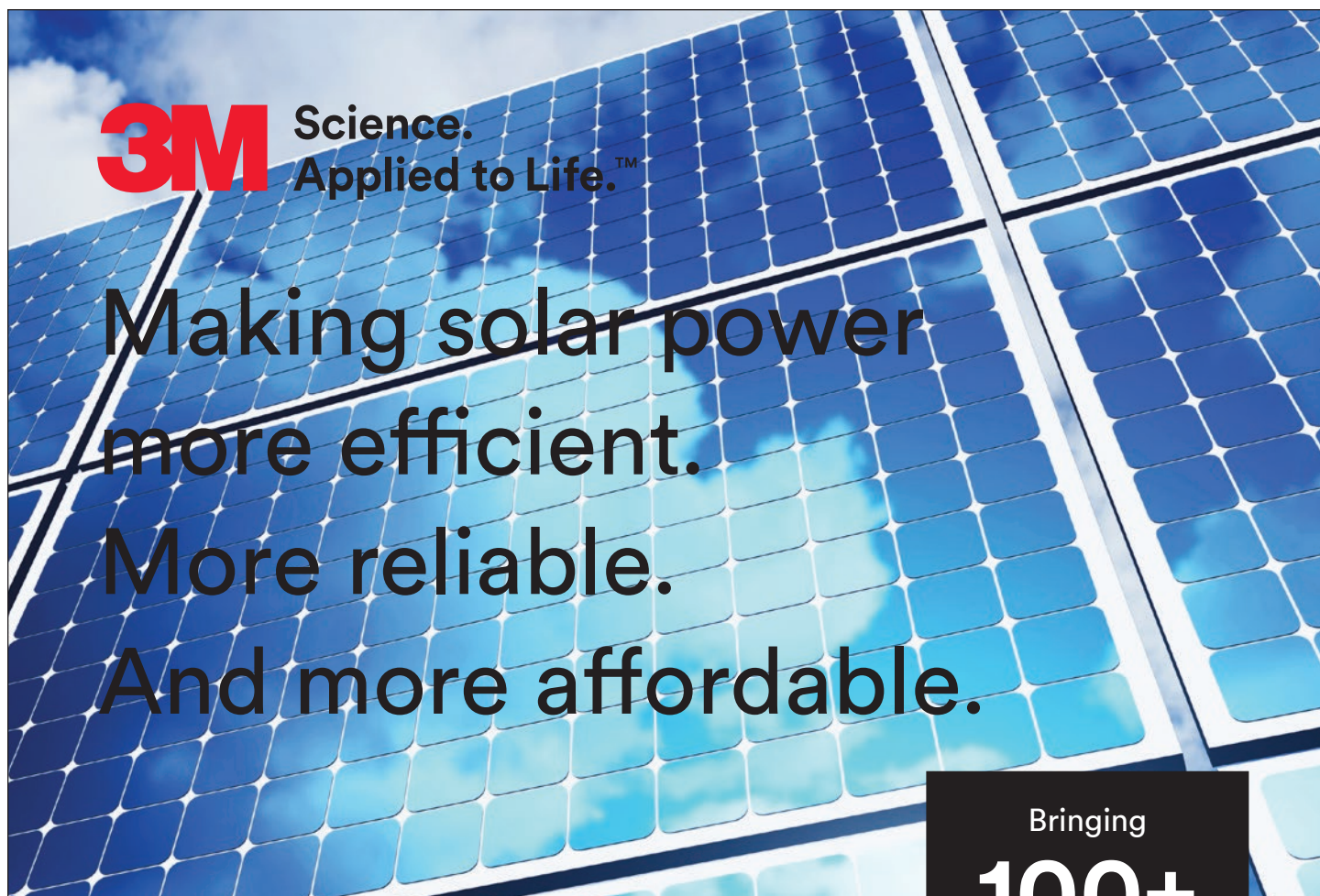
The solar trackers implemented at the Kern County site were designed to endure harsh conditions and ensure the lowest cost of ownership over time. A flexibly linked, single-axis tracker architecture was selected for its streamlined design with fewer components, fewer potential failure points, and a risk-free load mitigation approach. The trackers use industrial-grade components designed for outdoor applications, and are built to withstand temperature swings from -30°F to 140°F (-34°C to 60°C). Lastly, the tracking system features a torsion limiter, which is a unique component that allows each row to assume a variable safe-position naturally, to mitigate excess loads from high wind speeds, or loads from the formation of sand dunes. This low-risk tracking system guarantees optimized solar generation over the project's lifespan, regardless of the environmental pressures present at the site.

Conclusion

The solar tracker is the foundation of a utility-scale project. The choice of tracker is a fundamental decision that has enormous implications for a project's overall economics and profitability, especially for sites facing harsh conditions. It's important to ensure that the tracker is designed to withstand the particular environmental considerations of each site in order to experience the full production-enhancing properties of solar tracking technology while minimizing operational risk.

John Williamson is the executive chief engineer for Array Technologies, Inc., where he leads a team of engineers of various disciplines as they optimize mechanical systems, components, and software for Array products. In his years at Array, he has been an integral part of the success and expansion of the company and its core product lines. John holds a MS and BS in mechanical engineering from the University of New Mexico.

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Why Owners Have Difficulty Finding the Cause of Solar Underperformance

by Adam Baker

IDENTIFYING SMALL PROBLEMS EARLY IS CRITICAL TO maximizing the long-term revenue of a solar plant. Even at pennies per kilowatt-hour, when considering one bad cell in one module, the math over the life of the plant can translate to tens of thousands.

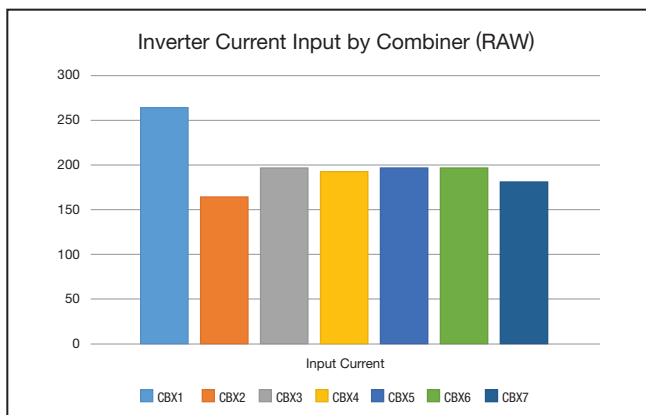
The problem is, owners aren't finding issues. Terabytes of data gleaned from onsite SCADA and monitoring systems does no good if it's misinterpreted or not analyzed correctly.

Many solar plant owners assume that, just because inverters reach maximum output, they're making maximum possible energy. Or they base day-by-day plant performance off misleading or vague solar data.

The raw value deception

Raw solar data values get operators into trouble. When viewing raw values, the user must know precisely what values should be to correctly determine underperformance.

Let's look at an example.



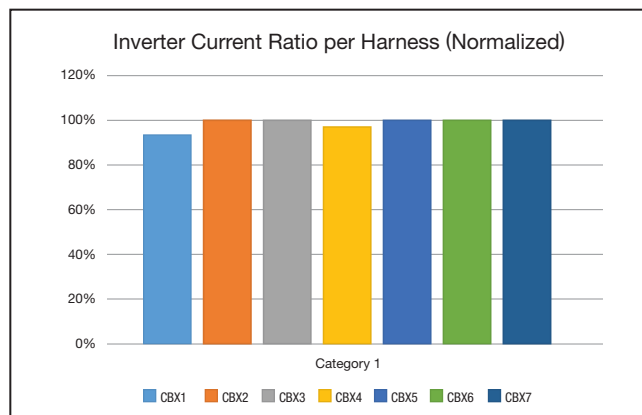
With the geographical variability found in smaller sites, array layouts may be unique for each inverter. The result is a set of combiner boxes with different harness quantities, and therefore, noncomparative raw data values.

An operator looking at combiner box current as a raw value may see 210A from combiner box 1, and 165A from combiner box 2. A logical operator would most likely draw the (incorrect) conclusion that, because the output from combiner box 2 is lower than combiner box 1, box 2 has a problem.

In reality, combiner box 1 has 25 harnesses, while combiner box 2 only has 19. In fact, producing 210A means combiner box 1 is actually the one with the problem. In fact, it's underperforming by almost 9 percent.

That incorrect assumption would trigger a waste-of-time work order to investigate combiner box 2.

This is where normalized values come into play.



A normalized value of "current per harness" divides total combiner box DC current by number of harnesses. Using this calculation, the scenario above would easily identify combiner box 1 as the underperformer.

Where the problem begins

The site's Supervisory Control and Data Acquisition (SCADA) integrator is responsible for gathering and setting up data points. Some integrators without a background in utility-scale solar plant production don't completely grasp the hierarchy of energy production.

Their experience in other industries tells them all similar devices are created equal. They see no reason to normalize data points, so solar human machine interfaces (HMI) are developed with correct, but extremely deceptive, raw values.

Start normalizing data for simpler analysis

Data normalization is the first step to remedy SCADA systems that pull deceiving raw values. The most important data to normalize includes:

- Combiner box current
- Module bin class
- DC watts behind inverters

A SCADA integrator with solar experience takes raw data, and adjusts it based on other values and percentages onsite. By viewing comparative values, operators have a better picture of real-time performance.

To make normalized data even easier to view, a SCADA integrator can design a bar chart based on the normalized data. Playing the 'one of these things is not like the others' game is a lot easier when looking at a graphical representation. When everything is performing as expected, all the bars line up. When one bar falls below the standard line, it's a quick visual signal that identifies underperforming modules.

Investigating underperformance with deep dive analysis

Examining the possibility of underperformance by taking a deep dive into the data collected by SCADA should be a regular action taken by solar operators. Unfortunately, it's not.



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Connectors for large diameter cables

HARTING's Han 3A now can be assembled with cable diameters as large as M25 instead of the previous limit of M20. This increase allows the connectors to be configured with any contact insert in the series, including those with higher rated current and bigger cross sections – such as the Han Q series. The hoods also meet the requirements of protection classes IP 65/67. The new Han 3A hood components feature a narrow external geometry overall, terminating in the cable holding area. In the plastic version, the hood is available with a bigger M25 connection, which makes additional types of mounting feasible, for example on control cabinets. For metal Han 3A, coupling hoods are available in M25 along with the existing housings. Other versions, such as EMC – electrically conductive and M – for stricter corrosion requirements, also are available. The HARTING M25 screwed cable glands for both the plastic and metal 3A size hoods cover a clamping range of 9-18mm.

www.harting.com

Solar data performance analysis helps answer the “why” of low site performance, but is often left out of initial engineering design. The critical insight collected from performance analysis allows users to answer questions such as:

- Was there downtime yesterday?
- What does a comparison of Thursday to last Thursday look like?
- What does a comparison of yesterday to the same day a year ago look like?
- What components underperformed?

For example, you can compare today's performance to a day with similar ambient temperature and insolation, while factoring in the number of daylight hours and inverter clipping time to normalize watt hours.

With that formula, you can see today the site produced 45.2MWh, but on a day with similar weather the site produced 47.2 MWh.

Detailed reports are created when you start to drill down and investigate why performance differs from one time period to another. Unlike the typical megawatt-hours vs w of irradiance revenue reports run by most solar operators, performance analysis reporting goes deep into the details of factors that could cause performance decrease.

Successful performance analysis relies on a deep understanding on how solar farms production works. Most owners don't have this detailed level of knowledge, and lack a performance engineering team to maximize revenue for their plant. Those owners must instead rely on a system integrator who does.

Instead of concerning themselves with site power, the integrator should focus on factors that affect the MWh per month, and related plant inputs that can be tweaked to increase revenue.

The better an owner's support team and toolset to find the issues, the sooner they will be able to recover any lost revenue and resume normal plant operations.



Adam Baker is Senior Sales Executive and a solar SCADA integrator at Affinity Energy, with 25 years of experience in utility-scale solar plant controls, instrumentation, and data acquisition.

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California Farms' Newest Harvest - Solar Energy

by Garrett Colburn



ACROSS THE GOLDEN STATE, FARMERS ARE TURNING THEIR FOCUS from the soil to the sky by adding large-scale photovoltaic (PV) installations to their land. California farms account for almost one-fourth of the total number of solar panels installed on farms nationwide. The adoption of renewables on farms is growing quickly, and spans the entire nation; over 57,000 farm businesses engaged in producing renewable energy such as solar, wind, and geothermal in 2012 - more than twice as many as in 2007. The agriculture industry is soaking up the benefits of solar like never before, and realizing the real business advantages associated with going green.

Like many industries, farms consume a great deal of energy. They must be able to heat and light onsite barns and buildings, pump water for irrigation, feed animals, harvest milk, and dehydrate or refrigerate crops. The University of Wisconsin estimates that the average dairy farm uses between 800 and 1200 kilowatt-hours per cow per year (kWh/cow-yr) of electricity. The EPA estimates that, in 2014, fuel and electricity constituted 12 to 16 percent of total cash expenses for rice, cotton, peanut, and poultry producers, compared with 7 to 10 percent for other crop and livestock producers.

Due to falling technology prices, solar has become a financially viable option to help both commercial and family-owned farms better manage this high-energy expense. Module prices have dropped 33.8 percent since the first half of 2016, and PV pricing is expected to continue to fall in the coming years. Labor costs have also fallen - the solar industry experienced a \$0.01 per watt of DC current (Wdc) drop from the first to the second half of 2016. Solar is on track to beat prices associated with traditional energy sources, making it a more attractive option to farmers across the golden state.

Here are some of the key benefits that farmers can gain from going green:

Cost Savings

Many farm owners currently see energy as a fixed cost; they believe there's nothing they can do to bring that cost down. However, smart farmers are quickly realizing that solar enables them to control energy costs and better manage their expenses. Solar resources allow farms to purchase electricity at or below local rates, and lock in fixed energy pricing for years. Attractive tax incentives, and financing options like Power Purchase Agreements (PPAs), can also help farms go solar with little to no up-front cost. Every dollar counts for farmers. Solar reduces operating costs to free up vital revenue and help farms succeed.



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Energy Independence

Energy price volatility can greatly impact farms. The ever-changing rates, incentives, and demand charges make it difficult for many farms to plan financially. By investing in onsite power generation like solar, farms can more effectively manage and plan for future expenses.

A leading provider of fresh produce has recently taken advantage of solar and wind installations at its facility. Through the combined power of these two clean energy assets, that facility can now offset up to 25 percent of its energy use with predictable and affordable onsite supplies.

“Solar power, and other forms of renewable and alternative energy are a great way to manage energy costs in a predictable way and create a platform for promoting sustainable business practices,” said the Director of the facility. “It’s important for companies in the food industry or any other sector to understand their energy profile to identify the best mix of alternative energy investments that can help the company meet their energy goals.”

Attractive Branding Opportunities

Solar also offers a unique “sustainably produced” branding opportunity to farms, branding that’s in demand by today’s consumers. Sustainable practices can increase business; consumers are more likely to spend money on products that were grown sustainably, for the “green glow” of knowing that they are responsible and eco-friendly in their consumption.

The 2015 Nielsen Global Corporate Sustainability Report states that 66 percent of global consumers say they’re willing to pay more for sustainable brands. In consumer markets, sustainability and environmental responsibility are increasingly important corporate values that impact purchasing decisions. To remain attractive to modern consumers, farms can emphasize that they utilize onsite solar energy to produce their crops.

Farmers are quickly realizing the many economic and environmental benefits of installing onsite solar. In addition to greening operations, the predictable and low energy costs, and sustainable company branding, make going solar a no-brainer for California agriculture.

Garrett Colburn is the Director of Marketing Communications and Demand Generation at REC Solar, which has been a commercial solar leader since 1997, and is majority-owned by Duke Energy, the largest utility in the United States.

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Focus on Service Can Unlock Solar Revenue Growth

by Athani Krishnaprasad

The solar industry faces several hurdles in the near future as subsidies fluctuate, government policies shift, and traditional oil and gas companies enjoy resurgence. With these realities, solar companies must look beyond simply selling more infrastructure and product for growth. With competition growing, leveraging service (not product) as a differentiator is more important than ever.

Investing in modern service systems can prove wildly effective in fostering organic growth in the face of these challenges. As we recently found in a multi-industry study of the results the customer sees, those who invest in their service businesses see a 13 percent uptick in service revenue on average. And as Bain & Company recently posited, “Service can be a highly profitable business in its own right for industrial goods companies, generating a better and faster return on investment than large-scale R&D programs, new production facilities or acquisitions.”

But at the end of the day, it’s all about making customers happy — and shipping product can’t do that on its own. Efficient and revenue-generating service will yield major growth opportunities in the solar space in the face of a changing landscape. Here’s how it works:

Generate new revenue streams

Advanced service technology is going something like this: Internet of Things sensors proactively beam equipment information back to HQ to create a predictive model that can nix unplanned downtime. While this model

hasn’t completely proliferated just yet, and many companies are still (trying to) use paper and pencil to run effective service organizations, the companies that have begun leveraging it, such as Enphase in the micro inverter space, are creating business models where they can generate revenue based on the outcome (such as solar wattage) versus the product itself. So rather than selling solar panels, companies can sell “power by the hour” via service contracts that promise to maintain and fix any machines down the line, which keeps the money consistently flowing in.

Customers don’t really care how a machine gets serviced — they just want it up and running. The service is the means to an end (i.e., an outcome), and you simply can’t move to an outcomes-based business without modernizing the service piece of the puzzle.

Even if your company isn’t there yet, working towards the model of connected field service will yield big returns in the future, when geopolitics and subsidies prove less certain. If a machine can inform a technician about imminent failure and dispatch him or her to prevent that failure before a customer is aware of it, that removal of unplanned downtime means happier customers and steadier revenue streams.

Change the customer experience

Again, it’s all about keeping customers happy. In an uncertain era for solar, however, this task can feel all the more daunting. Sure, modern service technology could have an effect on your processes and equipment, but what does that have to do with customers?

When you’re better able to respond to, and anticipate outages in the field, you can improve the customer experience as a whole. Technicians are often the face of a company — they meet the customer, bring the right parts, do the repairs, even upsell the product, and then shake hands when they leave.

Modern service involves getting the right tech, with the right skills and parts, on-site at the right time. That translates into faster fixes, shrinking costs, higher productivity, happier techs, and happier customers. What it boils down to is that technology helps transform field engineers into the customers’ trusted advisors, rather than just “repairmen.”

Be an early adopter

As an industry built on forward-looking decisions, clean-energy businesses have been some of the earliest adopters of new technology. If clean energy is the embodiment of modern utility, how can the industry continue to optimize and improve?

Now is the time to invest in tools and technologies that will push them forward, instead of maintaining the status quo. Even when the current solution to a problem

seems good enough, look for ways to make it better. This is especially important when it comes to adopting new technology. As drones, virtual and augmented reality, and robotics continue to proliferate, the solar industry will find new ways to answer the advancing call of duty.

For example, wind turbines take significant effort to repair because a technician has to make climbs of several hundred-feet just to diagnose a problem. The tech then has to order the part, wait for its arrival and then climb back up to make the repair and close out the work order. By then, several (risk-filled) days have passed — days where the turbine could have been generating energy. Using IoT sensors for remote monitoring and/or flying a drone or autonomous underwater vehicle for offshore wind farms eliminates 90 percent of that workflow, resulting in a great reduction in risk, cost, and time to repair.

