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## **2018 SOLAR Buyers Guide**

## **NERC GADS Reporting to Include Wind Power**

## **Providing for Power Plant BES Safety and Reliability**

## **What You May Not Know About Thermal Management**

## **Renewables Turn to Innovation Amid Growing Uncertainty in 2018**

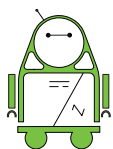
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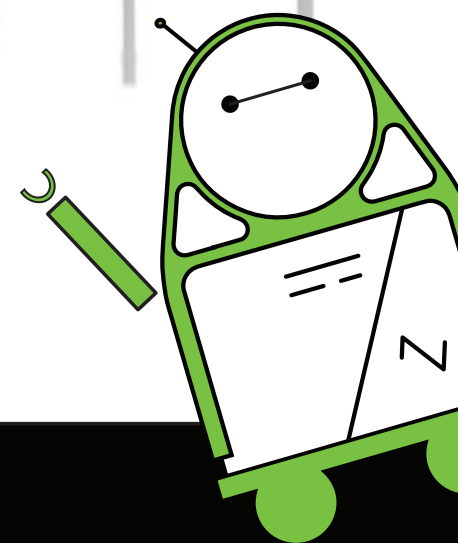
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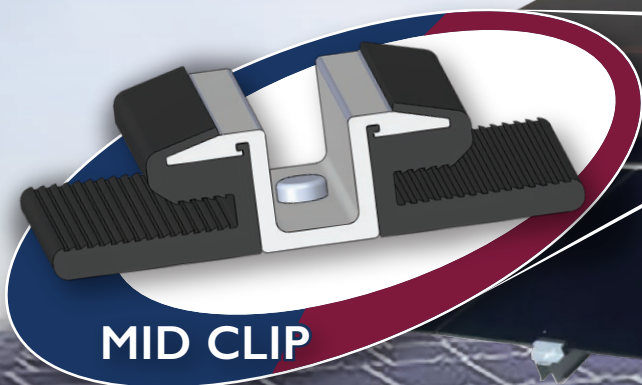
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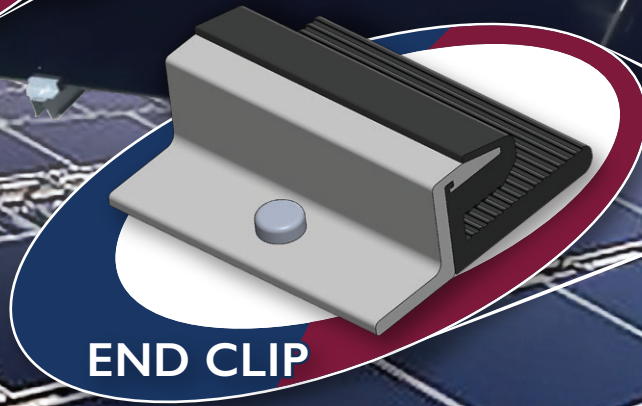


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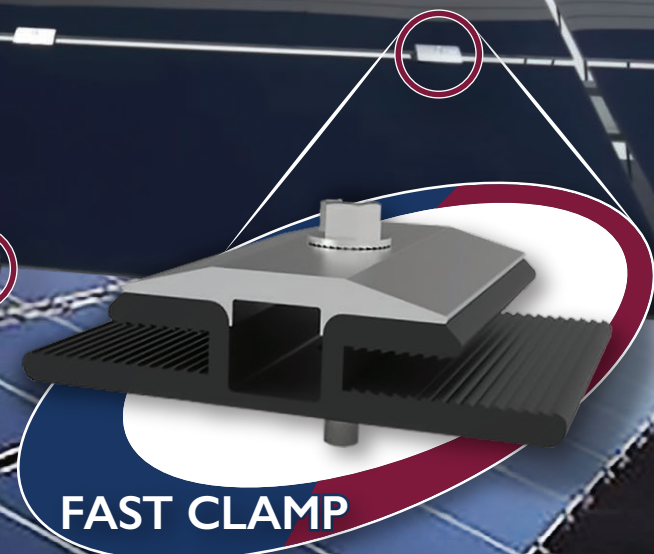
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**On our cover...**

When Salisbury University wanted a high-profile, visible project that would further align its commitment to environmental sustainability and educational rigor, it chose Rockville, Md., based Standard Solar to install a 541.8 kilowatt (kW) solar system featuring four solar canopies and five electric vehicle (EV) charging stations.

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## departments

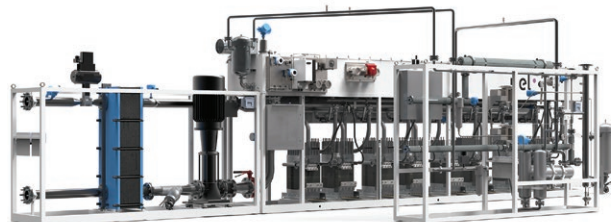
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**AS AN EDITOR, I ENJOY EXPANDING MY VOCABULARY.**

Among the 250 new words officially added to Merriam-Webster's dictionary in 2017, are familiar industry terms like "Internet of Things", along with unpleasant ones like "Ransomware". Although it's not new, another particularly ugly word is "Subsidy". It's more of an insult because it assumes that, with all of the latest technological advances and worldwide acceptance of clean energy, the general public will choose not to use renewable sources unless they're subsidized.



How much did your cell phone cost? We all know those free phones offered by the big cell carriers were never really free – they were subsidized. A few years ago, you may have scoffed at the idea of some poor sap shelling out hundreds of dollars for a phone he could get for "free", then trade in for a newer model after his contract was up. Last year, however, when Apple released the \$999 iPhone X (this is just the base price, mind you), several million people happily parted with \$1,000+ to pre-order the device. They could have chosen a subsidized and/or cheaper phone. Instead, they paid a lot of money for a highly engineered computer that they believe will make their lives better.

Most of these same people also believe that renewable energy will make their lives better. They know that clean power is worth the investment – we just need to trust them to vote with their wallets. The parallel I make between cell phones and clean energy isn't even that accurate, since competition and innovation continue to make renewable energy more affordable. Recent policy moves by the POTUS may appear to favor "big oil", and assume that, in the absence of financial aid, we won't make the smart choice. But the government does not know what's best for me. In fact, it's quite liberating to decide how and where to spend my money. With this in mind, I can safely say that you will not find the word "Subsidy" in the puzzle below, because I believe it no longer belongs in the lexicon of renewable energy.

Meg



**Running on e-waste**

Last October, Los Angeles based company IT Asset Partners (ITAP) claimed the official Guinness Book of World Records title for the Longest Range of an Electric Vehicle by traveling more than 1600km at the Auto Club Speedway of California in Fontana over a two day consecutive run. The Guinness Book of World Records flew in adjudicator Michael Empric to personally verify ITAP's world record. This breaks the previous record of 1298km made in Japan in 2013. The record breaking EV called The Phoenix, was created by ITAP leader Eric Lundgren, and is made from 90% recycled parts in an effort to promote electronic waste recycling, and it cost less than \$14,000 to build. The purpose of The Phoenix is to showcase Hybrid Recycling, and demonstrate to the world the possibilities and potential derived from electronic waste recycling. Lundgren promotes that re-use is the purest form of recycling, and to put this into action he created America's leading hybrid recycling plant called ITAP. Through efficiency and innovation, ITAP identifies all generic parts and components of value and preserve as discarded e-Waste, rather than just destroy them. They then extract and re-integrate into new applications. This Hybrid Recycling process decreases the demand for raw material production, conserving natural resources and reducing the carbon footprint.

**ITAP** | [www.goitap.com](http://www.goitap.com)

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**ACROSS**

- 6 liger or mule/grid-tied or not, a battery's got your back
- 10 truth-telling sense/shows wind speed
- 11 mesh in your viewfinder/getting credit for too much power (2 words)
- 12 pile of dung/something in the circuit that draws power
- 15 wealthy cephalopod toy/it has two to the third power rotors
- 17 \_\_\_\_ up?/amperes multiplied by volts
- 18 aim of grounded teenager doing chores without prompting/safety for bats
- 20 it crashed in Lakehurst, NJ/rotor home
- 21 where you keep your tackle/increases the rotation
- 23 popular cure for insanity/it's non-rechargeable
- 24 keep telling pointless stories/no men allowed on this vehicle

**DOWN**

- 1 it's nilla, not ocolate/cut from a single crystal
- 2 come in from the cold/separate a utility
- 3 where the tiniest tic-tac-toe games are played/can function independently from main supply
- 4 toe toucher/makes direct current useful
- 5 landlording like Don Knotts/generator self-defense
- 7 Boston pronoun/it's an axis thing
- 8 getting the newscast from your coconut radio/operating autonomously
- 9 'television' is also too long to say/makes energy from light
- 12 laughter overcomes stress/FAA rules require you to keep your UAS in this
- 13 lazy conductor or engineer/they reflect relative cost for a specific alternative or circumstance
- 14 visually pleasing produce department feature/modules that function as a single unit
- 16 pickpocket art/a bargain for the customer
- 19 rainbow spark/result from a low-impedance connection through air to ground (2 words)
- 22 vampire hunter/it converts flow into motion
- 25 traditionally aided by java/can neither be created nor destroyed