Cue happy customers

The solar business has always been a leader in the future-focused way of doing things. Be sure to apply the same approach to how you serve your customers in the field. Prioritize improvements that benefit the customer, track those improvements with real metrics, and be an early adopter of industry-changing technology. With this plan of attack, the future of solar looks pretty... bright.



Athani Krishnaprasad is co-founder and Chief Strategy Officer at ServiceMax Inc. He is responsible for creating, communicating and executing strategic initiatives around growth & innovation, and creating strategic alignment behind the vision. Since founding ServiceMax, Athani has led ServiceMax’s product vision and strategy, product design, and product marketing and management functions. With his intimate understanding of customer needs and pain points, as well as technology and industry trends, Athani has played a key role in driving growth & positioning ServiceMax as a leader in the market.

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QAx1 series are DC/DC converters specialized for IGBT driver. This series integrates driving IC's features and provides +15/-8.0VDC asymmetrical output voltage which maximizes reduced driving consumption. With output currents up to 120mA, it meets a wider power requirement of IGBT. This series also features efficiency up to 81%, operating temperature of -40°C to +105°C, ultra-low isolation capacitance (6PF), maximum capacitive load (1000uF), and 3000VAC isolation. 12VDC, 15VDC, and 24VDC input voltages are available now.

www.mornsun-power.com



Industrial grade X2 capacitors

TDK Corporation presents a new series of robust EPCOS MKP X2 capacitors for EMI suppression. Compared with conventional X2 capacitors designed for rated voltages of 305VAC, these new components offer a higher rated voltage of 350VAC. This makes them suitable for EMI suppression in input filters – specifically for applications on the North American market – and output filters of photovoltaic inverters, for example. The capacitance range extends from 0.47 µF to 10 µF in accordance with the E12 series. Even under severe ambient conditions the new capacitors are characterized by a stable capacitance, as verified in damp heat tests, in which the change in capacitance does not exceed 7.5% (test conditions: 1000-hours at 85°C with a relative humidity of 85% and a voltage of 330VAC). The maximum operating temperature of the components is 110°C. The X2 capacitors are approved in accordance with UL and EN and, depending on the capacitance, are available with a lead spacing of 27.5mm (B32924*4*) or 37.5mm (B32926*4*). Both the casing and the epoxy resin sealing material comply with the UL 94 V-0 standard. The capacitors are especially suitable for applications with higher demands in terms of current capability, as well as capacitive power supplies.

www.epcos.com



PV immersion heater controller

RESOL has developed an economical solution for using excess current produced by PV systems; the DeltaTherm PV immersion heater controller. This new controller can be fitted to all stores equipped with an electric immersion heater and is very easy to install, thus saving time and money. The controller reliably detects excess current and calculates the energy available. It then redirects the energy to a variable electric heater of up to 3kW for heating the store. In this way, the excess power of a PV system can be converted into thermal energy and stored as renewable energy. The intelligent control helps by using more regenerative power for yourself and decreasing heating costs. All the while household power has absolute priority and grid compliance is maintained.

www.resol.com



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The Market Has Spoken

It wants easy-to-use hybrid PV/grid-tie power solutions

by James Polcyn



DECREASING PRICES FOR PHOTOVOLTAIC MODULES HAVE made solar power more accessible than ever, for both off-grid applications and as a back up to unreliable grid-tie applications. Increasing demand for consumer electronics and appliances translates into a growing need for convenient and reliable AC power from solar home systems. Advanced technology is now able to provide all-in-one electronics cabinets that manage off-grid and grid-tie power sources for delivery of reliable energy to AC and DC loads used in homes, businesses and industry.

More Buying Power Per Watt

Price indices for PV modules all share the same trend lines: Prices declined steadily over the last decade, while efficiency increased. Current prices are under \$1USD per watt and projected to fall even further through 2020. For energy consumers, this means more buying power per watt, which makes installing or expanding off-grid and back-up home solar systems more accessible and affordable than ever.

More Demand for AC

The demand for AC loads in off-grid is increasing for two reasons. First, total system cost allocations are changing as PV prices decrease. In prior years, owners might have tried to make everything work on more energy-efficient DC loads in an effort to save on panel and array costs. Today,

owners can power more AC loads since the PV price to support them is relatively low. Adding more PV modules at a negligible incremental cost can offset any efficiency lost in the DC to AC inverter.

Second, consumer AC electronics and appliances dominate the market and fuel the demand for a reliable off-grid solution for AC power. DC loads can still operate necessary appliances such as lights, but the digital revolution requires AC loads to operate computers, mobile devices, and TVs, especially in rural electrification applications.

Top Priorities: Convenience, Ease of Use and Reliability

Consumers expect convenience, ease of use and reliability from their electronics and appliances, at an affordable price. These expectations also extend to the technology upstream of these electronics. While energy efficiency and load reduction are still high priority in new technologies for the off-grid market, convenience and ease of use are equally important.

Plug and Play Electronics Cabinets Deliver

Electronics companies are driven to make their technologies incredibly easy to use to compete in the grid-tie and AC markets. Consumers in the off-grid and unreliable grid markets want the same thing: convenient, easy and reliable solutions to operate both DC appliances and AC electronics, regardless of the power source. Suppliers respond by delivering plug and play electronics cabinets to manage power conversion, and performance monitoring to supply AC and DC loads from solar or grid-tie power sources. The result is a solar home system that is reliable, easy to use, and affordable.



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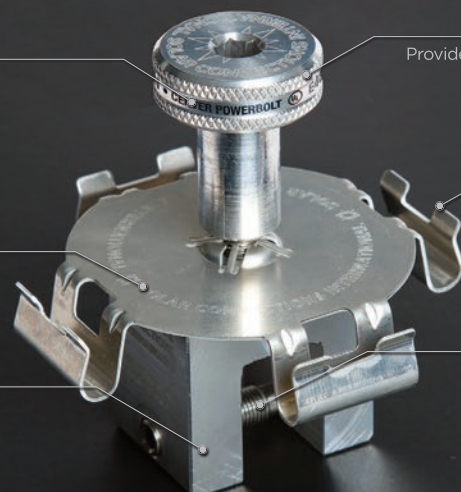
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Crimp or zip tie to secure
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Available with 1, 2, or 3 set screws

5 Things to Look for in All-in-One Electronics Cabinets

Most system failures are the results of sub-optimal components, system design and integration. The most reliable all-in-one electronics cabinets for hybrid PV/grid-tie systems will have quality components which have been tested, designed, and integrated to perform reliably together.

Here are five key items to consider when choosing an all-in-one electronics cabinet:

- 1. Design by solar experts.** Some designs use a hodge-podge of mixed components, which can result in unreliability if the specifications of each component are not properly matched to ensure optimal performance and long life. Pre-engineered solutions by recognized experts in PV as well as grid-tie systems remove the guesswork and potential for error.



Advanced texturing solutions

RENA Technologies GmbH offers advanced solutions to customers for texturing of both mono and multi-crystalline silicon sliced by diamond wire saw technology. The increased demand for texturing solutions for diamond wire sawn multi-crystalline silicon is met by RENA's solution, InTex-E, process allowing for weighted reflection values well below the typical level of RW~26-28% of an acidic texture to values of below RW<20% for the RENA InTex-E approach. The technology features metal-free chemistry based on HF/HNO₃ etching solutions and allows for inline processing at similar footprints compared to conventional acidic texturing tools. RENA has also improved the alkaline texturing process for mono-crystalline silicon using the RENA monoTEX texturing agent and has increased the bath lifetime to over 250 runs with a single bath makeup. This allows a very high productive uptime of the texturing equipment RENA BatchTex and lowers the operation expenses at the same time.

www.rena.com

- 2. High-quality components.** System reliability is as only as good as the individual components. The weakest point in reliability is the one low-quality component in the enclosure. Look for high-quality components from reputable manufacturers used throughout the enclosure.
- 3. Automatic, fast switching between PV and grid.** For constant power to critical loads, look for an automatic change-over relay to switch to battery backup within milliseconds of a grid outage, and automatically switch back to grid power when service has been restored.
- 4. Data integration for system monitoring.** The central control unit should have data integration capabilities so that important system data that can be downloaded or remotely accessed to monitor and manage system health.
- 5. Affordable price.** Economical pricing is important, especially for the rural electrification markets. Consumers should not have to sacrifice quality and reliability for economy.

Quality, Functionality and Affordability

Design quality, component quality, functionality, and price contribute to the overall user experience of AC and DC consumer electronics. The same holds true for power supply systems. They should also be easy to use, reliable, and affordable. Pre-assembled electronics cabinets simplify specification, installation, and operation of hybrid PV/grid-tie systems. By following the five guidelines, installers and end-users can get a system that delivers on that promise.



James Polcyn is Managing Director, Phocos North America, a world-leading manufacturer of solar-powered charge controllers and various components for off-grid power supplies.

Phocos | www.phocos.com

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To learn more about the value of the DPS-250 solution please visit www.dynapowerenergy.com/dps-250-dc-to-dc-converter/ to download our white paper and data sheet, or email rpratt@dynapower.com.

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The BTM-250 is available in 2, 4, and 6 hour configurations. Units can be paralleled to scale to meet the needs of any behind-the-meter installation. The BTM-250 features Dynapower's proprietary **Dynamic Transfer™** allowing the system to seamlessly transition from grid-tied to islanded mode while maintaining all critical loads.

To download the BTM-250 data sheet please visit www.dynapowerenergy.com/sdi_dpc_offering/ or email rpratt@dynapower.com.



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The Multipurpose-Gym Canopy, by M Bar C Construction, was designed in response to requests from school districts for large shade canopies for their campuses. With clear spans of 40' and 66', the Multipurpose and Gym Canopies offer clear spans that are double that of any other PC available. The canopies are pre-approved for solar panels and 100% solar ready.

www.mbarconline.com



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UL approved components

Hollaender Manufacturing has received UL 2703 Recognized Component Approval under Intertek ETL mark No. 5006508. The thorough and rigorous testing conducted by Intertek has shown that specific Speed-Rail fittings form a safe and reliable bond with assured electrical continuity. A proprietary set screw developed by Hollaender that is used to secure the fitting to the pipe, penetrates the surface of the pipe. When properly installed, the set screws are electrically bonded to the pipe and bracing, thereby fulfilling the grounding and bonding requirements of UL 2703. Testing was done with both galvanized steel and aluminum pipe. Because Speed-Rail solar pipe rack fittings are UL 2703 approved, installers in many cases, and depending on the judgement of the local AHJ, will no longer need to add additional bonding components or bonding devices to meet the requirements of electrical inspectors. This reduces installation time and costs. Hollaender's Speed-Rail slip-on pipe fittings are used with aluminum or galvanized steel, to easily and cost-effectively build solar panel racking systems. They are strong, lightweight, and come in a wide variety of fixed and adjustable configurations. All Speed-Rail fittings are made of 535.0 aluminum-magnesium and are corrosion resistant. They are backed by a 10-year warranty against corrosion, will not rust, and can be used with galvanized steel or other metals without concern for galvanic corrosion. Solar rack systems utilizing Speed-Rail fittings install quickly, securely, and cost effectively.

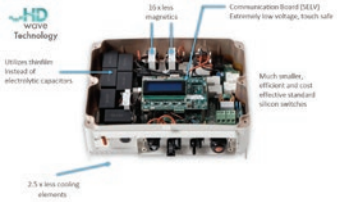
www.hollaender.com



Electromagnetic flow instruments

Endress+Hauser releases Proline 300/500, a family of industry optimized "smart" Coriolis mass and electromagnetic flow instruments. The Proline Promass Coriolis mass flowmeters are available in 11 models ranging in sizes from 1/24 to 14" in diameter, for measuring flows up to 100,000 tons per day. Proline Promag flowmeters are available in three models in sizes from 1/12 to 78" for volume flows up to 634 million gallons per day. Proline instruments connect to control systems via 4-20mA HART, WirelessHART, PROFIBUS PA/DP, FOUNDATION Fieldbus, Modbus, EtherNet/IP, or PROFINET. They provide access to users via the device's display, a web server, a wireless LAN, handheld devices, asset management or process automation solutions, and Fieldbus protocol. Each provides fast commissioning, in-situ device verification during operation, continuous self-diagnostics, and automatic on-board data storage. The transmitter housings have a two-chamber system with a front-mounted compartment for connecting source power, wiring the analog and/or digital inputs and outputs, and accessing the Ethernet service access port or device display. The second chamber permits service technicians to access the electronics modules for repair functions while maintaining protection against dust and contamination. Local or remote four-line backlit optical displays with a WLAN connection allow access from a handheld device such as a smartphone or a tablet. All Proline instruments have custody transfer approvals and meet the requirements of cCSAus, ATEX, NEPSI, INMETRO, EAC, IEC/EN 61326, NAMUR NE21, and EU and ACMA directives. They are also approved for use in SIL 2 and SIL 3 applications.

www.us.endress.com



Efficient and lightweight PV inverter

SolarEdge's HD-Wave technology inverter breaks the mold of traditional inverters. Using power conversion technology that is based on a distributed switching and powerful DSP processing, the HD-Wave technology inverter is able to synthesize a clean sine wave that leads to a dramatic reduction in the magnetics and heavy cooling elements. This small and lightweight inverter enables simplified shipping and storing and one-person installation. The 99% CEC weighted efficiency allows more energy production for an improved ROI.

www.solaredge.com



Solar optimizers

Tigo's next generation of solar optimizers now feature UHD-Core (Ultra-High Definition) technology. The UHD-Core technology is available within Tigo's TS4 products: TS4-O (Optimization) and TS4-L (Long Strings) optimizers. With a new design architecture and component rating, Tigo's TS4-O and TS4-L support up to 90V maximum input voltage and 12A maximum input current. The UHD-Core delivers superior performance resulting in higher energy harvest with optimization efficiency up to 99.6% for any module up to 475W. The new optimizers with UHD-Core technology are fully monitored through Tigo's Cloud Connect Advanced (CCA) data loggers with remotely upgradeable firmware. High definition sampling rate technology allows high accuracy remote monitoring of voltage and current. However, the new TS4-O and TS4-L further employ this monitoring capability to also provide remote access to individual module information, such as panel type, barcode, manufacturing origin, location, and production date. Furthermore, these products now comply with NEC 2014 & 2017 Rapid Shutdown requirements with a recently awarded UL-certification. All Tigo TS4 platform products are autonomous and feature selective deployment. They can be fitted to new or existing installations on any string or sub-string size. Selective deployment is compatible with most of Tigo's inverter partners and any module type including monocrystalline, polycrystalline, thin-film, and bifacial.

www.tigoenergy.com



Monocrystalline 72-cell modules

The AXIpremium 72-cell monocrystalline solar module from Axitec has a performance output of 340Wp and they will be ramping up to 360Wp by the end of 2017. These high-performance solar modules provide efficiencies of up to 17.83% and excellent low light performance for high power output. AXITEC offers these modules with a positive power tolerance and a 25-year guarantee on 85% of the performance. To simplify installation and offer additional flexibility on the roof, AXITEC uses a 43.4" wire on the junction box.

www.axitecsolar.us

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Cell modules

EUTECT cell modules are a new and flexible tool for developing customer-specific automation and production systems. This allows the customer to tailor soldering systems between X-Y-Z-D linear axes, a revolving transfer table, various 6-axis or SCARA robots, as well as batch or inline versions of belt systems. Six-axis robots are playing an increasingly important role in industrial automation, and can be mounted overhead as well as on the process area. Up to eight different grippers can be stored and equipped fully automatically in one system, which opens new possibilities for processing the most varied products.

www.eutect.de/en



900V MOSFETs

STMicroelectronics addresses high power system demands with its latest 900V MDmesh K5 super-junction MOSFETs. The new series contains the first 900V MOSFETs with RDS(ON) below 100mΩ. With an extremely low gate charge (Qg), they ensure fast switching for flexibility where a wide input-voltage range is required. They are suitable for all types of flyback converters including standard, quasi-resonant, and active-clamp designs covering power ratings as low as 35W up to 230W or higher. In addition, low input and output capacitances (Ciss, Coss) enable zero-voltage switching with minimal energy loss in half-bridge LLC resonant converters.

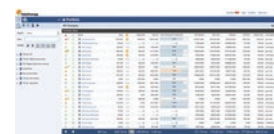
www.st.com



Solar powered thermal mass flow meters

Fluid Components International introduces its FCI Model ST75V solar-powered Flow Meter with built-in Vortab flow conditioner. It features a no-moving parts thermal dispersion mass flow-sensing element, and provides direct mass flow measurement of the gas at this site. Its non-clogging sensor design operates over a wide flow range with low-flow sensitivity. The integral Vortab flow conditioner provides a fully developed flow profile in just seven total pipe diameters. The ST75V Flow Meter is compatible with solar power systems that provide 24Vdc power without any special modifications. It has a rugged NEMA 4X/IP67 rated enclosure, and features an inline-style flow body providing accuracy to ±1% of reading with flow ranges from 0.04 to 560 SCFM (0.07 to 950 NCMH), depending on pipe size, and repeatability of ±0.5 percent of reading. It is suitable for line sizes from 0.25 to 2 inches (6 to 51 mm) diameters. The ST75V Flow Meter's flow element is constructed with a 316L stainless steel body and Hastelloy C-22 thermowell sensors to resist corrosion. It is approved for use in hazardous/explosive oil/gas production environments and carries global approvals that include: FM/CSA, Class 1, Div 1, Groups B, C, D; Class 1, Div II, Groups A-D, ATEX/IECEX Zone 1, II 2 G Ex d IIC T6 ... T3, II 2 D Ex tD A21 IP67 T90°C...T300°C.

www.fluidcomponents.com



HTML based software

AlsoEnergy announces the release of PowerTrack Web. This new platform provides web browser access for all users, and it helps users complete daily work faster. PowerTrack Web is built using the universal HTML5 programming language. This enables web access for users with Chrome and Firefox web browsers. Designed for universal compatibility and fast performance, PowerTrack Web is a streamlined version of the original PowerTrack application. It supports the most critical and frequently used functionality of the original PowerTrack platform, including real-time data at portfolio, site, and device level; aggregated and itemized portfolio overviews; analytics and full charting functionality; and alerts status and acknowledgement. PowerTrack Web joins the existing products in the PowerTrack application family, including PowerTrack IE (for use with Explorer browser); PowerTrack Desktop (available for Windows or Mac); and PowerTrack Mobile. Many users will employ PowerTrack Web in conjunction with other PowerTrack platforms. Since all PowerTrack programs are built for interaction with the same back-end server system, actions executed in one platform are immediately visible and actionable on the other platforms. Users may move back and forth between versions with no fear of losing work.

www.alsoenergy.com



Low-profile solar mounting solution

SolarRoofHook's Low Profile QuickBOLT offers installers a simple and efficient way to mount panels to composite roofs without compromising water resistance. Unlike the height adjustable L-Foot of the QuickBOLT, The LP includes an L-Foot that sits flat on the leak-proof Stainless Steel Backed EPDM Washer without having to make any adjustments. Simply drill, seal, and mount.

www.solarroofhook.com



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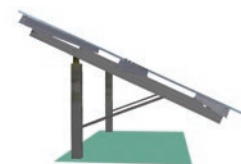
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Cost-effective pre-texturing treatment

DW PreTex can be integrated into the existing production as a modular wet process system without additional requirements, both for wafer and cell manufacturers. DW PreTex uses common materials used in the PV industry. The process achieves extremely uniform surfaces with reflection values down to 21%. The in-line process developed by SCHMID provides enormous savings for the PV industry. DW PreTex requires only one process step to allow the processing of diamond-wire cut multi-wafers with the proven standard texture HF/HNO3. Due to the pre-treatment by DW PreTex, the diamond-wire cut wafers have more uniform surfaces than slurry-cut wafers. Thus further increases in cell efficiency are possible. DW PreTex is available in two versions: as a separate single unit that roughens the surface of the wafers and then uses the available texture capacity, or as a combined line for complete texturing. Due to the modular design, the in-line process can be designed for serial production of up to 4,500 wafers per hour.