ANSWERS ON PAGE 78



**Millennials less likely to recycle; more likely to buy from companies that go green**

A new survey designed by the Shelton Group, found millennials are pushing companies to make a positive impact on the world because they believe global problems are too big for individuals to solve, but corporations have the power of many and can help Millennials do what they think they can't do for themselves. They will spend money with corporations taking action and addressing problems for them, as a form of activism and crowdsourcing by consumerism. Shelton Group's 2016 EcoPulse study found that most Millennials aren't particularly concerned about certain sustainable habits. They fall behind others when it comes to the more easier green activities: Only 33% of Millennials say they adjust the thermostat to save energy (vs. 48% of all Americans) and just 34% recycled paper and aluminum cans (vs. 46% overall). The survey also found 76% of Millennials say they are "somewhat to extremely concerned about the impact climate change will have on their quality of life during their lifetimes." And 82% say they're worried about the impact of climate change on their children's quality of life. By comparison, in the EnergyPulse survey, only 51% of the general population said they were anxious about climate change. Almost 70% of Millennials say a company's environmental practices play a major part in their purchasing decisions because they feel the problems are too big for them to tackle as individuals, so they look to environmentally/socially responsible corporations to take action, which then frees them up to focus on other things. The survey also found 81% of Millennials say they seek information about a company's environmental or social/business practices while making a purchase decision, at least occasionally.

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# NERC GADS Reporting to Include Wind Power

by Todd Chwialkowski

**CONSIDERING THE RECENT REPORTS THAT WIND POWER** capacity recently surpassed hydroelectric capacity in the U.S. for the first time (AWEA, 2017), it only makes sense that U.S. regulators would like to capture performance data as part of the Generating Availability Data System (GADS) reporting program. Actually, GADS for wind generators started about 10 years ago, with participation from the American Wind Energy Association (AWEA), Independent System Operators (ISOs), software vendors, operators, and manufacturers. The North American Electric Reliability Corporation (NERC) has promoted the upcoming requirements with webinars, classes, and presentations at AWEA conferences. However, even with past efforts to introduce and educate on GADS, collecting the data for reporting will be no small endeavor, and stakeholders in the wind industry are asking how this data will be used, and more importantly, what does this mean for our operational, technical, and compliance departments?

Let's start with a little background on GADS. The electric utility industry initiated GADS back in 1982, to collect data for conventional power generation; the start of data collection activities really began as far back as 1963. The NERC GADS program is mandatory for conventional generating units that are 20MW and larger, and maintains operating histories on more than 7,700 conventional generating units in the North America (GADS, 2017). The program was developed to provide a source of data for reliability statistics and high-level outage analysis. It is widely used by industry analysts in a variety of applications, including operational and financial forecasting. Like GADS for conventional generators, NERC assigns an Identification code to a wind generation site (sub-group) that remains with that generation site through any ownership changes or mergers. This allows NERC to accurately track the performance of a specific site over time, regardless of ownership.

NERC is phasing in the program for wind generators with milestones, to both minimize the impact on industry, and to ensure that their systems can handle the anticipated amount of data that they will collect. GADS Wind (GADS-W) reporting requirements are mandatory for wind plants with a total installed capacity of 75 MW or more, and with a commissioning date of January 1, 2005 or later. Generation Operators will be required to report on a quarterly basis according to the following phased-in schedule:

- January 1, 2018: Mandatory reporting begins for plants with a Total Installed Capacity of 200 MW or larger;
- January 1, 2019: Mandatory reporting begins for plants with a Total Installed Capacity of 100 MW or larger; and
- January 1, 2020: Mandatory reporting begins for plants with a Total Installed Capacity of 75 MW or larger.

But how is this data being used? NERC has great interest in the availability data to prevent outages, gauge regional capacity, reliability reporting, and modeling for generation resources. This helps NERC understand changes in resource availability/performance. The data is also used for unavailability (outage) analysis. As an example of GADS use, data is collected to specifically track outages due to components such as electronics, sensors, hydraulics, rotor blades, gearbox issues, or yaw/pitch systems. As part of an availability analysis, this data is incredibly important for decision-making processes, and the calculation and measurement of both event and condition-driven risks. Like the conventional generators, unavailability is classified by their type: forced, maintenance, or planned. A unique data element for the wind industry concerning availability is fuel. Fuel can be a problem for conventional generators, especially for hydropower, where fuel (or water) is a definite factor. Wind power's critical fuel source is completely out of an operator's control. For that reason, a unique data element was created to accommodate the ever-changing fuel level: Resource Unavailable Turbine Hours, or RUTH. Wind turbine generators have specifications (normal operating range) for wind speed and temperature. When the resource is outside the working envelope for the turbine, but the turbine IS AVAILABLE, the hours are referred to as RUTH. For GADS-W reporting, RUTH is considered available hours. RUTH indicates the number of turbine hours that fall outside of the operating specifications of the wind turbine due to environmental conditions. For those looking at the plant's output capability (i.e., ISO) RUTH periods may be considered as unavailable hours.

The data submitted to NERC is confidential, but one of the benefits of the reporting data is that benchmarking data is available to industry participants that follow the GADS-W reporting requirements, to the level of participation in the GADS-W program. This data can be used for baseline or comparability analysis, and to improve forecasting the performance of generators.

What does all of this mean for your operation? GADS-W reporting will require planning, new processes, and coordination for the reporting entities. Reporting is an ongoing activity for an organization, and can be automated to a certain degree. The information is gathered on a monthly basis, but reported quarterly through NERC's web-based application. The quarterly reporting consists of submitting three files (as spreadsheets or in CSV format): Sub-Group, Performance, and Component Outage







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**EDF Renewable Energy** | [www.edf-re.com](http://www.edf-re.com)

AWEA, (February 9, 2017). Near-record growth propels wind power into first place as America's largest renewable resource. American Wind Energy Association. Retrieved from: <https://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=9812>

GADS, (2017). Generating availability data system (GADS). NERC. Retrieved from: <http://www.nerc.com/pa/RAPA/gads/Pages/default.aspx>

reporting. The first two are required for reporting; however, the third is optional.

The wind farm is identified by a Plant name, and then divided into Groups, and Sub-Groups. Sub-Group reporting information consists mainly of site characteristics, location, and equipment information. Once complete, this required section of the reporting requires minimal monthly resources to complete.

The Performance reporting piece of GADS-W is also required, and consists of both static (unchanging) and dynamic (changing) data. With established systems and tools in place, the majority of this information can be automated; however, just like with conventional GADS reporting, there are areas of the reporting that require manual entry. One such area is shared with conventional generators, and concerns generation unavailability (forced, maintenance, or planned) for reasons that are outside of management control (OMC). An organization may rely on monthly reports from their site manager(s) to relay that information for reporting purposes.

The final segment of GADS-W is Component Outage reporting. This is optional, but of great importance to the overall purpose of GADS-W. It identifies the general area or reason for the loss of production, and uses a set list of component (system) codes to ensure consistency in reporting. Many wind turbine operations already work at the component level to make effective plant improvements, monitor warranties, and understand the reliability of the equipment. This section of GADS-W reporting may only require a cross-reference table to convert data already collected to the GADS-W data format.

For detailed information on GADS-W, download the Data Reporting Instructions (DRI) from NERC's website: [www.nerc.com](http://www.nerc.com). The DRI explains the reporting process, attempts to normalize the language used, and the way that calculations are completed for the industry. This will help us all to speak the same language in reference to our operations. Browse NERC's website for a schedule of free classes on GADS-W in 2018, and for PowerPoint presentations concerning GADS-W reporting.

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DPS-375



# Providing for Power Plant BES Safety and Reliability

by Thomas Wilkins and Miles Downing



As an engineer, you're used to figuring things out. If you're an engineer in the wind power industry, you're also used to dealing with the numerous, and sometimes onerous, regulatory changes thrown at you every few months. 2018 brings some challenges to your job, courtesy of the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC). Luckily, we're here to help.

The U.S. Congress wants a safe and reliable Bulk Electric System (BES) with renewables, and FERC and NERC have been providing Orders and Standards to meet those objectives, and there is an upside for renewables; but first renewables must rise up to "new-challenges" so they can realize the upside with the rest of the BES.

## The Challenge

Your mission is to provide for meeting the old and new Point of Interconnection (POI) requirements found in FERC Order 827, NERC standards PRC 024-1-2, and the various other PRC, MOD and VAR standards. Let's get technical; with regard to the Bulk Electric System – with Rated Voltage greater than or equal to 100KV, and Rated Power greater than or equal to 100MW – it may be achieved with:

- Reactive Following
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FERC Order 827 means that wind generators must now provide "dynamic" reactive power. New plants can adjust to the new standards, but what about the older wind power plants that were built with this exemption in mind? More importantly, how can you redesign your company's aging wind plant to meet the newer FERC orders?