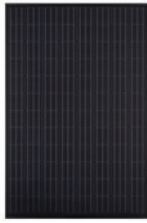
www.schmidgroup.com



Steel PV mounting system

Schletter Group, expands its ground mount product line with G-Max, the first of a new generation, designed with attention to cost-effective installation standards and practices. Noteworthy cost benefits include increased adjustment capability in the field, increased spans between foundations, standardization and reduction of hardware, and lower costs across multiple installation steps. Schletter will pre-assemble many components prior to shipment in order to allow installers to unfold and connect the structure more easily on site. G-Max is manufactured in the United States and comes with a standard 20-year limited manufacturer's warranty.

www.schletter.us



Black solar panels

Panasonic introduces the new Solar Panels HIT; N310k, N315k, and N320k. These panels feature an all black appearance, a 19.1% efficiency, and a low temperature coefficient of -0.258%/°C. HIT Solar Panels are 100% emission free, have no moving parts, and produce no noise. Their unique water drainage means that water is drained off the panel surface, which prevents water accumulation and water stains after drying, even in low-angle installations. The advanced bifacial design generates more electricity from both sides of the cell. Panasonic's Pyramid cell structure helps absorb more sunlight, and continues to perform at its best quality, even at high temperatures. These modules are supported by a 25-year product workmanship guarantee. Panasonic HIT solar panels' annual degradation is no more than 0.26% a year. The HIT panels will achieve at least 90.76% of their rated output power after 25 years.

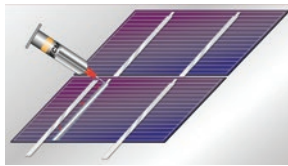
www.business.panasonic.com/solarpanels



Multi-purpose waterjet cutting system

The T-model is Water Jet Sweden's first machine model with a flying bridge construction. It has been designed to meet a list of very specific requirements: to fit into a container for low transportation cost; quick and easy installation; easy to operate. The T-model is designed for in-house production, part manufacturing, design workshops, engineering workshops and prototype workshops, cutting any kind of material of various size and shape, up to 200mm thick. T-model is operated with a real CNC control system from Fanuc, and powered with original intensifier pumps from BFT and KMT. The waterjet cutting machine includes an extended five-year performance warranty. Water Jet Sweden guarantees that it will keep the same tolerance requirements as when the machine was first delivered, either after five years, or 10,000 hours.

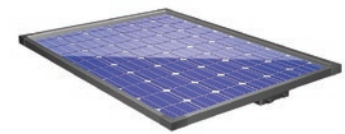
www.waterjetSweden.com



Conductive adhesives for solar modules

Engineered Material Systems, Inc. (EMS) announces the introduction of its new CA-150 Series Snap Cure, Low Cost Conductive Adhesive for stringing and shingling crystalline silicon and Heterojunction solar modules. The EMS CA-150 series is designed for use in modified ribbon stringers. The material will snap cure and fixture cells and ribbons in seconds at 150°C with enough strength to withstand module manufacturing processes until the adhesive cure is completed during the encapsulant lamination process. EMS CA-150 series conductive adhesives can be dispensed by time-pressure, auger, or jetting. The adhesive is more stress absorbing than solder to withstand the rigors of thermal cycling and processes at lower temperatures than solder.

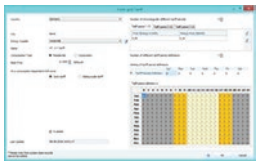
www.emsadhesives.com



Front side silver paste

DuPont Photovoltaics Solutions introduces Solamet PV20A, the company's latest front-side silver paste designed specifically for P-type solar cells. Solamet PV20A is designed to be used in both Lightly Doped Emitter (LDE) and Passivated Emitter Rear Cell (PERC) solar cell construction. Solamet PV20A. It was developed to enable exceptional ultrafine line printing and contact performance with lower firing temperature, and is ideally suited to maximize efficiency for the most demanding conventional and PERC architectures while also ensuring reliable production performance.

www.photovoltaics.dupont.com



New software for calculation of solar thermal systems

T*SOL 2017 is the new version of Valentin Software's program for the simulation of solar thermal systems. Automatic functions have been expanded to include the net present value, the return on capital, and the heat price. This makes it possible to determine the influence of the size of various components of a solar thermal system. In the "P3 - Preheating with buffer storage" system, up to 6 collector loops and 6 different loads can be connected. The T*SOL database dialogs have been standardized and reworked so that selecting, pasting and editing components (collectors, heat generators and air collectors) is now much faster and smoother. In all dialogs, it is now possible to create favorites and to keep an overview of the frequently used components. T*SOL simulates the energy efficiency of heating systems supported by solar thermal energy, and generates the energy label for direct output to a printer; this enables heating installers to create a label for each individually built system.

www.valentin-software.com

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franklinwater.com



Batteries

A reliable battery is a key component to any efficient and sustainable solar energy system. Here are some of the more popular choices in the industry today...

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Trojan Battery Co., LLC

Product: Trojan IND33-2V with Smart Carbon

Description: Smart Carbon is a standard feature in Trojan's Industrial flooded battery line to address the impact of Partial State of Charge (PSOC) on batteries in renewable energy (RE), inverter backup, and telecom applications. Trojan's Smart Carbon proprietary formula provides improved battery charge acceptance and faster recharge in PSOC applications.

Chemistry: Advanced lead-acid - flooded technology

Capacity (Ah @ 20hr rate): 1849Ah

Voltage: 2V

Energy: 4.81kWh @100hr rate

Cycle life: 1500 Cycles at 80% Depth-of-Discharge; 5000 Cycles @ 20% Depth-of-Discharge

Operating temperature range: 80°F (26.6°C)



Dimensions: 17.33" x 10.22" x 24.01"

Weight: 278lbs (125kg)

Warranty: 8-year warranty

Certifications: IEC 61427, ISO 9001:2008

Key Features:

- Designed to achieve 17 years in a renewable energy system;
- High amp-hour capacity batteries are suitable for use in large off-grid photovoltaic (PV) systems, off-grid hybrid PV systems, grid-tied PV systems with battery backup, smart grid peak shifting systems, and a variety of other applications;
- Features Smart Carbon, Trojan's proprietary formula which addresses the issue of partial state of charge (PSOC);
- High capacity 2V-4V and 6V, 601 to 2405Ah @C100Hr;
- Housed in a dual container construction for enhanced battery protection.

www.trojanbattery.com

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Crown Battery Manufacturing Company

Product: 2CRP3690 Power Module

Description: The 2-Volt 2CRP3690 Power Module combines massive ampere-hour capacity availability to renewable energy system users. The battery delivers application flexibility, while providing a better solution for temperature management and electrical isolation.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 2550 Ah

Voltage: 2V

Energy: 7.1586kWh (100hr), 4.9470kWh (20hr)

Cycle life: 1500 cycles @ 100% Depth-of-Discharge; 4300 cycles @ 30% Depth-of-Discharge

Operating temperature range: -40°F to 120°F (-40°C to 49°C)

Dimensions: 12.81" x 6.56" x 33.38"

Weight: 313lbs (141.9kg)

Warranty: 5-year full replacement limited warranty

Certifications: Conforms with BCI and IEC Test Standards

Key Features:

- Rugged internal construction with heavy-duty plate, cast-on strap, and terminal-post components, which deliver strong performance and durability;
- Posi-Wrap Plate Protection ensures active material retention, protecting from internal short-circuits to deliver proven ROI for customers;
- Low-maintenance design features reduced frequency of preventative maintenance to lower service costs and total cost of ownership;
- High-capacity 2-Volt Power Module design includes fixed handles and the flexibility to be installed with or without battery racks;
- Lead-acid batteries are 99% recyclable.

www.crownbattery.com/applications/renewable-energy-systems

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WWW.USBATTERY.COM



Discover

Product: 12VRE-3000TF

Description: Discover Tubular Flooded RE Series Batteries provide superior deep-cycling performance and reliability for demanding commercial, industrial, and residential renewable energy applications. Tubular Flooded RE Batteries utilize Advanced Tubular Plate Technology to deliver long service life with low maintenance requirements.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 215Ah

Voltage: 12V

Cycle Life: 2500 cycles at 50% DOD

Dimensions: 19.7" x 7.4" x 16.2"

Weight: 152lbs (69kg)

www.discoverbattery.com



GS Battery

Product: SLR1000-2

Description: The GS Battery SLR1000-2 is part of GS Battery's complete line of rechargeable batteries and energy storage systems. These batteries feature advanced lead and nano-carbon technology. These features allow the SLR1000-2 to deliver on performance and provide long service life.

Chemistry: Advanced lead-acid

Capacity (Ah @ 20hr rate): 1096Ah

Voltage: 2V

Energy: 48kWh @48VDC

Cycle life: 5000 cycles @ 70% DOD; 5500 cycles @ 50% DOD

Operating temperature range: 5°F to 113°F (-15°C to 45°C)

Dimensions: 11.3" x 6.5" x 19.41"

Weight: 147lbs (67kg)

Warranty: 10-year warranty

Certifications: UL

www.gsbattery.com



OutBack Power

Product: EnergyCell Nano-Carbon 200NC

Description: In applications with limited sun hours for proper recharging of standard deep cycle batteries, the demand for a PSoC battery technology is growing. The Outback Power EnergyCell Nano-Carbon advanced technology battery meets this demand by improving overall cycle life by up to 44%.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 178Ah

Voltage: 12V

Cycle Life: 6500 cycles at 20% DOD, 2800 cycles @ 50% DOD

Operating temperature range: Discharge -40°F to 160°F (-40°C to 71°C); Charge -9.4°F to 140°F (-23°C to 60°C)

Dimensions: 22.01" x 4.95" x 12.6"

Weight: 131lbs (60kg)

Warranty: 2-year full replacement in PSoC applications

www.outbackpower.com

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SimpliPhi Power

Product: AccESS

Description: SimpliPhi Power's AccESS is a plug-and-play solution that optimizes equipment, streamlines cost calculations, and integrates power storage into new and existing on/off grid solar installations. It combines SimpliPhi's battery technology, Schneider Electric inverter charge controller, associated power electronics, and system management in one box that can be installed outside or inside.

Chemistry: Lithium-ion

Capacity (Ah @ 20hr rate): PHI 10.2kWh - 201Ah 48VDC, OR PHI 6.8kWh - 134Ah 48VDC

Voltage: 195 to 550VDC (PV array, operating)

Energy: Available in 10.2kWh or 6.8kWh; can scale up for more capacity

Peak power: 6.8kW / 8.5kW (10.2kWh model); can scale up for more power

Cycle life: 10,000 @ 80% DOD

Operating temperature range: -4°F to 122°F (-20°C to 50°C)

Dimensions: 16" x 28" x 72"

Weight: 10.2kWh - 701.31lbs (318.1kg); 6.8kWh - 625.8lbs (283.8kg)

Warranty: 10-year warranty

Certifications: ETL Certified UL 1973 Standard, CE listed, UN/DOT and RoHS compliant components

www.simpliphipower.com



6-VOLT AGM BATTERY



2-VOLT AGM BATTERY

PREMIUM DEEP-CYCLE AGM BATTERIES

fullriverbattery.com

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Rolls

BATTERY ENGINEERING

Rolls Battery Engineering**Product:** Rolls 2 YS 62P

Description: Offering double the delivered Amp-Hour capacity of the Rolls 2 YS 31P, the new 2 Volt 2 YS 62P model offers 4860 AH in a single dual-container case design, offering significant storage capacity for large-scale off-grid and grid-tied applications.

Chemistry: Flooded lead-acid**Capacity (Ah @ 20hr rate):** 4860Ah**Voltage:** 2V**Energy:** 9.72kWh**Cycle life:** 3200 @ 50% DOD; 5000 @ 20% DOD**Operating temperature range:** -4°F to 110°F (-20°C to 43.33°C)**Dimensions:** 27 3/8" x 9" x 31 5/8"**Weight:** 570lbs (259kg)**Warranty:** 10-year manufacturer warranty, covering 3-year full replacement and 7-year pro-rated warranty.**Key Features:**

- Durable, dual-container construction and industrial grade robotically welded cell formation;
- Included Rolls hydrogen R-cap reduces watering frequency, safeguarding against cell damage;
- Double the AH capacity of the popular 2 YS 31P model in a space saving single case design, reducing footprint for large-scale applications.

www.rollsbattery.com

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**U.S. Battery****Product:** US RE L-16XC2

Description: Design optimized for maximum performance and life in stationary (non-vehicular) applications, including solar power and renewable energy installations, the OSP battery design and insulating DEFENDER "moss shields" increases life expectancy and performance.

Chemistry: Flooded lead acid**Capacity (Ah @ 20hr rate):** 401Ah**Voltage:** 6V**Energy:** 2.41kWh**Cycle life:** 675 Cycles at 80% DOD, and 1150 Cycles at 50% DOD**Operating temperature range:** 0°F to 120°F (-17°C to 49°C)**Dimensions:** 11.875" x 7.125" x 16.75"**Weight:** 114lbs (51.7kg)**Warranty:** 5-year warranty**Key Features:**

- OSP outside positive plate;
- Higher peak capacity and increased initial capacity;
- Lower acquisition and per-cycle cost than lithium ion, nickel metal hydride, or other rechargeable battery systems.

www.usbattery.com**ViZn Energy Systems****Product:** GS200 Energy Storage System

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

Chemistry: Flow**Voltage:** 420/630VDC**Energy:** 3000kWh**Peak power:** 1000kW**Cycle life:** 10,000 cycles @100% DOD - 20 years**Operating temperature range:** 14°F to 113°F (-10°C to 45°C)**Warranty:** up to 20 year-warrantywww.viznenergy.com**Princeton Power Systems****Product:** PEMS250-500

Description: Outdoor-rated all-weather AC battery system for off-grid and on-grid applications.

Chemistry: Lithium-ion**Capacity (Ah @ 20hr rate):** 752Ah**Voltage:** 480VAC**Energy:** 500kWh**Peak power:** 250kW**Cycle life:** >4000 over 10 years**Operating temperature range:** -4°F to 122°F (-20°C to 50°C)**Dimensions:** 12.1' x 4.9' x 8.3'**Weight:** 15,100lbs (6850kg)**Warranty:** Under negotiation at time of print**Certifications:** UL1642, UL1973RU, UN38.3, UL 1741, IEEE 1547www.princetonpower.com**Lithium Power, Inc.****Product:** ESS-500-48

Description: ESS-500-48 is a rechargeable NMC backup battery pack to suit for Telecom UPS applications. ESS-500-48 consists of the battery gas gauge controller and protection IC (BM3398). BM3398 is used to monitor the current, individual cell voltages, capacity, temperature, and other critical battery parameters, and generates control signals required by the Battery Management System (BMS). Various hardware and software protection features are included to ensure the battery safety.

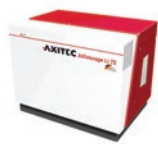
Chemistry: Lithium-ion**Capacity (Ah @ 20hr rate):** 44Ah**Voltage:** 48V**Energy:** 2.112kWh**Cycle life:** over 300 with retention capacity over 60%**Dimensions:** 19" x 20" x 3.5"**Weight:** <55lbs (<25kg)**Warranty:** 5-year warrantywww.lithiumpowerinc.com**Valence Technology, Inc.****Product:** U-Charge U27-24XP

Description: Valence's new U27-24XP battery joins its U-Charge line of lithium iron magnesium phosphate batteries. Offered in a Group 27 size, the U27-24XP includes a new terminal design allowing for the use of dual-hole lugs for greater contact surface, or for easier parallel connections.

Chemistry: Lithium-ion**Capacity (Ah @ 5hr rate):** 69Ah**Voltage:** 24V**Energy:** 1.76kWh**Peak power:** >5kW**Cycle life:** >4000 cycles @ 80% DOD**Operating temperature range:** -4°F to 122°F (-20°C to 50°C)**Dimensions:** 12.04" x 6.77" x 8.86"**Weight:** 40.9lbs (18.6kg)**Warranty:** 5-year warranty**Certifications:** UL1642 (cells), UN 38.3www.valence.com**Younicos****Product:** Y.Cube

Description: Y.Cube is a ready-to-install energy storage system with all components integrated inside a single enclosure. This off-the-shelf solution comprises batteries, inverter, HVAC, and auxiliary components, tested and pre-assembled by Younicos experts. All components are controlled safely and efficiently by proprietary Younicos Y.Q software.

Chemistry: Lithium-ion**Voltage:** 480VAC / 3-phase**Energy:** Up to 920kWh**Peak power:** 250kVA or 500kVA**Cycle life:** Up to 20 years, depending on use cases**Operating temperature range:** -4°F to 113°F (-20°C to 45°C)**Dimensions:** 120" x 104" x 108"**Weight:** 16,808lbs to 24,665lbs (7,624kg to 11,188kg)**Warranty:** 2-year warranty**Certifications:** UL 1741, IEEE 1547, IEC 62477-1, CSA C22.2 #107.1, G59-3www.younicos.com



AXITEC, LLC

Product: AXIstorage

Description: An all-purpose, high-performance lithium-ion-energy storage for residential, e-mobility, and commercial applications.

Chemistry: Lithium-ion

Capacity (Ah @ 20hr rate): 121.5Ah

Voltage: 55.5VAC

Energy: 6.8kWh

Peak power (kW): 8.3kW

Cycle life: 6,600

Operating temperature range: 113°F (45°C)

Dimensions: 21.1" x 26.6" x 18.7"

Weight: 216lbs (98kg)

Warranty: 10-year warranty

Certifications: IEC, DIN EN, CE, UN38.3

www.axitecsolar.us



Iron Edison Battery Company

Product: Lithium Iron Phosphate Battery

Description: The Iron Edison Lithium Iron Battery brings new technology to energy storage projects, and is a plug-n-play replacement to lead acid battery options. Fully compatible with inverters and charge controllers, Iron Edison's Lithium Iron Batteries offer a safe, simple, and dependable energy storage solution for off-grid and grid tied battery backup applications.

Chemistry: Lithium-ion (Lithium Iron Phosphate)

Capacity (Ah @ 20hr rate): 180Ah to 5,500+Ah

Voltage: 12V, 24V, 48V, and High Voltage Custom Configurations

Energy: 2kWh to 286kWh

Peak power: 2kW to 104kW

Cycle life: 5,000 cycles @ 50% DOD, 2,000 cycles @ 80% DOD

Operating temperature range: 32°F to 113°F (0°C to 45°C)

Dimensions: Varies

Weight: 120lbs to 9,000lbs (54.43kg to 4082kg)

Warranty: 10-year warranty

www.ironedison.com



NEC Energy Solutions

Product: 12V Lithium Ion Battery / ALM 12V35

Description: NEC Energy Solutions ALM family of lithium-ion batteries offers high performance, a long operating life, and are safe batteries for tough, critical applications. The ALM 12V35 is available in standard (s), intelligent (i), and High Power (HP) series to match application requirements.