## More Than Just "Ride Through"

Wind turbines need a system to help them stay online through power interruptions, or "ride through" the event while providing dynamic reactive support during the disturbance. However, "Low voltage ride through", "High voltage ride through", and "ride through with zero voltage capacity" will not, by themselves, provide the functionality to meet the new FERC orders and NERC standards. WPPs and SPPs are constructed with collection systems; plant components like the main transformer, generator step up transformers, junction boxes, branch, string, and homerun cables, all include an impedance (Z) within the collection system. When it comes to meeting the FERC and NERC standards, overcoming the "Z(s)" is your problem. "Z(s)" come in many forms, as presented in the equations below:

1.  $Z_{element} = [R_{element} + jX_{element}]$
2.  $I_{element} = I_r + jI_{lim}$
3.  $S = P_{WTG} + jQ_{WTG}$
4.  $S = VI^*$
5.  $VMPT = V_{POI} + (IMPT * Z_{MPT}) * OLTC * Ratio$
6.  $V_{Homerun\_cble} = [IHomerun\_cble * Z_{Homerun\_cble}] + VMPT$
7.  $V_{branch} = I_{branch} * Z_{branch} + V_{Homerun\_cble}$
8.  $V_{wtg} = I_{gsu} * Z_{gsu} + V_{branch}$
9.  $V_{wtg\_imbalance} = V_{wtg} * Phase\_Imbalance$

Equations 1 through 9 are presented to calculate the voltages within the collection system of the power plant. Think of them like tree, where you start at the Trunk (5) or Main Plant Transformer (MPT) at the Point of Interconnection (POI), and work your way back to the furthest leaf, or wind turbine or solar generator (9). The idea is to calculate the voltage

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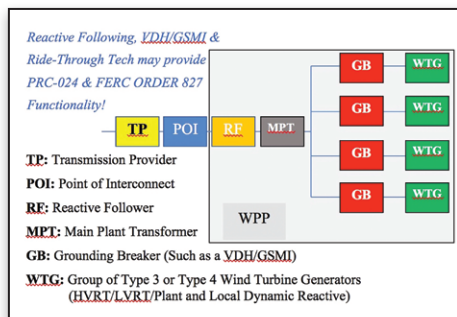
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with the collection system for a given POI voltage (with a Real and Reactive power flow through the POI). The standards include dynamic conditions, so we need to include control systems and other dynamic elements into our considerations, where many calculations are needed to provide a more complete picture. To gain better insight into the plant, we need a time domain analysis tool like PSCAD.



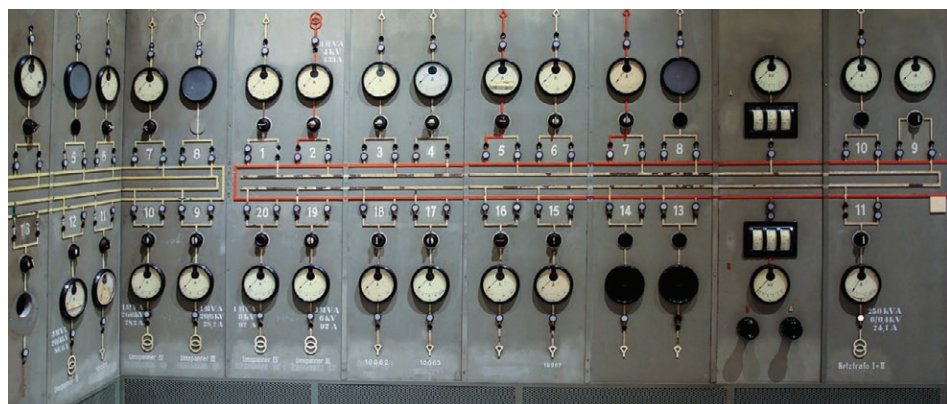
## Constraints

The constraints measured in PSCAD are dynamic and transient – they appear and disappear. Within the plant, constraints may be physical and/or regulatory, and are generally measured in different locations, cataloged, and checked against operating requirements as dictated by FERC and NERC. At the end of the day, however, constraints are compared against the interconnection agreement. A technique called Reactive Following, used to assess the constraints, provides plant owners several safe and reliable methods to exceed their Large Generation Connection Agreement (LGIA) compliance, with both the Transmission Provider (TP) and electric reliability organization (ERO). Your interconnection agreement requires a certain amount of reactive power support to the transmission system. Reactive Following will help your facility meet FERC Order 827, NERC PRC-024, and any other requirements for non-synchronous generators. It's all very technical, and can be confusing even for a seasoned engineer, but with the right tools, you can find the optimized solution for your company.

## Why PSCAD?

PSCAD uses time domain/time step simulation in the microsecond range (with combined Power System Simulations, the control system, and control logic) to provide engineers an animation of the performance of the WPP or SPP. This lets the engineer “see” an ideal of the dynamic constraints that appear during a disturbance, or contingencies on the power system. With the Control System coupled to the electric power system, PSCAD can use reduced order models to simulate constraints within the plant; this makes it easier to determine the type of ride through and dynamic power controls needed to meet relevant FERC and NERC targets.