Chemistry: Lithium Iron Phosphate

Capacity (Ah @ 20hr rate): 35Ah

Voltage: 12 volts

Cycle Life: 10,000 cycles

Dimensions: 7.8" x 5.2" x 7.1"

Weight: 13.8lbs (6.3kg)

www.neces.com

The Battery Matters



The Difference Between Deka Solar and Other Batteries Is Like Night & Day

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Fullriver Battery

Product: DC400-6

Description: Fullriver DC Series Deep-Cycle AGM batteries are specifically built for cyclic use in demanding solar applications. The thick plate design and AGM construction combine for a robust battery delivering optimal performance in both fair weather and extreme climate conditions, all in a spill-proof, non-hazardous, and maintenance-free package.

Chemistry: Lead-acid suspension (Absorbed glass mat)

Capacity (Ah @ 20hr rate): 415Ah

Voltage: 6V

Energy: 2.4kWh

Cycle life: 1700 cycles to 50% DOD

Operating temperature range: 5°F to 104°F (-15°C to 40°C) recommended, -40°F to 159.8°F (-40°C to 71°C) maximum

Dimensions: 7.0" x 11.6" x 16.7"

Weight: 123lbs (55.8kg)

Warranty: 7-year warranty in approved solar applications

Certifications: ISO9001, ISO14001, ISO18001, UL, CE, TUV

Key Features:

- Rugged construction inside and out;
- Over partition welded straps;
- Heavy-duty, pure lead plates;
- Sealed and maintenance-free, with little or no gassing.

www.fullriverbattery.com

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MK Battery

Product: Deka Solar M100-33 Maintenance Saver

Description: Deka Solar Maintenance Saver High-Capacity Flooded-Batteries are available as a single, 3, or 6-cell configuration. They are designed to offer reliable, low maintenance power for renewable energy applications where frequent deep cycles are required and minimum maintenance is desirable. Design variations can be based on specific application needs.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 1896Ah

Voltage: 2V cells (optional 3 cell - 6V and 6 cell - 12V)

Cycle Life: 3400 cycles @ 50% DOD



Operating temperature range: -22°F to 122°F (-30°C to 50°C)

Dimensions: 12.81" x 6.56" x 31.3"

Weight: 275lbs (124.7kg)

Key Features:

- High capacity flat plate cells;
- Long life: 12 to 14 years in cyclic service application;
- Extended watering interval of up to six months due to the large reservoir for electrolyte;
- Thermally sealed cover to container with custom design modules;
- Robust, long-lasting epoxy coated steel trays.

www.mkbattery.com



Hoppecke Batteries, Inc.

Product: Batteries

Description: Reliable German-designed, valve regulated lead-acid batteries for high cycling renewable applications. Systems range from off-grid microgrids to solar PV on-grid smoothing.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 350Ah

Voltage: 6V

Cycle life: 3,000 at 50% DOD and 8,500 at 20% DOD

Dimensions: 15" x 8" x 15"

Weight: 161lbs (73kg)

Warranty: 10-year prorated warranty

Certifications: DIN 40742, IEC 60896-21/22

www.hoppecke.com/en/



ESS Inc.

Product: 50kW/400kWh All-Iron Flow Battery

Description: Utilizing earth-abundant iron, salt, and water for its electrolyte, and simple materials for battery components, the Iron Flow Battery (IFB) from ESS Inc. is a durable, environmentally-safe, long-duration storage solution.

Chemistry: Flow

Capacity (Ah @ 20hr rate): 8Ah

Voltage: 480V 3-phase

Energy: 400kWh

Peak power: 50kW

Cycle life: >20,000

Operating temperature range: 41°F to 122°F (5°C to 50°C)

Dimensions: 40' x 8' x 9'6"

Weight: 11,000lbs (4989kg) dry, 37,000lbs (16,783kg) wet

Warranty: Comprehensive 20-year warranty with continuous extended service agreement

Certifications: NRTL Field certification, UL

www.essinc.com

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Alevo

Product: GridBank Energy Storage Systems

Description: Alevo's non-flammable lithium-ion GridBank ESS is a robust, safe, and reliable system that can be used anywhere along the electricity supply chain and works with both conventional and renewable generation.

Chemistry: Inorganic lithium-ion

Capacity (Ah @ 20hr rate): 1MWh

Voltage: 730 to 1152VDC

Energy: 1MWh

Peak power: 2kW

Cycle life: 50,000+

Operating temperature range: -4°F to 113°F (-20°C to 45°C)

Dimensions: 40' x 8.5' x 9.5'

Weight: 90,000lbs (40,823kg)

Warranty: Contract specific warranty

Certifications: NFPA70, UL1741 pending

www.alevo.com



Mercedes-Benz Energy

Product: Mercedes-Benz Energy Storage Home

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

Chemistry: Lithium-ion

Voltage: 48V

Energy: 2.5kWh to 20kWh

Peak power: Depends on configuration

Cycle life: 8000

Operating temperature range: 46.4°F to 86°F (8°C to 30°C)

Dimensions: Depends on configuration

Weight: Depends on configuration

Warranty: 10-year warranty

Certifications: UL1973

www.mercedes-benz.com/energy



SCHMID

Product: EverFlow Storage Container

Description: Power and capacity of the EverFlow Storage Container are easily scalable, making the intrinsically safe VRFB attractive for various applications. All components and tanks are integrated in a single container for fast and easy installation, safe operation, and controlled environmental conditions.

Chemistry: Vanadium Redox Flow

Voltage: 400V/230V / 3-phase AC

Energy: Up to 200kWh

Peak power: 15kW to 60kW (in 15kW steps)

Cycle life: Typically 10,000

Operating temperature range: 32°F to 86°F (0°C to 30°C), expandable with optional climate control

Dimensions: 19.69' x 7.87' x 9.51'

Warranty: 1-year warranty

www.schmid-group.com



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Dynapower

Product: BTM-250kW Fully Integrated Energy Storage System

Description: The BTM-250 is a fully integrated 250KW/500KWH behind-the-meter energy storage system. The BTM-250 couples Dynapower's UL 1741 SA listed MPS-250 smart inverter with Samsung SDI's E2 batteries. The system is available in 2, 4, and 6 hour configurations and can be used in both grid-tied and microgrid applications. Multiple units can be paralleled together.

Chemistry: Lithium-ion

Voltage: 480 VAC 3 Phase, +10%, -12%

Energy: 550kWh

Peak power: 250kW

Operating temperature range: -13°F to 112°F (-25°C to 44°C)

Dimensions: 136.25" x 72" x 108.50"

Weight: 17,000lbs (7711kg)

Warranty: 5-year standard warranty, extendable

Certifications: Inverter: IEEE 1547, UL 1741 SA Listing Batteries: UL 1973 (Tray), UL 1623

Key Features:

- Dynamic transfer with seamless transition from grid-tied to islanded mode;
- Redundant HVAC cooling system;
- Optional direct release fire detection and suppression system;
- Black Start;
- All AC and DC switchgear.

www.dynapower.com



Sharp

Product: Sharp SmartStorage

Description: The SmartStorage system is an "intelligent" storage system. As a building's demand starts to spike, the intelligent, predictive controllers trigger a rapid power discharge to offset the spike. Sharp SmartStorage installations are available with a 10-Year Asset Management Agreement which includes a 10-Year Performance Guarantee.

Chemistry: Lithium-ion

Voltage: 480V, 3-phase (208V option)

Energy: 80kWh or 40kWh

Peak power: 30kW

Operating temperature range: 50°F to 105°F ambient (10°C to 40.5°C)

Dimensions: 42" x 28" x 59"

Weight: 1600lbs (726kg)

Warranty: 10-year service warranty

Certifications: UL1741, IEEE1547

www.sharpsmartstorage.com



BAE Batteries USA

Product: Energy Storage Stationary Battery

Description: Low carbon, deep cycling, and high reliability advanced lead-acid batteries for demand response or frequency regulation for renewable and energy storage applications.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 67 to >4000Ah

Voltage: 2 to >1000VDC

Energy: Depends upon application

Peak power: Depends upon application

Cycle life: 2000 to >5000 depending upon discharge parameters

Operating temperature range: -4°F to 113°F (-20°C to 45°C)

Warranty: 5-year full warranty, 10-year warranty on post/post-seal

Certifications: ISO, IEEE 535 (Europe), IEC Testing Requirements

www.baebatteriesusa.com



Sun Xtender Batteries

Product: Lead-acid batteries for renewable energy storage

Description: Recombinant gas Sun Xtender Series renewable energy batteries are deep cycle AGM batteries. Transport Hazmat exempt.

Chemistry: Lead-acid

Capacity (Ah @ 20hr rate): 224Ah @24hr rate

Voltage: 6V

Operating temperature range: -40°F to 160°F (-40°C to 71°C)

Dimensions: 10.28" x 7.06" x 9.92"

Weight: 67lbs (30.4kg)

Warranty: 12-month limited warranty

Certifications: ISO 9001, AS9100

www.sunxtender.com



Electrovaya

Product: Lithium-ion Forklift Battery

Description: The ELivate product line of lithium-ion batteries are designed as direct lead-acid replacements for the material handling sector. This product is based on the LITACELL, which is the fundamental building block for all Electrovaya products.

Chemistry: Lithium-ion

Capacity (Ah @ 20hr rate): 960Ah

Voltage: 36VAC

Energy: 35kWh

Peak power: 35kW

Cycle life: 9,900

Operating temperature range: -4°F to 122°F (-20°C to 50°C)

Weight: 2600lbs (1179kg)

Certifications: UL1642, UL1973

www.electrovaya.com



Storage Battery Systems, LCC

Product: Renewable Energy Storage Cell SBS-6PzS967

Description: Designed and developed with precision in mind, these bolt-on renewable energy cells provide high charge acceptance and long and durable service life. The design and use of high-quality raw materials guarantees the reliability and efficiency of this energy solution.

Chemistry: Lead-acid

Voltage: 2V

Cycle Life: 3250 cycles at 50% DOD

Dimensions: 7.80" x 4.69" x 28.31"

Weight: 114lbs (51.7kg)

Warranty: 120 months: 5-year full warranty with balance prorated based on prices at the time of replacement

www.sbsbattery.com/solar



Powin Energy

Product: Stack140

Description: Stack140 is a modular, flexible, purpose-built 140kWh battery array that is easily and cost-effectively scalable from 125kW to multiple megawatts. Powin Energy's patented bp-OS, an advanced battery management system, comes installed in every Stack140 module.

Chemistry: Lithium-ion

Voltage: 720 to 990VDC

Energy: 140kWh to 2.0MWh

Peak power: 140kW to 2.0MW

Operating temperature range: -4°F to 122°F (-20°C to 50°C)

Dimensions: 40' x 8' x 8'6" (40ft container)

Weight: 72,000lbs (40ft container) (32,659kg)

Certifications: UL1642, Designed for UL1973, UL9540

www.powinenergy.com



Enphase Energy

Product: Enphase AC Battery

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

Chemistry: Lithium iron phosphate (LFP)

Capacity (Ah @ 20hr rate): 48.5Ah

Voltage: 240 / 211 / 264VAC

Energy: 1.2kWh

Peak power: 280VA

Cycle life: 7,300

Operating temperature range: -4°F to 113°F (-20°C to 45°C)

Dimensions: 47" x 39" x 36"

Weight: 55lbs (25kg)

Warranty: >80% capacity; up to 10-year warranty or 7,300 cycles

Certifications: UL 9540, Cell safety certifications: TUV Rheinland, UL

www.enphase.com



Leoch Battery Corp.

Product: Leoch Model 16 OPzV 2000

Description: Tubular plate gel design provides long cycle life, low self-discharge rate, and performs well in wide temp range. Cells are sealed, maintenance-free, safe to handle, and easy to install in a variety of rack types.

Chemistry: Lead-acid

Capacity (Ah @ 10hr rate): 2000Ah

Voltage: 2V

Energy: 5000kWh

Cycle life: 5500+ cycles 30% DOD

Operating temperature range: -4°F to 131°F (-20°C to 55°C)

Dimensions: 15.7" x 8.43" x 31.8"

Weight: 342lbs (155kg)

Warranty: 5-year conditional warranty

Certifications: UL, CE, IEC

www.leoch.us



EnerSys

Product: Genesis 200EP Battery

Description: Genesis 200EP batteries, manufactured with advanced Thin Plate Pure Lead (TPPL) technology, are part of an EnerSys off-grid solar photovoltaic solution for renewable applications. Housed in a thermally-managed outdoor enclosure, supported by an inverter and solar panels, this sustainable backup power solution manages energy flow from the solar panels to and from the batteries.

Chemistry: Pure lead-tin Valve Regulated Lead Acid (VRLA) Absorbent Glass Mat (AGM)

Capacity (Ah @ 20hr rate): 208Ah

Voltage: 12V

Energy: 2.5kWh to 10.2V per battery

Peak power: 5148W per battery at the 10min rate, to 10.2V per battery

Cycle life: 600 cycles @ 80% DOD; 1500 cycles @ 50% DOD

Operating temperature range: -40°F to 113°F (-40°C to 45°C); -40°F to 176°F with mental jacket (-40°C to 80°C)

Dimensions: 22.87" x 4.92" x 12.46"

Weight: 132.3lbs (59.9kg)

Warranty: 2-year warranty

Certifications: Recognized by UL File no: MH18697

www.enersys.com



Fluidic Energy

Product: Energy Storage Solutions

Description: Fluidic Energy's proprietary zinc-air battery technology is a solution for long-duration applications from off-grid renewable microgrids to grid reliability applications.

Chemistry: Zinc-air

Operating temperature range: 32°F to 122°F (0°C to 50°C)

www.fluidicenergy.com

The Center of Your Solar System

CROWN

RENEWABLE POWER
BATTERIES

This is where your investment in Solar & Wind Power Equipment pays off.



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

- ▶ The most complete, dedicated array of RE batteries with unmatched application flexibility and ease of handling
- ▶ Battery capacity ratings that range from 120 to 3690 ampere-hours (100 Hour Rate) and unmatched application flexibility
- ▶ Recognition of Crown Renewable Power Batteries as best-available and most-reliable by serious RE system owners

You've researched the renewable energy equipment you've bought. Now it's easy to select the storage batteries you need. Crown Batteries. Once you compare all the other renewable energy batteries in the world today, you'll find there's really no comparison. It's truly the best batteries for your solar system.

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



CROWN BATTERY MANUFACTURING CO. | FREMONT, OH | MADE IN U.S.A.

SOLAR POWER SOUTHEAST

May 11-12, 2017
Lowe's Atlanta Hotel – Atlanta, GA

Solar Power Southeast has proven to be the premier solar event in the region. In 2015 there were over 200 companies in attendance, and over 300 companies attended the 2016 event. The growth is in part due to the exponential solar growth that's happening in the southeastern United States, as well as the passion the of the region. The focus is to bring together those who are doing business in the region, or would like to conduct more business in the region to discuss strategies, market trends in the southeast, policy updates impacting businesses, and numerous networking opportunities to make more connections.

www.events.solar/southeast

show in print

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

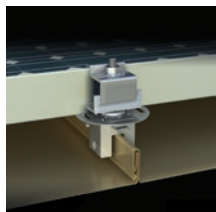


Reliable single axis tracker

Genius Tracker offers fast install and overall value for low O&M costs. It has completed Black & Veatch technical assessment, CPP wind tunnel testing, is rated 150mph, and ETL / UL 2703 tested. Genius Tracker provides 99.3% panel density on rows. It's linear actuator drive system has a 40-year operating life and is IP 66 rated for operation in harsh environmental conditions. Every drive actuator has its own battery backup and wirelessly linked controllers, eliminating all trenching. Tru3D-Gimbal bearings account for pile installation being out of plumb, out of azimuth, and out of vertical and east-west alignment. Self-powered rows eliminates central drive, allowing for uninterrupted grass cutting and panel washing. GameChange Solar provides free installation training and tracker commissioning for their Genius Tracker systems.

GameChange Solar

www.gamechangesolar.com



Non-penetrating mounting solution

The S-5! PV Kit is a UL subject 2703 listed solar module mounting solution, and has gained an ETL listing to UL 1703. This non-penetrating, DirectAttach PV mounting solution for standing seam metal roofs fits the majority of solar panels on the market and can withstand harsh weather conditions while maintaining electrical conductivity. S-5!'s new EdgeGrab is specifically designed to be used in conjunction with the patented S-5-PV Kit for solar array end conditions. The S-5! PV Kit reduces cost by eliminating the need for inter-module copper wires and lug bonding, and ultimately saves time and materials by providing the entire attachment system.

S-5! | www.s-5.com



Single axis tracker & fixed ground mount

Arctech Solar has supplied over 10GW of module mounting structures across 600+ projects in over 10 countries. Arctech Solar increased its production capacity to 9GW a year along with introducing new products. The Arctracker Pro is a new single axis tracker designed to accommodate larger 1500V systems while still incorporating Arctech's signature redundancy design. The new fixed tilt ground mount is designed specifically to reduce balance of system costs by focusing on minimizing the part count, increasing land adaptability, and decreasing installation time.

Arctech Solar

www.arctechsolar.com



Versatile ground mount system

The Advanced Modular ground mount system is a solution for large commercial and utility scale solar projects. Features including integrated bonding, cable management trays, and UL Certified components reduce electrical costs. Engineered cross bracing, high strength steel, and physical testing on every site makes the Advanced Modular ground mount system a strong and rigid system. The shallow helical foundations allow massive versatility with soil issues such as soft soils, low friction soils, high water tables, shallow bedrock, deep frost lines, and rolling topography.

AP Alternatives

www.apalternatives.com

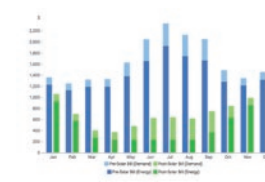


High performing solar tracking

The PST-1AX6 Single Axis Solar Tracker from Sun Action Trackers highlights premier technology and superior materials to offer efficiency and improved production while also giving longer product life. Their systems do this through their patented real time sensing solution partnered with their Magnesium Alloy Coated Steel. With high production rates and material longevity, their Single Axis Solar Tracking systems provide cost-effective performance.

Sun Action Trackers

www.sat-energy.com



Integrated solar design and financial analysis

Aurora Solar has recently released an innovative commercial financial analysis suite. Now customers can calculate their depreciation tax shield, take into account demand charges when using Green Button data, and include fixed and variable O&M costs in their financial analysis. This new feature makes Aurora an integrated commercial solar design and financial analysis platform.

Aurora Solar | www.aurorasolar.com

- ✦ **Top five** global tracker supplier
- ✦ **Number one** supplier of tracker and fixed structures in Asia
- ✦ Supplied over **10GW** of module mounting structures across **600+** projects in over 10 countries.

Your Bridge To The Sun

www.arctechsolar.com

📍 Offices of Arctech Solar



SOLAR POWER TEXAS

June 13-14, 2017

Sheraton Austin Hotel at the Capitol – Austin, TX

Several hundred attendees from all cross-sections of the industry convened in San Antonio, June 2016, for the inaugural event, Solar Power Southwest. The program centered around trends and policies that impacted the Southwest United States, with a particular focus on Texas, Colorado, Arizona, and New Mexico. This year's event, Solar Power Texas, will focus on the growing Texas market.

www.events.solar/texas

show in print

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



Solar and energy storage inverters

Eaton Power Xpert 2,000-kilowatt (kW) and 2,200kW solar inverters and 2,500kW energy storage inverters provide high power ratings for grid-tied, utility-scale projects. The Eaton solar inverter technology yields lower levelized cost of energy (LCOE) and 98.5% efficiency by the California Energy Commission (CEC). Eaton's Power Xpert solar inverters also enable a skid-less inverter station design to reduce equipment requirements and installation costs. Eaton Power Xpert energy storage inverters are designed to increase electrical resiliency in large-scale applications and work with a wide-range of battery chemistries to store and transmit power when needed. The inverter design also helps provide precise power ramp rate control and frequency regulation to enhance the reliability of electrical power transmission and distribution.

Eaton | www.eaton.com/solar



Engineering services for utility-scale solar

Tropenas Company provides independent engineering to developers, owners, utilities, and solar OEMs by offering turnkey electrical and civil solar permit packages. With 3+GW of interconnection applications and designs, their multi-state local engineers will lead any portion of a solar project. Designed blending contractor field experience with value engineering, Tropenas' designs incorporate and clearly communicate lean solutions, enabling fast installation and long durability improving profitability. Example offerings: stamped electrical and civil permit drawings, independent engineering, medium voltage, and substation design.

Tropenas Company | www.tropenas.com



Direct from manufacturer racking solution

OMCO's Field-Fast Rack design provides a solution which includes various features to reduce installation costs and ensure proper construction. These features include preassembled clips that optimize packaging and shipping, reduces on-site labor requirements, accelerates total build time, and eliminates loose hardware. The slide and stay modules allow a simple two person installation that improves safety by utilizing no overhead lifting. The rail is designed to hold modules during installation through integrated locating/spacing features, engineered tabs for safety/speed, and ensuring optimal orientation for any framed module. The reverse clip install feature allows all work to be completed at ground level, eliminating lift equipment and consolidating tool requirements. The row pitch capabilities simplifies installation on uneven terrain, maximizes linear articulation, and utilizes a single point connection. Lastly, the OMCO Field-Fast Rack allows customers to buy direct from the manufacturer providing a cost advantage along with unparalleled customer support.

OMCO Solar | www.omcoracking.com



72-cell mono module

The monocrystalline modules of the AXIpremium series are the specialists among the AXITEC solar modules. These high-performance solar modules with efficiencies of up to 17.83% and excellent low light performance guarantee high power output. These modules are a solution for maximizing power on commercial projects.

Axitec Solar | www.axitecsolar.us



Accelerated foundation method

TerraSmart's ground screw patented spiral thread system and pinpoint tip allow it to cut through the most arduous soil conditions imaginable. From bedrock to permafrost to coral, ground screws have an innate ability to penetrate the toughest soil conditions in minutes. Ground screws eliminate the need for concrete and allow foundations to be set within minutes, not hours. This accelerated foundation method has redefined installation times to 150 ground screws per day in medium dense soils. Imagine how fast a ground mount project will progress when you can set foundations in minutes and erect structure instantly.

TerraSmart | www.terrasmart.com



Solar wire management

Nine Fasteners is pleased to announce the upcoming release of their newest solar wire management clip; NFI-1701. The NFI-1701 was designed in conjunction with Enphase Energy for use with their newly released 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 in the U.S. Constructed out of .025" thick 301½ hard stainless steel material and incorporating a rolled outer edge for maximum wire safety. The clip will receive UL certification once production quantities are available at the end of Q2 2017.

Nine Fasteners | www.ninefasteners.com



Simple and smart solar solution

Fronius introduces the Fronius Smart Solution, satisfying all needs for residential and commercial systems: flexible system design, shade mitigation, NEC compliance, high performance, and monitoring while keeping the number of components low and installation easy. The Fronius Smart Solution combines the benefits of traditional MLPE and microinverters with DC optimizers with the ease of installation and cost-effectiveness of string inverters. For example, a typical residential system of 6.5kW with traditional MLPE 24 components would have to be installed on the roof. All power electronics needed with the Fronius Smart Solution include an inverter and a Fronius Rapid Shutdown Box.

Fronius USA, LLC | www.fronius.com



WINDPOWER 2017

May 22-25, 2017

Anaheim Convention Center – Anaheim, CA

Wind is an American resource creating American jobs. Wind power contributed more new electric generating capacity in 2015 than any other source. Wind power is on a path to generate 10% of American electricity by 2020. Wind power is Big League. Wind power is the choice of some of the world's most iconic brands. Google, Microsoft, Amazon, Walmart, General Motors, IKEA, Yahoo! to name just a few. WINDPOWER has a Brand New Attitude.

WINDPOWER is the largest North American wind energy trade show and they will introduce their Brand New Attitude in Anaheim this May.

www.windpowerexpo.org

show in print

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



Combined breaker & grounding switch

EMA Electromechanics' VDH/GSMI combined 34.5kV outdoor vacuum circuit breaker and high-speed, mechanically interlocked grounding switch is specifically designed for wind power projects. This patented system for switching and grounding of wind collection circuits replaces traditional use of oil insulated grounding transformers combined with conventional circuit breakers in every feeder of a wind power substation, making green energy greener.

EMA Electromechanics LLC

www.emaelectromechanics.com

Booth 2472



Blade inspection and repair

Many owners don't think of blade inspections and repairs as a top priority—until they experience a failure. Not only are damaged blades a large contributor to wind farm underperformance, but they can be costly to fix if problems aren't caught early. EDF RS provides advanced blade inspection processes. They use modern camera technology to pinpoint damage and problem areas. Their technicians then work with owners to formulate a repair plan to bring blades back to peak performance and keep them running for years to come.

EDF Renewable Services

www.edf-renewable-services.com

Booth 2420



Condition monitoring system solutions

Bachmann Monitoring provides comprehensive condition monitoring system (CMS) solutions consisting of stand-alone to fully integrated options, installation offered worldwide, remote monitoring with global support, and a multitude of training options to the wind industry. Bachmann Monitoring has custom designed CMS solutions tailored to the needs of their customer's fleets and guaranteed high availability with backwards compatibility maintained with every new product rollout, ensures wind turbines will be equipped with the latest in predictive maintenance technology throughout their lifetime.

Bachmann Electronic | www.bachmann.info

Booth 3720



Full-service wind engineering & manufacturing

Janicki Industries is a privately owned, full-service engineering and manufacturing company. Janicki specializes in manufacturing wind energy parts, patterns, and production tools made of advanced composite materials and metals. They are capable of tackling large-scale projects, utilizing high-precision five-axis mills, curing ovens, autoclave, and large annealing oven. Janicki also has extensive experience using many composite systems, such as: 71°C | 160°F machined syntactic putty; 121°C | 250°F carbon/fiberglass hybrid molds; 177°C | 350°F carbon molds; and 177°C | 350°F invar and steel molds. This 100% in-house capability for the total tooling and parts solution enables a one-stop shop for customers.

Janicki Industries | www.janicki.com

Booth 3226



Parker enables its partners in the wind industry to minimize equipment downtime, increase productivity, and protect the environment. This reflects Parker's commitment to the profitability of our customers and to helping solve the world's greatest engineering challenges. **See us at AWEA WINDPOWER - Booth #2886**



ENGINEERING YOUR SUCCESS.

solutions.parker.com/AWEA2017



Project cargo services

Martin Bencher Group is a Scandinavian based shipping and freight forwarding company, transporting and specializing in the handling of projects and oversized/heavy cargo. Their expanded network and strategically located offices offer services to customers worldwide. Martin Bencher Group currently serves the following industries; oil and gas, shipbuilding, paper and pulp, power, mining, cargo handling equipment, yachts and wind power.

Martin Bencher Group

www.martin-bencher.com

Booth 2743



Handheld printer for on-site marking

The handheld Thermofox printer from Phoenix Contact is lightweight and rugged, for easy marking on-the-go. Material cartridges hold an average of 25% more material than other printers on the market. The user can easily swap the cartridges for terminal block marking, shrink sleeves, self-laminating wire wraps, and indoor/outdoor vinyl tape in a variety of colors. The Thermofox also features barcode creation, a symbol library, automatic sequencing, and the ability to save files.

Phoenix Contact

www.phoenixcontact.com/handheld

Booth 2272



**EXPERIMENTS
BELONG IN A LAB**

**NOT
IN YOUR TURBINE.**



DEVOTED TO PROTECTION™



SEE US AT BOOTH #2848

The right oil shouldn't be a guessing game. Maximize your ROI with AMSOIL PTN 320, one oil, no guessing.

- Specifically formulated to meet the needs of wind turbines, addressing the areas where others failed.
- OEM approved, customer verified for over 8 years with an industry leading warranty.

**NO ADDITIONAL
TOP TREATS NEEDED**

FIND OUT MORE AT AMSOILWIND.COM



Fire suppression system

The Firetrace automatic fire suppression system is a solution for the unique environment in a wind turbine unaffected by vibration, dust, airflow, and temperature. Their systems can protect the control panels, capacitor cabinets, braking system, transformer, and other at risk areas of the turbine, without requiring power or excessive space usage.

Firetrace International | www.firetrace.com
Booth 3012



Versatile and durable torque tester

SmartCheck is a newly launched small sized, versatile, and easy-to-use torque tester suitable for any workshop and service vehicle. Its compact dimensions coupled with its rotatable display and the ability to mount it horizontally or vertically, provides versatility in any location. With a splash-proof display and keypad, it can be operated through power supply or battery. SmartCheck quickly provides information on whether or not a torque wrench is within the prescribed tolerances or if it requires adjustment. The integrated visual and audible overload protection mechanism and impact resistant plastic housing ensure the durability associated with STAHLWILLE products.

STAHLWILLE | www.stahlwille-americas.com
Booth 3732



Renewable energy wire and cable

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

LS Cable & System U.S.A., Inc. | ls.spsx.com
Booth 3869



High torque bolting solution

Critical bolting demands tools that deliver high torque with superior performance. The HT Series, from AcraDyne, combines these features in an electric, high torque bolting tool and provides accuracy, speed, and safety. When combined with AcraDyne's Controller, customers have a high torque, bolting system that can handle tough and critical bolting jobs. The AcraDyne HT series tools are not only accurate but are also up to 100 times faster than other hydraulic tools; additionally, AcraDyne tools offer a torque range from 1 Nm to 12,000 Nm. AcraDyne tools feature an ergonomic, robust design, five handle configurations, and over 300 models to choose from. The built-in, integral transducer provides optimal monitoring and control, the HT Series is also a traceable system at the square drive. All AcraDyne tools are made in the USA.

AIMCO | www.amico-global.com
Booth 3832



Transportation, distribution, and storage

The Port of Stockton is an inland facility located in the extended San Francisco Bay Area that has handled breakbulk cargo since 1933. It has 2.5 miles of on-dock rail connecting to the UP and BNSF that offer service throughout the United States. The Port is adjacent to less congested highways, I-5, I-4, and I-99, and is an hour from I-80. It has handled shipments of clean energy cargo of all shapes and sizes. The Port of Stockton has around the clock security and uniquely offers customers 24/7 access to their freight.

Port of Stockton | www.portofstockton.com
Booth 2685



Auto lube systems for wind generators

BEKAwind offers 3 customizable lubrication systems for wind generators; The Single Line System is easy to install, operate, and maintain and can be applied to main bearings, blade bearings, and yaw bearings. The Progressive System offers a flexible lubrication system for oil and grease up to NLGI Class 2 and can be applied to main bearings, blade bearings, and yaw bearings. The Progressive System can be matched with a lubrication pinion for the pitch and yaw drives. BEKAwind Flow, a spray lubrication system, is selected for use with special lubricants with high solids content. This efficient non-contact technology offers a clean alternative for pitch and yaw drives.

BEKAwind | www.beka-lube.com
Booth 3358



Using wind energy efficiently: Hybrid tower for greater yield.



Hybrid Tower System

- Economic optimum by combination of concrete and steel
- Assembly independent from weather conditions
- Manufacturing on-site with mobile fabrication

Mobile Factory



www.max-boegl.com



Developer & operator

BayWa r.e. Wind, LLC is a turn-key developer and operator of renewable energy projects in North America. Headquartered in San Diego, CA, the company has been active in the U.S. since 2001. The company's business model is to develop, construct, own and operate renewable energy projects. It seeks to complete the life-cycle by either divesting of or partnering on the operating assets. The company is actively seeking new renewable energy projects.

BayWa r.e. Wind, LLC | www.baywa-re.us

Booth 2244



Coating systems

Duromar has a full-line of high performance, zero VOC, color stable coating systems for the repair, resurfacing, and long-term protection of wind turbine blades, including the leading edge. Whether a blade is suffering from cracks, pits, or general wear, Duromar has a repair solution. OEMs may also apply these coatings for long-term blade protection starting at day one of operation. These products are easy to apply by hand or by spray.

Duromar | www.duromar.com

Booth 4151



Slip rings for wind turbine applications

BGB Technology provides custom designed and standard slip ring and fiber optic products covering all utility and small wind turbine requirements including: generator slip ring assemblies, hub and pitch control slip rings, yaw slip rings, lightning suppression, shaft grounding systems, and brush assemblies. Capabilities also include the incorporation of fiber optic rotary joints within pitch control slip rings to provide contactless signal transmission.

BGB Technology, Inc.

www.bgbtechnology.com

Booth 3704



Bolt tensioning cylinders

ITH bolt tensioning cylinders are designed for tightening large diameter bolts (M16 and larger) of all major OEM wind turbine applications including: foundation rods, tower bolts, bearing bolts, and other applications. Combine ITH tensioners with the standard-duty ITH Eco-MAX pump for construction jobs or the lightweight and compact Micro-MAX pump for maintenance jobs.

ITH Engineering | www.ith.com

Booth 3316



Bringing
100+
Products and counting
to help increase
wind turbine efficiency

Your investment in wind power is substantial, make sure your return is as well. From manufacturing to maintenance and beyond, 3M is a trusted partner with technology to help maximize efficiencies at every turn. We provide a robust offering of tapes, coatings, fillers and vortex generators to fit your needs. As a global company you can rest assured that we will be with you wherever the wind blows.

Visit 3m.com/windnace to learn more

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Hybrid tower for greater yield

Max Bögl Wind AG offers hybrid wind towers with hub heights of up to 590ft (180m), which provide reduced wind turbulence and thus, high wind yield. These economical towers are made possible due to a combination of precast concrete parts and steel elements. For projects outside Europe, they are manufactured locally in a mobile factory. Max Bögl is also working on a pilot plant combining wind turbines and pumped storage to further increase the efficiency and yield of wind turbines.

Max Bögl Wind AG | www.max-boegl.de
Booth 3256



Engineering & environmental consulting

Employee-owned Barr Engineering Co. integrates engineering and environmental expertise to help clients develop, manage, process, and restore natural resources. Their projects span across the Americas and around the world. Since 1998, Barr has worked on over 400 windpower projects in 30 states, Canada, Mexico, and South America. They assist clients with everything from pre-construction permitting, and geotechnical investigations to foundation design, construction oversight, and O&M engineering.

Barr Engineering | www.barr.com
Booth 2320



High yield wind turbines

Nordex/Acciona Windpower has installed more than 21GW of wind energy capacity in over 25 markets, and, in 2016, generated revenues of EUR 3.4 billion. The company currently employs a workforce of approximately 5,000. The product portfolio of the group is focused on onshore turbines in the 2.4 to 3.9MW class, which are tailor-made for the market requirements in developed and emerging markets. The group offers multi-megawatt wind turbines for nearly all geographical regions, from grid-constrained, unrestricted projects to sound restricted, land-constrained, complex terrains.

Nordex SE | www.nordex-online.com
Booth 3336



Approved lubricant solution

AMSOIL produces high quality lubricants for the wind energy market. With their research and technology, their process guarantees a cleanliness code of 16/14/11 or better on every main gearbox, pitch, yaw, and hydraulic lubricant they produce. With more than 8 years running the wind industry on the same formula, and reaching over 15,000 MW Class turbines in North America, AMSOIL lubricants are cost-effective choices for prolonging equipment life, reducing maintenance, and increasing gearbox performance and reliability. Anti-foam qualities preserve oil film thickness and optimize bearing life by controlling micro pitting and scuffing wear, increasing run times and reducing maintenance costs. AMSOIL's resistance to moisture extends filter life and eliminates additive depletion.

AMSOIL, Inc. | www.amsoilwind.com
Booth 2848



wind.automation

RELIABLE – ALWAYS AND EVERYWHERE

MAXIMUM AVAILABILITY.

Robust automation solutions also for extreme environmental conditions

EXPERTISE.

Over 90,000 wind turbines automated, more than 6,000 CM-Systems installed

TRANSPARENCY.

Open system solutions and web-based SCADA



May 22 - 25, 2017
Anaheim, USA
Booth: 3720

bachmann.

www.bachmann.info



Broadband satellite internet service

Skycasters provides reliable data communications which keeps critical data flowing. The company serves all businesses needing a premium connection with maximum uptime, including those involved in renewable energy exploration and delivery. Their business-grade, high-speed satellite Internet solutions offer a low-latency connection with guaranteed speeds supporting all communications and data operations needed by the energy sector—SCADA, VoIP, email, fax, streaming data, and more. A direct and redundant connection to the U.S. Internet backbone provides Skycasters customers with reliable communications whenever and wherever they go. Fixed and mobile satellite Internet solutions all utilize business-grade equipment built to last and perform in the most rugged environments. Flexible and customized service plans are available to meet individual business needs, backed by a 24/7 Technical Support Group offering support based out of their company-owned and operated Ohio NOC/Teleport.

Skycasters, LLC. | www.skycasters.com
Booth 3623



HUB converter upgrades

PSI Repair Services, Inc., provides product upgrades for H bridges (aka hub converters) to the wind energy industry. Their custom upgrades prevent failures from high heat loads and stripped ground screws. PSI's custom Switching Driver replaces the OEM part and efficiently translates into less heat, while reducing mean time between failures by 80%. Steel inserts are used to create more durable ground lug threads. PSI has field tested this upgrade on over 3,000 installations with successful results. PSI offers component repair and engineering services for GE, Vestas, Gamesa, Siemens, Suzlon, RePower, and Clipper wind turbines. They cover the critical electronic, hydraulic, and precision mechanical components driving the turbines' pitch and yaw systems, and down-town electronics.

PSI Repair Services, Inc.
www.psi-repair.com
Booth 3708

CUSTOMIZED
SOLUTIONS
FOR HARMONIOUS
PERFORMANCE

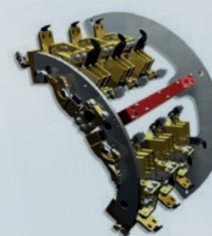
...MAXIMIZING
COMPONENT LIFE



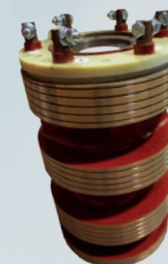
A FULL RANGE
OF SOLUTIONS
DEDICATED TO
YOUR WIND
TURBINES



CARBON
BRUSHES



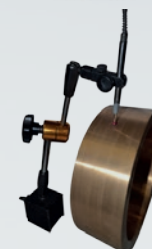
BRUSH-HOLDERS



SLIP RING
ASSEMBLIES



SIGNAL & POWER
TRANSFER SYSTEMS



CL-PROFILER:
SLIP RING
DIAGNOSTICS



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Expertise, our source of energy



Closed-loop cooling system

Many 1.5MW wind turbines use traditional open-loop water/glycol cooling systems. Regular water evaporation in the reservoir elevates the mixture's viscosity, prohibiting cooling of the IGBT and associated critical controls, causing the wind turbine to overheat unless serviced, which, in turn, means turbine downtime and high maintenance costs. Parker's KleenVent Coolant Evaporation Inhibitor (KV-CEI) is a simple add-on to the legacy cooling system, that eliminates water evaporation in the coolant solution and stops the ingress of airborne contaminants, by enclosing the cooling loop. The KVCEI also removes the need for continuous coolant monitoring during the warm season. Traditional maintenance calls to replenish or rebalance the fluids, take the wind turbine and transformer offline, resulting in significant downtime and revenue loss. Parker's cooling system solution optimizes wind turbine uptime and revenue, reduces maintenance costs, and increases overall efficiencies.