*Miles Downing and Thomas Wilkins are both independent Power Systems Engineers who, for the past 19 years, have worked in the power systems industry with a focus on renewables. Miles Downing is a registered professional engineer with a Master Degree from Portland State University in Power Systems Engineering. He has worked with Bonneville Power Administration and with EDF Renewable Energy, and is currently based out of Vancouver, Washington. Thomas Wilkins has a BSEE from San Diego State University and is an inventor with several power systems related patents, and has worked both nationally and internationally on interconnection related matters for renewables. He is based out of Henderson, Nevada. Miles and Tom maintain a website called Rfwind.com*



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# Monitoring Wind in Cold Climates

by Michael Clarke

## WIND FARM OPERATORS IN CANADA AND THE

northern United States are faced with challenges not experienced by their southern neighbors. Ice buildup causes a variety of challenges, and in cold weather climates where icing is a frequent occurrence for 6 months of the year, wind energy projects are often viewed as less feasible or less successful.

Fortunately, a variety of technologies are levelling the playing field between cold and warm weather climate operators.

### Challenge #1: Reduced Production Power

At any given time, a change in vibrational and/or torsional force on the turbine blade can result in a loss of production power; in cold weather, where ice build-up is frequent, changes in torsional force are commonplace. Many systems exist to detect such changes, and would traditionally trigger an automated shut down cycle. Such a cycle lasts for a period of time, which lengthens each time the turbine attempts to re-start, detects a continued change in torsional force, and triggers the next shut down cycle.

While this shutdown mechanism is beneficial in reducing unnecessary wear on the equipment, it's hugely detrimental to power production. In cold weather climates, ice buildup can sometimes last for days, during which time the shut down cycle has continued to increase to the point where, when the ice finally melts, the turbine may not be triggered to start up again for several hours. This results in significant losses in power production.

According to a six-year CanmetENERGY Ottawa (CEO) study, the average loss factor of wind energy production in cold weather climates is 3.9 percent. This translates to an estimated total loss of 959 GWh per year across Canada, representing \$113 million in lost revenues country wide (Natural Resources Canada, 2017).

### Mitigating Power Loss

The torque sensor is an indirect measurement of ice. Its mechanism involves sensing the effect ice buildup has on the turbine, and can only perform a measurement during turbine operation. While this is beneficial in some respects, this detection method isn't enough to mitigate production losses.

There are, however, a variety of direct measurement devices designed to detect ice buildup and reduce production downtime.

### Blade Heaters

Blade heaters are an option that work to eliminate ice buildup by forcing hot air directly into the blades. While highly effective in reducing ice formation, they are an expensive option, and require a power source to run - which doesn't help reduce power production.

### Icephobic Coatings

Icephobic coatings are another potential solution; a coating or spray is applied directly to the blades, which discourages the accumulation of ice. The lower initial cost of application makes these coatings an effective solution, though ongoing maintenance and continued applications are required.

### Ice Detectors

Ice detectors are one of the least expensive, low-maintenance, and long-lasting solutions available today. Attached to the hub or a nearby meteorological tower, they work to detect ice accumulation via an ultrasonic axially vibrating tube that senses changes in mass as a result of ice accretion. They act as an early detection system, allowing operators to shut down turbines immediately, and then restart them once the ice has melted, significantly reducing operational downtime.

### Challenge #2: Reduced Lifespan of Equipment

IEA Wind's recent publication, *Wind Energy Projects in Cold Climates*, affirms the economic risk of, "increased maintenance costs due to low temperatures and the likely higher than average downtime between repairs caused by turbine inaccessibility" (2017).

Ice greatly impacts the longevity of turbine blades, nacelles, and motors. As we know, ice buildup will create an imbalance in the forces acting on the turbine; depending on the blade orientation, if one blade has accumulated ice it can begin pulling outwards, putting additional strain on the gear box. In addition, ice fall has the potential to impact surrounding blades, as well as the roof of the hub, causing significant damage.

### Eliminating Unnecessary Wear & Tear on Equipment

Each of the solutions outlined above - blade heaters, icephobic coatings, and ice detectors - can also be utilized as tools to mitigate unnecessary wear and tear on equipment. By either eliminating the instance of ice buildup altogether, or detecting the presence of ice to trigger a shut down and remove the risk of damage, the lifespan of the wind turbine will be extended.

### Challenge #3: Safety Concerns

Ice throw from turbine blades is a significant concern for public safety. A turbine with an 80m blade diameter and 70m hub height, has the potential to throw a piece of ice a distance of 225 meters. And as the number and height of installed turbines increases in and around urban areas, public safety becomes increasingly important. In well-established markets like Germany, where the density of wind turbines is much higher than that of North America, it has been mandated that ice detectors be present on all turbines. As the North American market densifies, it may be subject to similar mandates in the future.