Parker Hannifin - Energy
solutions.parker.com/AWEA
Booth 2886



Miniature doppler sodar

REMTECH manufactures and maintains the REMTECH DOPPLER SODAR(s) and the RASS (Radio Acoustic Sounding System). Their DOPPLER SODAR systems remotely measure a vertical profile of wind speed, direction, thermal stratification, and turbulence parameters (sigma W, sigma Theta) up to 400, 700, and 3,000 meters average altitude range depending on Sodar model. They are suited for wind energy site assessment, airport safety (wind shear detection), for air pollution control and forecast, as well as site surveys (power plants). Military organizations are using the SODAR in programs for weapons development, parachuting, landing on aircraft carriers, and general flight tests. REMTECH's RASS remotely measures temperature profiles in the atmosphere. It can be used in environmental studies and study of telecommunication network disturbances due to atmospheric conditions. It comes as an option to their long range SODAR and can provide measurements up to 1500 meters above ground.

Remtech Inc. | www.remtechinc.com
Booth 3204



Generator brush and slip ring upgrades for high output turbines

Mersen's experience in the protection of electrical rotating machines enables them to offer unique solutions which improve the reliability of a range of associated turbine components, such as non-drive end bearings, brush riggings, brush holders, and electronic cards. The expertise and design philosophy adopted by Mersen, while striving for continuous improvement, has led to significant advances in the domain of slip ring and carbon brush technology. New solutions, including carbon grades designed specifically for wind power applications, have resulted in reduced operating costs. The increased demands from today's high output wind turbines requires a deep technical understanding of the machine's intricate systems. Mersen has worked with all major OEM's and power utilities worldwide to understand these requirements. The SR13-15 is an upgrade to one of the most common wind turbine generators in North America. Its robust design allows high operating loads, has proven to run cooler, and increased availability in high winds.

Mersen | www.mersen.com
Booth 3236



Whether you need a system for wind blade production or repairs, come by and learn how Mankiewicz can provide your complete coatings solutions.



Booth # 3174



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 Europe: +49 (0) 40 / 75 10 30

www.mankiewicz.com



Fully automated blade inspections

SkySpecs is a robotics company offering fully automated blade inspections. After the push of a single button, their inspections are completed in under 15 minutes, and data is available for viewing in the SkySpecs portal in under 48 hours. SkySpecs provides worldwide onshore and offshore inspections for their wind energy customers.

SkySpecs | www.skyspcs.com
Booth 3372



Wind turbine main shaft bearings

SKF's new self-aligning spherical roller bearing delivers performance and reliability for a service life of more than 25 years. These new bearings are significantly lighter than SKF's standard spherical roller bearings and feature improved radial and axial robustness, making them especially suitable for wind turbine applications. Optimized internal geometry and improved lubrication capabilities also provide lower contact pressures and enhanced load carrying capacity.

SKF | www.skfusa.com
Booth 2664



Highly reliable pitch system

Moog has developed a new pitch system, the Moog Pitch System 3, to meet the growing need for wind farm operators and turbine manufacturers to reduce wind farm capital and operating expenses. The design of Pitch System 3 reduces the Levelized Cost of Energy by increasing wind turbine reliability and minimizing downtime. With an architecture that consists of significantly fewer parts, the Moog Pitch System 3 is up to three times more reliable than the industry's standard pitch systems, which reduces turbine downtime and maintenance.

Moog | www.moog.com
Booth 2215

Assessing, Repairing, and Monitoring Wind Turbine Foundations

Known for designing turbine foundations, consulting firm **Barr Engineering Co.** is receiving more and more requests to inspect existing foundations (whether designed by Barr or by others). The scenarios for which clients are asking for assessment include:

Repowering existing wind-energy developments.

Companies seeking to maximize their return on investment are outfitting their turbines with new controls and/or new blades to optimize performance and generation capacity. Because these improvements can increase the load on foundations, though, companies must first determine whether upgraded turbines will remain stable for their extended service lives (foundations are typically designed for 20 years of operation).

Barr's structural engineers evaluate the integrity of existing foundations and their ability to support repowered turbines. For one repowering project at a Montana wind farm built a decade ago, Barr performed non-destructive foundation monitoring that identified anomalies in the performance of one turbine. Targeted exploratory concrete coring confirmed the presence of cracks deep inside the foundation. After injecting structural epoxy to fill the cracks, Barr conducted additional monitoring, which confirmed a significant increase in the foundation's rotational stiffness and verified the effectiveness of the repair.

Assessing potential damage. After a tornado damaged some towers at a Kansas wind farm, the client was concerned that foundations may also have been damaged—but visual inspection wasn't sufficient because the bulk of each foundation was underground, and excavating around the foundations to examine them still might not reveal cracks deep inside the concrete. Therefore, Barr assessed the foundations' condition with non-destructive testing, which revealed no signs of damage.

Performing due diligence. Buyers and sellers of wind developments need confidence in the integrity of a project's towers, turbines, and foundations. Barr's structural engineers evaluate foundations for soundness, and recommend and perform repairs when necessary.

When assessing foundation condition, in some cases a desktop evaluation is enough to determine appropriate stiffness; in others, field assessment is required. Field evaluation can range from simply exposing a foundation for visual inspection to conducting concrete coring or measuring tower and foundation behavior under real operating conditions. To contain costs and minimize turbine downtime, Barr begins with the minimum amount of study and progresses to the next level only when test results warrant further investigation. The firm's wind-turbine foundation work has been reviewed and approved by independent engineers working in the industry.




environmental review and permitting
for renewable energy projects

- due diligence for project acquisitions
- Phase I environmental site assessments
- energy-facility-site permits and certificates
- local land-use and zoning approvals
- shadow-flicker and noise monitoring
- management of wetland, cultural, and protected-species surveys
- SPCC plans, SWPPPs, AIMPs, and field inspections

resourceful. naturally.®



Electrical & integrated solutions

CG provides electrical products and integrated solutions for T&D and Renewable industries with offices and plants located on four continents. Their products, solutions, and services include: distribution, secondary unit substation and power transformers, multi-winding (3, 4, or 6) step-up transformers for wind and solar applications, generator step-up transformers, complete mobile substations (new and refurbishment), and full turn-key field repairs and commissioning services. CG has been serving the North American renewable market for more than 20 years from their manufacturing plants and service center in Washington, Missouri with an installed base of more than 12,000 wind and solar step-up transformers (24GW).

CG Power Systems | www.cgglobal.com
Booth 2674



Wind project services

Sargent & Lundy brings the knowledge, experience, and resources to help their clients tackle all aspects of wind energy projects: from planning to commissioning; from due diligence to complete facility design; to grid interconnection solutions. They have been providing engineering, consulting, and support services to the wind power industry for over 15 years. Their experience spans the spectrum of geographic sites, wind turbines, complex terrain, and grid interconnection requirements as well as integrating battery energy storage into renewable generating facilities. Sargent & Lundy has been serving clients including utilities, developers, financial institutions/lenders, constructors, and manufacturers worldwide for 126 years.

Sargent & Lundy | www.sargentlundy.com
Booth 3015



Formulation-centric lubrication strategy

ExxonMobil's Mobil SHC Gear 320 WT synthetic wind turbine gear oil is formulated to help deliver outstanding protection for critical turbine components over long oil drain intervals. Specifically, Mobil SHC Gear 320 WT has shown the ability to deliver equipment protection across a wide range of onshore and offshore conditions, including: outstanding protection against micropitting and wear; reliable foam-control performance; exceptional water tolerance; and, superb oxidative stability and excellent viscometrics, even at temperatures as low as -45°C (-49F). This performance is backed by a 7-year limited warranty.

ExxonMobil | www.mobil.com/wind
Booth 3514, Hall D



Grounding cable for wind farms

Grounding cables improve both capital and O&M costs up to 40 percent. Copperweld cables replace theft-prone copper cables for grounding. Proper grounding saves turbines, transformers, and electronic circuits from severe damage during lightning or fault conditions. Copperweld's metallurgical bond process provides owners, developers, and contractors with cost-efficient grounding cables from tower base to collector system through substations.

Copperweld | www.copperweld.com
Booth 3624



Blade protection tape

3M introduces a Wind Protection Tape 2.0 designed to extend turbine blade life and maintain AEP by protecting the leading edge from erosion due to rain, sand, dirt or other debris. Easy to apply with no special tools, 3M Wind Blade Protection Tape 2.0 shows no damage even after 50 hours of accelerated rain and erosion testing. 3M WPT 2.0 tape is made from a translucent polyurethane – resistant to puncture, erosion and UV rays – backed by a highly durable acrylic adhesive.

3M Renewal Solutions | www.3m.com/wind
Booth 2004



Renewable energy consultants

Natural Power's team of engineers, analysts, asset managers, and environmental experts can address the latest developments facing onshore wind. Over the past 21 years, Natural Power has developed a full lifecycle approach to wind energy projects that help their clients to reduce risk and maximize returns across the lifetime of their projects.

Natural Power | www.naturalpower.com
Booth 2872

VDH/GSMI®

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



Visit us at AWEA WINDPOWER 2017!
Booth #2472

EMA Electromechanics LLC is the designer and manufacturer of model VDH/GSMI® combined 34.5 kV vacuum circuit breaker and high speed, mechanically interlocked grounding switch, a unique and patented system specifically designed for switching and grounding of wind collection circuits.



EMA ELECTRO MECHANICS

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



Powered access and safety solutions

Power Climber Wind helps major wind turbine OEMs, owners, and service providers manage their operation and maintenance (O&M) costs by providing reliable access equipment and expertise to improve employee safety, productivity, and retention. Their solutions for global wind farms include IBEX climb assist, turbine service lifts, tower and blade access platforms, safety equipment, and training.

Power Climber Wind
www.powerclimberwind.com
Booth 2865



Reliable and robust lockbolt

The Huck BobTail (12, 14, 16, 20mm and 1inch diameters) has gained the German national technical approval, Allgemeine bauaufsichtliche Zulassungen, from DIBt (Deutsches Institut für Bautechnik) for use in static and dynamic civil engineering applications. Used for nacelle, blade, and frame construction, the BobTail is a maintenance-free, structural lockbolt which eliminates the need to take towers offline for re-tightening; yielding more uptime and more power generation per tower. Consisting of a pin and collar, it installs via direct tension, not torque. The pin is pulled and the collar is simultaneously swaged into the pin's locking grooves, which provides consistent clamp, reliability, and vibration resistance. The shallow design of the locking grooves allows for a large bolt root radius, contributing to a fatigue strength of up to 5 times that of a conventional nut and bolt. The Huck BobTail is offered in a wide range of sizes (up to 36mm) and materials.

Arconic Fastening Systems and Rings

www.afsrhuck.net/wind

Booth 2772



Powerful clean energy solutions

Wood Group's clean energy business is a renewable energy and grid integration consultancy, providing engineering and technical advisory services in onshore and offshore wind, solar, wave, and energy storage projects. The company has been involved in more than 160GW of renewable energy projects in over 90 countries around the world.

Wood Group Clean Energy

www.woodgroup.com/cleanenergy

Booth 3517



Harness for safety at heights

The Elastrac Wind harness features superior functionality and comfort using Elaspac stretch webbing and independent leg straps providing full freedom of movement in all daily work positions for wind technicians. This harness includes dorsal, sternal, side, and front D-rings, a back support belt and a suspension loop for rescue scenarios.

Tractel, Inc. | www.tractel.com

Booth 2477



Functional coating application

The DECC Company provides coating applications for all medium to large sized hardware for the wind power energy sector. They apply Magni and Doerken MKS corrosion resistant coatings, as well as Xylan dry-film lubricants from Whitford Corporation, among others. Their rack-spray process provides coated components with a quality finish.

The DECC Company | www.decc.com

Booth 2316



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Port of Stockton
CALIFORNIA

Diversity
Productivity
Accessibility
Interconnectivity
Congestion Free

Strategically located 75 nautical miles from San Francisco Bay, this 35-foot deep-water omni-use port accommodates diverse cargoes.

Benefit from a productive labor force, 24/7 open gates, FTZ #231 and the proximity to Interstate 5 plus highways 99 and 4. Served by BNSF and UP, the port offers direct cargo transfer to and from rails, vessels, trucks and barges. Our large warehouses, distribution centers and open spaces are available for staging, development and leasing.

The port has two 140-ton mobile harbor cranes and reinforced docks to facilitate heavy-lift and project cargoes.

We are your advantage.



209.946.0246
portofstockton.com



Fall arrest and work positioning harness

The ANSI-certified fall arrest and work positioning VOLT WIND harness is easily donned due to its EASYFIT design; a vest ensures the harness keeps its shape, and the FAST automatic buckles on the waistbelt and leg loops allow the harness to be donned with both feet on the ground. The VOLT WIND harness' anatomical design and wide, semi-rigid waistbelt ensures comfort throughout the workday. Its LADDER CLIMB attachment point allows for ventral attachment of the fall-arrest trolley, thus ensuring optimal comfort during progression. It has wear protectors on the waistbelt and below the dorsal point to limit wear when moving about inside the wind turbine tower.

Wind Access Engineering
www.windaccessengineering.com
Booth 2788



Engineering & consulting services

EAPC Wind Energy provides engineering and consulting services for wind farm development throughout North and South America, North Africa, and Europe. They help developers achieve their financial goals by providing intelligent wind farm design, accurate energy assessments, and bankable reports. EAPC Wind Energy provides energy assessment and feasibility studies, development consulting, contract negotiation and review, technical due diligence, financial and economic analysis, balance of plant design and engineering, strategy consulting, wind measurement services, and windPRO software sales and support. windPRO is a comprehensive software package for wind farm project planning and design. EAPC regularly conducts windPRO training workshops across North and South America.

EAPC Wind Energy | www.eapc.net/we/
Booth 2879



Complete solution for wind turbine gearboxes

EcoGear270 XP is a wind turbine gearbox lubricant made from polyether polyol and has been engineered specifically to eliminate disadvantages of other full-synthetic oils. American Chemical Technologies, Inc.'s polyether polyol based PAG's clean systems provide a natural detergency, while being incapable of insoluble varnish formation. EcoGear270 XP is hydrolytically stable and will perform without issue with corrosion or lubricity with up to 7500ppm. PAG chemistry is easily filtered, will provide better cold temperature start-ups, and extended drain intervals. The extreme pressure properties of EcoGear270 XP have been formulated with an additive package created by advances in lubrication used in aerospace technology. Once activated by high specific loads and corresponding temperatures, the additive package helps to equalize surface roughness without creating abrasion.

American Chemical Technologies, Inc.
www.americanchemtech.com
Booth 2706



Engineering, design, and procurement

POWER Engineers is a multi-discipline engineering firm specializing in energy, facilities, communications, and environmental services. Over the last 30 years, they have worked with pioneers of the industry and supported wind projects across the globe. They bring sound engineering and innovative solutions to help their clients through every phase of a wind project. They provide a wide range of engineering and environmental services for wind facilities, including serving as Owner's Engineer, providing environmental analysis for facility siting, and performing engineering design for wind farm collection systems, turbine foundations, fiber networks, SCADA, and any associated substations and transmission lines. They also offer interconnection support, electrical system studies, and testing and commissioning for wind farms. Their project approach is marked by their commitment to being flexible, reliable, and knowledgeable so they can quickly respond to a wide variety of project situations and seek out solid solutions for every challenge.

POWER Engineers | www.powereng.com
Booth 3716

Take Control.



Mortenson Construction - Uvalde, Texas

Remote control padding/shading operation made easy with our SPD-150.

- Remote control operation
- Ideal for smaller padding operations
- Adjustable escalator for steep gradients
- Reversible foldable conveyor
- Optional ROPS available
- Five models/sizes available



Global blade services

WindCom is a global blade service company with headquarters in Houston and offices in Madrid, Spain, and Brazil. Their engineering staff provides blade repair instructions and logistical and operation staff coordinates projects anywhere in the world. With OEM materials, modern access equipment, and highly trained technicians, projects are completed safely with high quality and value. Services include inspections, leading edge protection VG installs, lightning damage, leading or trailing edge splits, structural cracks, and balancing. WindCom provides free counseling, planning for preventative maintenance, and quotations for damages.

WindCom | www.windcomservices.com
Booth 3610

U.S. toll free 800 383 2666 | Intl. toll free 800 9675 3948
pipeline@wwmach.com | www.superiormftg.com



Worldwide Group family of companies



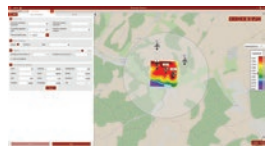
Slip ring brush kits

Morgan Advanced Materials is introducing their "Slip Ring Machining Brush Kits". These kits include Morgan's premium Long Life brush grades along with their "Surface Rounding Short" abrasive wafer brushes in the matching grade. These kits are installed in the holders like regular brushes and the generator is safely run as normal. The short machining inserts hone the slip rings, improving roundness and surface roughness. After the abrasive has done the job and is worn away, the brushes continue to perform as a regular brush until the end of life. The combination of their premium long life brush materials and SRS machining inserts equal years of improved brush and slip ring performance in tandem with reduced costs of ownership. With several years between brush changes these can be a regular one box installation, saving thousands in slip ring repair or up-tower machining as well as improving safety.

Morgan Advanced Materials

www.morganplc.com

Booth 2254



Wind engineering and climatology software

meteodyn develops applied meteorology software (wind, solar energy) and custom collaborative and distributive software platform including Meteodyn renewables expertise. The meteodyn WT software is CFD software for wind resource assessment and wind farm design in complex terrain. This wind flow modelling tool can be used to study site suitability, wind turbines layout optimization, and energy production. meteodyn WT is also useful for maintenance costs and turbines lifespan validation. Their new release of meteodyn WT includes strong new features including: a new intuitive and user-friendly interface, an integrated optimization tool, and a computation performance with an estimated time saving of 30%.

meteodyn | www.meteodyn.com

Booth 3229



Energy and environmental services

Established in 2002, Run Energy is a full service provider to the North American wind industry. Run's 190 wind technicians have multi-platform experience and provide a wide range of services covering: scheduled and unscheduled maintenance, installation and commissioning, project QAQC, facility O&M, balance of plant, retrofits, upgrades, major component exchange, oil changes, end of warranty inspections, site management, consulting, and training. Run has experience with GE, Acciona, Suzlon, Gamesa, Vestas, Nordex, Mitsubishi, Goldwind, and Repower platforms and completes services on over 8GW of installed turbines annually.

Run Energy | www.runenergy.com

Booth 3232



Alignment and geometric measurement solutions

The EASY-LASER alignment systems are specially configured with functionality and hardware suited for wind turbine alignment. No matter the manufacturer, coupling, or turbine type, EASY-LASER makes generator-to-gearbox alignment inside any nacelle easy. The EASY-LASER flange systems are ideal for measuring flatness on tower flanges regardless of diameter as well as for solving flange deformation problems.

LUDECA, Inc. | www.ludeca.com

Booth 3674

Smart solutions.
Strong relationships.

ENERGISE

Emission-free Electricity for a Greener World

PV, Salvador, Chile owned by Etrion, Total & Solvent

WE PUT ALL OUR ENERGY INTO SAVING YOURS

CG is a global leader in electrical products and integrated solutions for T&D and Renewable industries with our offices & plants located in four continents. Our products, solutions and services include: distribution, secondary unit substation & power transformers, multi-winding (3, 4 or 6) step-up transformers for wind & solar applications, generator step-up transformers, complete mobile substations (new & refurbishment) and full turn-key field repairs and commissioning services. We have been serving N.A. Renewable market for more than 20 years from our local state-of-the-art manufacturing plants and service center in Washington, Missouri with installed base of more than 12,000 wind and solar step-up transformers (24 GW). With proven track record of quality and on-time delivery, CG is one of the most reliable solution providers in the North America.



Visit us at booth # 2674



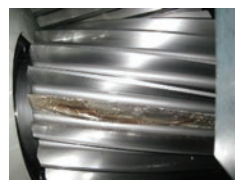
www.cgglobal.us



Developer and design solutions

Ulteig has contributed design and field services to over 16GW's of renewable energy projects across the U.S. Their team can support every aspect of a wind project, from a particular engineering scope, to fully integrated project design and management services. Ulteig understands the complexity of incorporating the needs of landowners, offtakers, utilities, local jurisdictions, and financing parties to ensure a successful renewable project. Balancing stakeholder priorities requires thoughtful risk management and a communication style fostering creative problem solving. Ulteig will proactively engage as a strategic partner, complementing their client's efforts as a liaison and facilitator to the project's stakeholders.

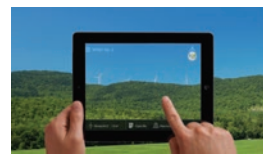
Ulteig | www.ulteig.com
Booth 3461



Client-hosted condition monitoring

VibroSuite is the condition monitoring software package designed by Brüel & Kjær Vibro for the wind turbine market, significantly reducing maintenance costs and increasing uptime at the customer's park. Brüel & Kjær Vibro is an independent supplier of condition monitoring systems and diagnostic services for wind turbines. Their solutions maximize lead-time to maintenance by detecting developing faults early, accurately, and reliably. VibroSuite is completely client-hosted, thus enabling end-users and operators to host, process, and analyze the data in-house. This powerful user-friendly solution is designed for monitoring all types of wind turbines under varying operating conditions and park sizes ranging from a few turbines to several thousand. VibroSuite enables the customer to undertake cross comparison of turbines by type, park, or drive train components. Individual alarm limits can then be easily calculated from statistical data.

Brüel & Kjær Vibro | www.bkvbibro.com
Booth 2737



A smart approach to siting and permitting

Because Ecology and Environment, Inc., (E & E) works across the energy project lifecycle—from initial feasibility study, through development and permitting, to operational compliance—they understand where and when to apply innovative technologies that can trim project schedules while bolstering integrity. Whether it's applying mobile and data visualization technologies to field data collection and reporting, or augmented reality for project siting and stakeholder engagement, E & E works with clients to develop and apply innovative IT/GIS solutions that result in efficient project development and permitting processes, and ensure project success. In their recent issue of The Current, E & E's quarterly examination of issues impacting markets and shaping progress in the environmental field, they investigate how sensing and deterrent technologies can help protect birds and bats in wind power growth areas.

Ecology and Environment (E & E)
www.ene.com
Booth 2966



Renewable generation development and consulting

Electric Power Engineers, Inc. (EPE), with multiple offices in the U.S. and internationally, is an engineering, consulting, and management service firm for electric utilities, municipalities, and cooperatives, as well as energy resource developers. Founded in 1968, EPE has extensive experience in transmission and distribution system analysis, substation and electric system design, energy market analysis, grid integration of energy resources, renewable energy, generation development, and design of wind, solar, and biomass, as well as energy storage. EPE's experience in generation interconnection and electric grid system studies extends all across the United States and internationally. Their North America expertise is extensive particularly in the Electric Reliability Council of Texas (ERCOT), Southwest Power Pool (SPP), Western Electricity Coordinating Council (WECC), Midwest Independent Transmission System Operator (MISO), and New York Independent System Operator (NYISO).

Electric Power Engineers, Inc. (EPE)
www.epeconsulting.com
Booth 3245

A complete portfolio of comprehensive engineering, procurement, construction management & testing services for project development

Interconnect Assistance & Electrical Studies
Complete Electrical Power Systems Design
Electrical EPC Design
Construction Services with Start-Up
Ongoing Electrical Maintenance & Testing

For more information, contact us at:
info@eciblg.com

ECI Engineering with Distinction
ELECTRICAL CONSULTANTS, INC.

EPC SERVICES COMPANY
An ECI Company

Visit Our Booth #3215 at the 2017 AWEA Windpower Show

www.electricalconsultantsinc.com

WOOD GROUP

Winds of change for SgurrEnergy

SgurrEnergy will formally rebrand to Wood Group from early May 2017, operating within the wider clean energy, water and climate service line. The leading renewable energy and grid integration consultancy has been part of Wood Group's clean energy business since 2010, providing engineering and technical advisory services to renewable projects all around the world. The rebrand will support the uniting of Wood Group's diverse individual businesses and will enhance the delivery of integrated services.

Visit us at **stand 3517** at AWEA WINDPOWER 2017

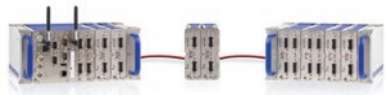
www.woodgroup.com/cleanenergy



High-yield wind turbine

The newest addition to Suzlon's product portfolio is the newly designed S128-2.6MW turbine, for low- to mid-range wind speeds. It features a rotor diameter of 129 meters and a swept area of more than 13,000 square meters to result in one of the highest-yield IEC Class III wind turbines in its class. The new turbine has been designed to deliver the greatest MWhs at the lowest possible cost. Cost efficiencies stem from the use of standardized turbine components sourced from one of the most competitive global supply chains in the wind power industry.

Suzlon | www.suzlon.com
Booth 2464



Distributable, modular system for fast measurements

When it comes to fast and flexible measurements, the spatially distributable imc CRONOSflex modules are up to tough data acquisition challenges, while performing under demanding environmental conditions. The imc CRONOSflex network-based modular system architecture means all modules can be distributed and synchronized throughout the entire wind energy installation. The devices can be assembled quickly and flexibly according to individual requirements. Communication between various components takes place via disturbance-resistant digital busses such as CAN or via Ethernet. imc CRONOSflex offers: up to 2,000 kS/s per system and up to 100 kS/s per channel; simultaneous recording of analog, digital, and fieldbus data; support of virtually any physical sensor / signal type; flexible modularity through frameless expansion; the "Click Mechanism" which connects modules physically and electronically; integrated real time analysis; and standalone, remote or interactive operation (via Ethernet TCP/IP connection).

imc DataWorks, LLC
www.imcdataworks.com
Booth 2778



Wind development region

Iowa is centrally located in the heart of a region that boasts some of the nation's most abundant wind resources, providing a strong economic environment for the wind energy industry. Companies can also benefit from a robust supply chain, with direct access to transmission lines that connect to regional transmission systems.

Iowa Economic Development Authority | www.iowaeconomicdevelopment.com
Booth 2946



Wind blade coatings products

Mankiewicz announces two new advanced coatings products that maintain turbine blade surfaces for optimal performance and efficiency. BladeRep5 is a fast setting putty that dries in one hour with the same profile-building and sandability traits of other Mankiewicz surfacing putties. And Mankiewicz's new ALEXIT Leading Edge Protection (LEP) single-coat innovation only requires one-coat application and provides substantial cost savings due to less application time. And, field testing has proven long product performance. These innovative coatings meet the requirements of the cosmetic blade maintenance market, as well as OEM blade specifications for high quality and durable products.

Mankiewicz Coatings | www.bladerep.com
Booth 3174



Engineered flexible tray cable

Lapp Group components have been field-proven to withstand temperature extremes, hydraulic fluids, corrosive oils, and the vibration and torsion stress often found in wind turbines, helping to deliver high performance and revenue generating wind farms. Lapp is introducing ÖLFLEX TRAY VTC, a flexible tray cable with TC-ER for easier installations. Engineered with premium PVC insulation provides greater flexibility over PVC/nylon without sacrificing cable size.

Lapp Group | www.lappusa.com
Booth 2960



Solving big machine challenges

With over 50 years experience, L&H Industrial provides technology innovations, custom manufacturing, and comprehensive services with offices on 5 continents. Their engineering and design teams, manufacturing and repair centers, and 24/7 field service network provides customers with a whole solution as an international provider. L&H Industrial offers uptowner turbine main shaft rebuilds as well as onsite inspection and analysis.

L&H Industrial | www.lnh.net
Booth 2805



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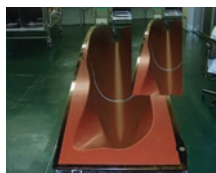
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“How Much Power Do I Really Need?”

The truth about sizing, depth of discharge, and surge capacity

by John Connell

PROPERLY SIZED BATTERY BANKS CAN DELIVER RELIABLE ELECTRICITY for years - and sizing them doesn't have to be complicated or time-consuming.

In this article, you'll learn how to slash electrical loads and accurately estimate power requirements. You'll also discover how to avoid two little-known sizing errors that wreak havoc on renewable energy systems.

Reduce power demands before sizing

Every extra kilowatt-hour of electrical demand necessitates additional solar panel or wind turbine capacity and battery storage. For this reason, it makes sense to improve efficiency and lower electrical demand before sizing a system.

Quick wins include replacing power-hungry appliances and electronics with Energy Star models, changing thermostat settings seasonally, and installing switchable

power strips to eliminate vampire loads.

Improvements to the building's envelope can dramatically increase efficiency. In North America, for instance, almost half of household energy goes toward space heating and air conditioning. Adding blown-in insulation in walls and attics can reduce temperature transfer, and lower electrical loads.

To decrease HVAC loads, consider high-efficiency traditional air conditioners. The newer, non-electric compressor, high-efficiency (20-30 SEER) Variable Refrigerant Flow technology offers even greater efficiency.

Finally, non-electric compressor systems are a viable option, and can reduce heating and cooling loads by up to 90 percent. Whole-house fans improve comfort with minimal power usage, and nighttime ventilation is highly effective in regions with low humidity.

Size batteries properly

The key to proper battery sizing is balance. Unused kilowatt-hour of solar panels, wind turbines, and battery storage are a waste of money.

Yet, undersized systems can leave you in the dark when you need power the most. Plus, the battery life of the system will be shortened due to deep discharging.

Fortunately, there's a standard method the entire industry uses to calculate electrical loads.

After following previous steps to increase efficiency, estimate power requirements by reviewing utility bills for the last 12 months. Also, use a power meter such as Kill-A-Watt™ to uncover vampire loads, and provide accurate monitoring energy usage of individual appliances.

Next, plug this data into the basic calculation for a system's power needs: $Watts = Amps \times Volts$

For example, if a system needs 1,000 Watt hours (1kWh) per day, a 12-volt / 84Ah battery bank (1,008W capacity) will be undersized, because the battery would be exposed to 100 percent Depth of Discharge (DOD) during every cycle.



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100 percent DoD means 0 percent reserve power, which means this system is undersized.

Renewable energy experts recommend sizing for a maximum of 50 percent DoD. This ensures adequate backup power during inclement weather, along with reserves for increased HVAC loads. In the example above, the battery bank above should be 12V/168Ah, to provide double the estimated Ah requirements, and ensure only 50 percent DoD.

The truth about depth of discharge

Recently, some battery technologies have been marketed for their ability to discharge 80 to 100 percent. There are several reasons to be wary of these claims.

First, every battery must have power reserves for days with increased electrical usage or decreased solar or wind production. This is a healthy margin of safety.

Second, some manufacturers size systems for 80 to 100 percent DoD. Once a battery has less than 20 percent of storage left, its user is in danger of running out of electricity. This level of DoD can shorten life. That translates into little or no reserve power for HVAC loads in the summer and winter, inadequate reserves for foggy or cloudy days, and not enough power to run large appliances.

The solution? Always request that a system be sized for 50 percent DoD; comparison shop with these numbers in mind.

Note that if an existing system still routinely drops below 50 percent DoD, installing an additional battery should help. Whether there's a backup generator or just a battery bank, plan for 3 to 6 days of stored energy for off-grid systems.

Surge capacity

Surge capacity is a battery's ability to handle high-draw loads like air-conditioning and refrigerators. This varies among battery types, and it can make or break a system.

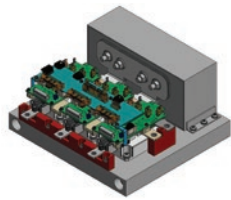
One emerging technology has a surge capacity so low (102A) that it can't handle a 1kW load (such as A/C conditioning) for more than 5 minutes. Another technology, lithium-ion, has a low surge capacity (~280Ah); to exceed this, there must be load shedding or additional batteries.

Whatever battery technology you select, make sure the manufacturer will provide you with printed specifications for surge capacity. If they refuse to give you this crucial measurement, keep looking.

John Connell is the vice president of Crown Battery's SLI Products Group. Crown Battery manufactures all its advanced technology batteries at its ISO-9001:2008-certified plant in Fremont, Ohio.

Crown Battery | www.crownbattery.com

For more information, read "How to Select the Right AGM Battery" from the July/August 2015 issue of North American Clean Energy



Stack reference designs

Mersen has teamed-up with AgileSwitch and FTCAP to develop two high performance 3-phase SiC and IGBT power stack reference designs. The SiC reference demonstrator has been designed using Wolfspeed SiC modules with power density value of 16kW/L for SiC 150kVA heavy-duty Electric Vehicle (EV) inverter, exceeding US Department of Energy (DoE) 2020 roadmap. The IGBT reference demonstrator has been designed in the frame of Infineon Industrial Power Partner Network (IPPN), powered by IGBT5 with .XT technology from Infineon and targeted for Electrical Energy Storage (EES) applications. This integrated architecture approach allows inverter designers to save time and confusion in selecting individual components and can greatly benefit from a solution that is optimally pre-designed for their specific application. Power modules, bus bar, cooling, gate drivers, and capacitors can now be optimally designed together in one step to answer electrical, mechanical and thermal challenges of the system. For both designs, a custom DC-link capacitor bank (700V/3,500µF for IGBT and 1,000V/760µF for SiC) has been specifically developed by FTCAP to minimize the footprint and optimize the thermal transfer to the heat sink underneath. High temperature, low inductance, AC and DC Mersen laminated bus bars are designed to minimize skin-effect induced by ripple-current. Mersen high performance aluminum vacuum-brazed cold plate can dissipate up to 10kW losses for IGBT and up to 3kW losses for SiC, keeping power module Tj below 130°C. Peak efficiency exceeds 98% in both cases.

Mersen | ep.mersen.com



Large-scale redox flow batteries

Fraunhofer UMSICHT developed a 3.2 m²-sized bipolar plate and produced it jointly with SAUERESSIG GmbH + Co. KG. To date, the plate is unique in its size and represents a key technology for large redox flow batteries. The novel bipolar plate material utilized has already been utilized successfully in small redox flow stacks of the Fraunhofer start-up VOLTERION and tested in the field. The large area bipolar plate provides for an output per cell corresponding to approx. 5kW (peak) and/or allows for approx. 350kW (peak) as a stack with 70 cells. A redox flow system with three such stacks (1MW, 10MWh) can provide up to 1,000 households with power for one day. The capacity corresponds to approx. 2,000 typical PV lithium ion batteries (at 5kWh, each). Additional decisive advantages of the new bipolar plate are the low minimum thickness (400-500 µm), the corresponding good conductivity, their flexibility, and the cost-efficient roll-to-roll production method. The objective of Fraunhofer UMSICHT is to not only realize large stacks of its own with this novel bipolar plate, but to also engage with industry partners in a worldwide commercialization.

Fraunhofer UMSICHT | www.umsicht.fraunhofer.de/en



30kW power conversion system

Ideal Power Inc.'s Stabiliti Series is a grid resilient 30kW advanced power conversion system (PCS) for system integrators and project developers who need to efficiently connect distributed energy resources to the grid. Stabiliti is the next generation of Ideal Power's patented Power Packet Switching Architecture (PPSA) technology and incorporates numerous new features and benefits for commercial and industrial (C&I) customers. The Stabiliti Series is available in two versions; two-port AC-DC bi-directional and a multi-port AC-DC-DC bi-directional. Key features of the Stabiliti include built-in galvanic isolation, bi-directional power flows on AC and DC, seamless transfer between grid-tied and grid-forming modes, integration of generation and storage, facilitate EV fast charging with buffer batteries, and enable peak shaving and demand applications. PPSA is a revolutionary approach to power conversion using 100% indirect power flow to deliver a bi-directional, fully isolated conversion while eliminating a majority of the bulky passive components, such as separate isolation transformer and bulk capacitors. Like Ideal Power's previous generations of 30kW PCS, Stabiliti is encased in a NEMA 3R rated outdoor enclosure and is UL 1741 certified.

Ideal Power | www.idealpower.com



Electric vehicle testing solutions

Chroma's instruments and Automated Test Systems (ATS) address the specialized requirements involved in testing EV's power electronics during the development phase as well as the production phase. Benefits of these ATS solutions include reducing hands-on manpower and human error, and providing automatic test data recording and creation of statistical analytical reports for design review and product improvement. Chroma provides instruments and automated systems for EV/EVSE, Battery and Electrical Safety applications.

Chroma Systems Solutions

www.chromausa.com



Taking Microgrids to the Extreme

by Michael Lippert

As technology has matured and manufacturing cost has fallen, Li-ion battery based energy storage systems (ESS), as part of microgrids, are being adopted by remote communities looking to reduce their reliance on diesel and other fossil fuels. There are now numerous examples of large-scale Li-ion based ESS employed in hybrid diesel/renewable power generation plants. Many are in island grids or remote areas where renewable schemes have become an affordable and sustainable means of energy production.

Integrating solar PV or wind energy into a microgrid can offer significant cost savings for remote communities. Additionally, the use of an ESS enables the operator to maximize the contribution of solar and wind, and reduce fossil fuel-based generation. This leads to reduced fuel consumption and savings on fuel delivery, which can be both significant and challenging in more isolated locales.

Using energy storage as a buffer to balance supply and demand, an operator can run diesel generators at maximum efficiency, or start standby generators only when needed, saving both fuel and maintenance costs. Integrating more renewable energy also helps operators reduce emissions and improve environmental performance.

One particular benefit of Li-ion technology is its performance at low temperatures. This has led to the deployment of ESS-backed energy schemes in some of the coldest regions of the planet, including the Arctic.

Li-ion and microgrids

Li-ion battery technology provides a number of important benefits in deploying microgrids. It offers high energy density, so the batteries are small and light enough to be housed in a standard 20-foot container. Such containers can be fully equipped and tested at the factory, making shipment, handling, installation, and commissioning quick and easy.

Li-ion has over a 10-year operational life and requires little maintenance. In addition, it's highly efficient and can accept fast charging, while offering predictable aging without risk of sudden death.