Operator safety is another serious concern. Ice throw and ice shedding (where fragments of ice and snow fall from the blade) are a risk for anyone working in close proximity to turbines.



### Tools for Improved Safety

In addition to all of the aforementioned tools for either eliminating the formation of ice or early detection of ice buildup, cameras are effective in improving safety around wind farms. Outdoor cameras built to withstand harsh climates are installed on the hub of the turbine, where they provide visual confirmation that corroborates data from other prevention methods.

Our climate presents many challenges to North American wind farm operators. Continued collaboration between manufacturers and energy producers will promote new and innovative solutions; these will work to shape the wind energy landscape, increase the viability of North American cold climate wind energy markets, and create opportunities for our operators to become leaders in renewable energy.

*Michael Clarke is a Technical Sales Consultant and subject matter expert on renewable energy at Campbell Scientific Canada (CSC). CSC is an innovator and systems integrator focusing on smart systems for wind and solar energy operations.*

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# Bringing Blade Repair to New Markets

by Tom Dyffort

## AS INTEREST IN RENEWABLE ENERGY GROWS

worldwide, new wind farms are being brought online across emerging markets in Africa, Asia, and South America. But the complex nature of wind turbine technology requires a specialized supply chain at all stages of construction, installation, and maintenance. This can be especially challenging at the maintenance stage, when turbines are located in markets that are fairly new to wind energy. The proliferation of wind energy, however, has the power to generate significant numbers of local jobs in new markets through the recruitment and training of local wind turbine rotor blade repair technicians.

Blade damage is the most common cause of wind turbine downtime, and requires highly-trained technicians to execute on-site, up-tower maintenance and repairs. Until quite recently, however, most technicians – and training centers – have been based in more established wind markets, requiring technicians to travel long distances in order to carry out repairs overseas.

## What to look for when hiring in new markets

Finding technicians in a newer wind energy market presents challenges, not least because local personnel often have little previous experience of the wind industry. At a very basic level, trainees need to have an aptitude for skilled manual work, though the rapid growth of the industry often means that trainees can't be expected to have much wind energy experience.

A growth-focused approach to training is also very important. While some trainees may possess the technical repair skills necessary to work with the various materials and composites found in turbine blades, they are unlikely to have experience working in the field. Performing intricate and detailed repairs at heights of up to 80m is very different to doing so on the ground.

On the other hand, prospective employees may have previous career experience or training in working at heights. In this case, the higher skill levels and corresponding rates of pay for rope access technicians, make the role attractive to many workers.

Beyond a misalignment of skills (which is to be expected in newer wind energy markets), it's necessary to consider challenges specific to a given market. Local markets will often have their own administrative and legal restrictions when it comes to the training and recruiting of workers; employers need to be aware of and proactive in meeting these, if they are to be successful.



## Boosting skills in South Africa

In South Africa, the wind industry has created more than 100,000 jobs over the past four years. Even for established wind organizations that have been operating in this market for years, a lack of local technicians require companies to bring in turbine rotor blade technicians on month-long assignments, in order to provide repair services across a number of wind farms in the country.

To address this shortfall of skilled local technicians, and reduce the logistical challenges of servicing clients, it's vital to team up with local consultants who are familiar with long-established operations. Not only can this act like a hub for those technicians operating in the region, but it also equips the next generation of rotor blade technicians with the skills they need to succeed in the industry.

Regarding South Africa, for example, Cape Town is an ideal location from which to train new rotor blade technicians. Excellent wind resources in the region will see the country continue to invest in its wind energy infrastructure, and provide immediate work opportunities for new trainees in the coming years. As other markets on the continent, such as Ghana, increase wind power capacity, the training provided in South Africa will also help meet the increasing demand for maintenance and repair.

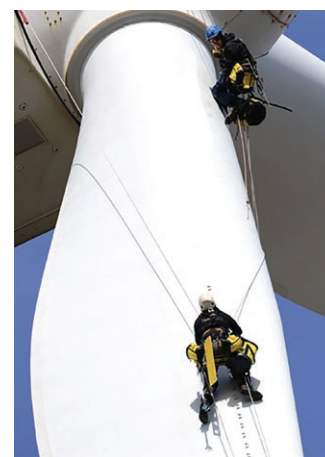
## Enhancing the global supply chain

Africa is a large and developing continent, and Cape Town offers a good base from which to carry out this training. Financially and logistically, the city beats Europe for ease of access for potential trainees on the continent.