Typically, adding a Li-ion ESS to a hybrid microgrid enables utilities to increase the penetration of renewables (in terms of the load they supply at any instant) by up to 150 percent of the power output of the diesel generators, as a result of being able to integrate solar PV or wind generation sources.

Cold temperature package for Canada's Northwest Territories

There are particular challenges to deploying ESS in extremely cold climates. Simply stated, low temperatures cause the electrochemical reactions inside batteries to slow down, meaning they cannot charge or discharge as quickly as they would at more moderate temperatures.

When Northwest Territories Power Corporation (NTPC) decided to install an ESS for a PV-diesel hybrid microgrid in Colville Lake, in the far north of Canada, it needed a long-term energy storage system capable of withstanding the extreme rugged environment of the Northwest Territories.



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NTPC installed the ESS to help balance supply and demand. This enables the diesel generators to operate at optimum efficiency, and to be shut down whenever possible to reduce fuel consumption. Reduced fuel consumption is a major advantage at Colville Lake, as large deliveries are only possible during the coldest months of the winter when the ice roads open.

The ESS is installed alongside an existing diesel generating plant, with a combined total capacity of 350kW, and 50kW solar panels with the potential to extend solar capacity in the future.

At Colville Lake, the winter is long and harsh, and outdoor ambient temperatures can drop to -50°C. A special 'cold temperature package' based on a containerized Li-ion battery system, helps cope with the extreme conditions. It offers additional protection to prevent the temperature inside the container dropping below the performance range of the Li-ion cells. The ESS can accept charge at -20°C and discharge at -50°C.

This is achieved using a two-fold approach. First, the container is equipped with high performance insulation to protect the batteries from extreme low temperatures. Second, waste heat from the diesel generators is captured using a hydronic heating coil. Usually, such a system would circulate a flow of water inside a sealed loop to transfer heat from the generators to the ESS. Due to the extreme cold, however, water wasn't an option. Instead, the system contains the industrial antifreeze, ethylene glycol.

Harnessing hybrid energy in the Arctic

Another containerized Li-ion ESS cold temperature package is in Kotzebue, Alaska. Kotzebue is located above the Arctic Circle in Alaska's Northwest Arctic Borough. Here, the ESS enables a hybrid wind-diesel power system to achieve its full potential in delivering cleaner, more reliable, and less expensive power.

Kotzebue isn't connected to an electrical transmission grid or to any road system, and has historically depended on diesel generators for electricity. The annual average temperature is -6°C; area residents face some of the highest energy costs in the USA.

Incorporating the Li-ion ESS enables better utilization of the wind generation system. It provides the cooperative with an additional tool to increase efficiency and reduce diesel dependence.

In addition to the Li-ion battery container, which provides 950kWh and is able to operate in environments where ambient temperatures fall to -50°C, the ESS features a 1.2MW power conversion system and grid connect transformer. The Kotzebue microgrid has the ability to ride through fluctuations in wind output, and to time-shift excess wind energy, providing significant reductions in diesel consumption.

Wind smoothing in Saskatchewan

Cowessess First Nation (CFN) has also installed a Li-ion ESS as part of its High Wind and Storage Project in Canada. This project is being run in collaboration with the Saskatchewan Research Council, and has received funding from a number of national funds.

This grid-connected BESS helps optimize renewable wind power performance by increasing reliability and decreasing volatility by as much as 70 percent over the 15-year lifespan of the system. Each Li-ion ESS includes a 400kW power conditioning system for use in conjunction with an 800kW utility-scale wind turbine.

The system is designed to harness intermittent wind power, and provide a continuous, predictable output for both on-grid and off-grid applications. The High Wind and Storage Project also reduces greenhouse gas emissions, reduces electrical production costs, provides more renewable power to the grid, and potentially reduces electrical rates (since the battery can be charged during off-peak periods and dispatched during periods of peak usage).

The base system has been shown to be capable of performing wind smoothing, and achieving a maximum ramp rate of ten percent per minute of the rated power output of the 800kW wind turbine. It also provides up to 400kWh of peak shaving capability. The flexibility and scalability of the solution enables the energy content to increase by 124kWh increments up to 992kWh, if additional peak shaving is desired.

Michael Lippert, marketing and business development manager for energy storage systems for Saft's Industrial Battery Group, looks at how lithium-ion (Li-ion) technology is being adapted for microgrid applications in extreme low-temperature regions, including the Arctic.



Saft | www.saftbatteries.com



Scalable energy storage product

JLM Energy's MicroStorage couples a battery pack directly to a corresponding solar panel. This solution enables the dual supply of power from solar to batteries and the grid simultaneously for an efficient, cost-effective solution. A key advantage of MicroStorage is that a single solar panel can concurrently charge a battery and deliver energy to the grid. The simultaneous nature of electron flow is unique to JLM's patent-pending technology. Phazr, the first in JLM's MicroStorage family of products, is mounted seamlessly behind the solar panel, making installation simple and virtually cost free. Phazr is designed for large scale solar-plus-storage applications, and is also suited for smaller residential and commercial installs. Phazr's patent-pending technology is included in JLM's energy technology bundle and is operated by Measurz software, which continually observes energy usage patterns and utilizes a variety of strategies to maintain a pre-set budget determined by the customer. Phazr is about the size of a small briefcase, weighing approximately 15lbs. In addition to new solar installations, it can be easily retrofitted on existing solar systems and is field replaceable. Phazr uses chemically, structurally, and thermally safe lithium iron phosphate batteries which operate at a low voltage (20-40V), are designed to scale with installation, and have a 20-year warranty. Solar plus energy storage systems built with Phazr qualify for the full 30% Federal Investment Tax Credit because the batteries charge exclusively from solar.

JLM Energy | www.jlmei.com



High voltage battery test system

NH Research, Inc. (NHR) has released its 9300 series, which provides a 100kW power module with a software-selectable high voltage range (1200VDC / 167A) and high-current range (600VDC / 333A), allowing for efficient testing of single-voltage and double-voltage electric vehicle (EV) batteries as well as high-voltage Energy Storage Systems (ESS) used in grid-tied applications. The 9300 analyzes battery performance under xEV drive cycles and grid-storage profiles such as PJM and time-shifting profiles. The 9300 modules are independent, allowing for testing of multiple batteries, each with a different test plan, power levels, and start/stop times. When higher power is needed, the 9300 modules may be paralleled, providing up to 1.2MW capability. This modular power capability allows a system to be sized to the power levels needed, while ensuring expansion capability should additional power be needed in the future. The standard 9300 system is outfitted with an internal controller, system software, and advanced touch panel for manual control. Through this interface, the operator is able to create, run, monitor, chart, and report UUT profiles without writing a single line of code. Alternatively, for complex test programs and for tests requiring additional data acquisition hardware, users can employ either NH Research's Enerchron test sequencer software, or their own custom LabVIEW or Python application using the supplied fully-documented drivers. The system is highly efficient and regenerative, returning more than 90% of the energy removed from a battery as usable AC facility power. Regeneration lowers the total utility consumption of the facility, reduces the amount of generated waste-heat, provides a cooler work environment, reduces air conditioning loads, and eliminates the need for elaborate water-cooling systems. The operating cost savings from using regeneration typically provides a return on investment within 1-2 years.

NH Research, Inc. | www.nhresearch.com

Smart Building Energy Disaggregation

Submetering with split-core CT sensors

by John Marino

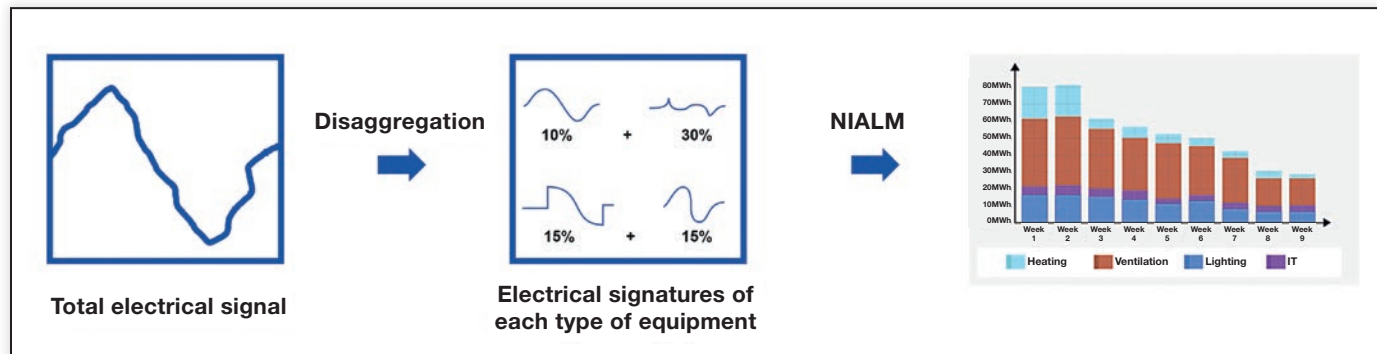


Figure 1

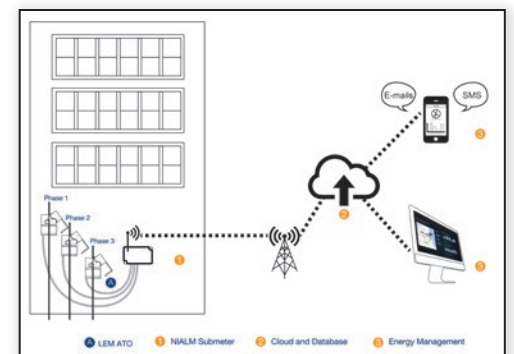


Figure 2

Industrial companies, factories, and multi-tenant building owners are increasingly installing submetering equipment in order to collect real-time, in-house energy usage data. This allows for accurate allocation of costs, calculation of internal billing, and the implementation of new energy efficiency measures.

Rising energy costs around the globe, along with government enforcement of ISO 50001 energy efficiency standards, have prompted many companies to launch initiatives to better understand their energy consumption and reduce peak demand charges wherever possible. Reducing the energy consumed by heating, air conditioning, lighting, display lighting, signage and other electrical appliances can result in hundreds of thousands in cost savings annually. In addition, companies with several factories want to participate in utility company peak-demand saving incentives aimed at reducing electrical loads at certain times of the day. These incentives reduce energy costs, provided the factories can “off-load” demand for a certain period when required. Companies need to understand how their properties are using electricity in order to develop strategies aimed at increasing energy efficiency.

A new approach to submetering

Traditionally, energy monitoring required installing several multi or single point submeters in each supply closet, each one capable of monitoring 1 to 3 phase circuits (Figure 1). Due to the layout of the factory, electrical distribution might be in several closets throughout the building, and might require several submeters mounted in close proximity. Unfortunately, this method is costly, intrusive, and requires significant installation and maintenance efforts.

A more innovative way to obtain appliance-specific data is by the disaggregation of total power consumption data, acquired at the main breaker level. The Non-Intrusive Appliance Load Monitoring (NIALM) method uses a statistical approach to processing a single power measurement to extract equipment and appliance-level data from the aggregate, without any plug level sensors (Figure 2).

Consumption data for an entire building can be collected by combining high-accuracy split-core current transformers, a NIALM submeter, and a gateway (Figure 3):

- Split-core ferrite-based sensors clamp directly onto the building’s main circuit without having to disconnect the primary conductor.
- The NIALM submeter carries out real-time power consumption breakdown and analysis, and then transmits energy consumption data to a gateway.
- The gateway stores this data to the cloud so it can be accessed by the building manager, and analyzed with an energy management application to identify ways to reduce power consumption.

New ferrite compounds

Although ferrite compounds have been used in current transformer sensors for years, their poor performance (in terms of saturation level and magnetic permeability) made them unusable at frequencies as low as 50/60Hz. Recent developments, however, have both greatly improved the performance of new ferrite compounds at these frequencies, and brought these advantages to a wide range of power monitoring applications.

The new types of ferrite have significantly enhanced permeability; they can be implemented in 50/60 Hz current transformers as a substitute for FeSi or FeNi cores, despite the low magnetic saturation level. Split-core current transformers using these new types of ferrite can accurately measure AC signals in an extended frequency range that includes 50/60 Hz. In addition to taking advantage ferrite’s intrinsic ability to provide high accuracy and excellent linearity even at very low current levels, these sensors can also feature particularly low phase-shift between input and output currents. This is essential for accurate measurements of true active power or energy. In contrast to materials like FeSi or FeNi, the hard, dense cores of the newer types of ferrite allow air gaps to be minimized, and are virtually immune to ageing and temperature changes.

Thanks to the ability of these new ferrite compounds to deliver all this at a lower cost, high performance can be delivered at a lower price. Features to look for in a split-core current transformer for use with a NIALM submeter include:

- 600V, Cat III insulation
- IEC 61869-2 compliance
- Phase displacement respected
- mA, 225mV, 333mV output
- No interruption of electricity

Today’s overall signal-to-noise percentage of correctly reconfigured appliances with IALM algorithm based submetering solutions is

around 80-90 percent, and keeps improving. Real-time energy information and energy disaggregation-based solutions, using high-performance sensors, can influence consumer behavior to increase savings and drive engagement, all at a lower cost than traditional submetering methods. Energy disaggregation technology can also be used to perform remote energy audits, measure and validate utility demand-response programs, and resolve high bill disputes between the utility and the building owner.

John Marino is the General Manager of LEM, the market leader in providing innovative and high quality solutions for measuring electrical parameters. Its core products - current and voltage transducers - are used in a broad range of applications in drives & welding, renewable energies & power supplies, traction, high precision, conventional and green cars businesses. LEM’s strategy is to exploit the intrinsic strengths of its core business, and to develop opportunities in existing and new markets with new applications. LEM is a mid-size, global company. It has production plants in Beijing (China), Geneva (Switzerland), Machida (Japan) and Sofia (Bulgaria). With its regional sales offices close to its clients’ locations, the company offers a seamless service around the globe.

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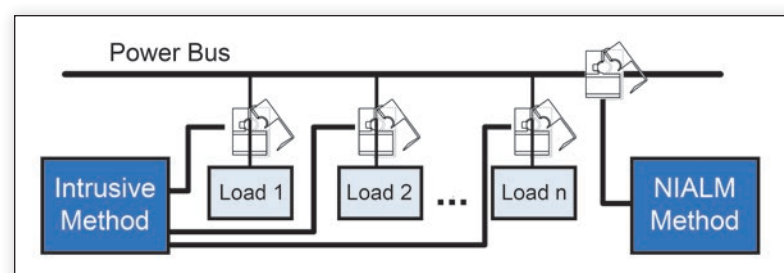


Figure 3



Clean, drinkable water from any source

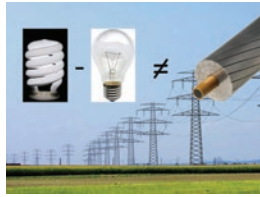
LIFESAVER products have been certified for the design, manufacture, and supply of portable nano-filtration technology, removing viruses, bacteria, cysts, and parasites from drinking water. LIFESAVER will turn any contaminated water into crisp, clear water in just seconds. Always be ready in case of an unexpected emergency with the LIFESAVER emergency preparedness packs; aluminum barrier foil packs providing clean water available for storage up to 10-years before use. LIFESAVER is highly effective at purifying muddy, thick water as it removes a minimum of 99.9999% of bacteria and 99.9% of cysts. It has been used and recommended by world humanitarian efforts as well as by military forces as a proven technology in any situation. LIFESAVER offers a variety of durable water containers for any sized crowd; LIFESAVER water bottle, the jerrycan, emergency preparedness packs, the cube, or the C2. All LIFESAVER products manufactured and sold meet NSF Protocol 231 based on the recommendations on the U.S. Environmental Protection Agency for the treatment of micro-biological contaminants. **LIFESAVER** | www.iconlifesaver.com



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Nest | www.nest.com



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- 07-11 LIGHTFAIR International 2017**
Pennsylvania Convention Center – Pennsylvania, PA; www.lightfair.com
- 10-11 GMLC DER Interoperability Technical Review Meeting**
Columbus, OH; www.gridmod.labworks.org
- 21-23 Solar Power Southeast**
Loews Atlanta Hotel – Atlanta, GA; events.solar/southeast
- 21-24 Strive for Sustainability - Solid Waste & Recycling Conference with Trade Show**
The Sagamore, Bolton Landing – New York, NY; nyfederation.org
- 22-24 2017 Midwest Solar Expo and Smart Energy Symposium**
Renaissance Minneapolis Hotel, The Depot – Minneapolis, MN; www.midwestsolarexpo.com
- 22-25 AWEA Windpower 2017 Conference & Exhibition**
Anaheim Convention Center – Anaheim, CA; www.awea.org

JUNE

- 13-15 The Clean Energy Finance Summit**
The Palms Hotel – Miami, FL; www.laccorefinesummit.org
- 15 Energy Storage Tutorial**
1:30pm The Chattanooga Marriott Downtown – Chattanooga, TN; www.sites.ieee.org/pes-essb
- 16-18 The 28th Annual Energy Fair**
Custer, WI; www.energyfair.org

JULY

- 10-13 ees North America Exhibition & Conference**
Moscone Center – San Francisco, CA; www.ees-northamerica.com
- 11-13 Intersolar North America**
Moscone Center – San Francisco, CA; www.intersolar.us
- 25-26 AWEA Regional Wind Energy Conference 2017**
Hyatt Regency Lake Washington – Renton, WA; www.awea.org

SEPTEMBER

- 08-10 The 28th Annual Energy Fair**
St. Paul, MN; www.energyfair.org
- 10-13 SPI 2017**
Mandalay Bay Convention Center – Las Vegas, NV; www.solarpowerinternational.com
- 19-21 tcbiomass 2017**
Radisson Blu Aqua – Chicago, IL; www.gastechnology.org/tcbiomass

OCTOBER

- 22-24 Renewable Energy Markets 2017**
New York Hilton Midtown – New York, NY; www.renewableenergymarkets.com

NOVEMBER

- 29-30 Solar Business Festival 2017**
Hilton Downtown Hotel – Austin, TX; www.sbf-texas.com

MAY 2018

- 07-10 AWEA WINDPOWER 2018 Conference & Exhibition**
Chicago, IL; www.windpowerexpo.org

Send us your clean energy show and event listings.
Email information to the editor at editor@naceenergy.com

Page	Company	Website
25	3M Solar Division	3M.com/solarnace
51	3M Wind Division	3M.com/windnace
49	Amsoil	amsoilwind.com
23	Arconic	AFSRHuck.net/wind
46	Artech Solar	www.artechsolar.com
52	Bachmann Electronic Corp	www.bachmann.info
5	Baja Carports	www.BajaCarports.com
55	Barr Engineering	www.barr.com
OBC	BayWa r.e. Wind, LLC	www.baywa-re.us
28	Bitimec USA	www.wash-bots.com
66	canwea	www.windenergyevent.ca/whycanada/
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17	Copperweld Bimetallics, LLC	www.copperweld.com
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10	IMPACT	www.impact-net.org
69	Intersolar	www.intersolar.us
9	Iowa Economic Development	iowaeconomicdevelopment.com
62	Janicki Industries, Inc.	www.janicki.com
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IBC	Morsun	www.morsunamerica.com
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3	OMCO Solar	www.omcoracking.com
48	Parker Hannifin Corporation - Parker Energy Business Unit	solutions.parker.com/AWEA2017
12	Port of Corpus Christi	portofcc.com
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15	Rad Torque Systems	www.radtorque.com
18	Remtech	www.remtechinc.com
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