There are a number of other wind energy markets around the world that offer fertile ground for the training of new blade repair technicians. These markets share a number of characteristics, such as a demonstrated commitment to the development of wind energy, and they lie at the heart of wider geographical regions, such as Mexico and Australia.

Ultimately, if wind energy is to thrive in emerging markets worldwide, and meet the needs of local wind farms owners and operators, then the industry will need to ensure smooth transfer of the knowledge and skills that underpin it. Faced with increased demand for highly skilled maintenance technicians, localized training that allows for rapid local service delivery will become more important. As businesses look to tap into the potential these new wind markets undoubtedly offer, the specialist skills and experience delivered by industry veterans will help spread the employment opportunities clean energy development provides.

*Tom Dyffort is Managing Director at Altitec Group, an independently operated, specialist rope access blade inspection and repair business that is headquartered in London and Berlin. Since 2010, Altitec technicians have provided regular inspections on more than 5,000 blades and 1,500 turbines throughout the UK, Europe and key emerging wind markets around the world. In November 2017, Altitec launched Altitec South Africa, a joint venture with Obelisk, a global infrastructure consultant. As well as acting as a hub for technicians operating in the region, Altitec South Africa will deliver specialized blade repair training from 2018.*



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# Extending the Life of Wind Turbine Components

by Dr. Florian Rovere

Specialized PVD coatings and nitriding significantly increase the durability and lifespan of wind turbine components, like roller bearings and planetary gears, under metal-on-metal, high load conditions.



With the increasing demand for carbon-free renewable energy, more companies are turning to wind power as a source for their energy needs. Although this presents a good deal of potential for the manufacturers of wind turbines and their components, the technological challenges of providing a reliable product that operates with minimal maintenance or repair, are increasingly daunting.

That's because enormous forces are at work on the individual internal components.

Turbine shaft bearings, planetary and sun gears, and rotating shafts, for example, operate under high load conditions that involve direct metal-on-metal contact, often in poor lubricating conditions. With components increasing in size, these forces only become more extreme. When this occurs, even components made of hardened steel or metal alloys break down from excessive wear, scuffing, surface fatigue, pitting and galling.

Wind farm operators bear significant costs for overhauls, which often involves using cranes for on-site repairs. When you have to bring in a crane to change the main shaft bearing, for example, the cost includes not only the new bearing but also the labor involved.

At \$100,000 or \$200,000 per overhaul, all of a sudden the green energy becomes quite expensive, which is why wind farm operators want to extend the longevity of the components as much as possible.

Coatings and surface treatments can address this issue by significantly extending the service life of wind turbine components. Today, this is being accomplished through the application of specialized physical vapor deposition (PVD) coatings, and nitriding treatments; both of these methods increase surface hardness and durability.

By applying coatings optimized for punishing environments, components benefit from increased surface hardness and a much lower coefficient of friction. Therefore, these critical parts do not have to be replaced as frequently, if at all, reducing maintenance and unplanned downtime, while improving wind turbine performance.



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### PVD Coatings

Physical vapor deposition encompasses a wide range of vacuum deposition methods. It essentially covers components with thin coatings to increase their surface hardness and durability, lower the friction coefficient, and resist corrosion.

By applying components with PVD coatings designed for such demanding conditions, not only is the surface hardness and durability increased, but essential parts are far less likely to fail, if at all. As a result, maintenance and unexpected downtime is drastically reduced.

A particularly effective PVD coating can be applied in thicknesses of 0.5 to 4 micrometers on roller bearings



and gear parts. The WC/C ductile carbide carbon coating has a high load-bearing capacity, even when used with insufficient lubrication or dry contact. Due to its low-friction coefficient, the coating can drastically reduce fretting corrosion and pitting. By forming an effective barrier between metal-on-metal contacts, it reduces metal structural damages such as white etch cracks and fatigue failure.

Alternatives to PVD coatings include black oxide, which is produced by a chemical reaction between the iron on the surface of a ferrous metal, and oxidizing salts. After a post-treatment with oil, the surface provides protection against corrosion, improved lubricity, and prevents galling during metal-to-metal interactions. However, black oxide is not very durable; it can be worn away quickly in repetitive, high load applications.

### Nitriding

There are limitations to the size of products that can be coated with PVD, such as the ring gears (in newer wind turbines) that can measure up to 2-3 meters in diameter. For these large gears, a nitriding process can be used. Nitriding is a heat treating process that diffuses nitrogen deep into the surface of a metal to create a case-hardened surface. Because it is not a coating, it does not affect the overall dimensions of the component. Although traditional gas nitriding costs less, plasma nitriding has the advantage of making the treatment more precise, by minimizing warping and distortion, while achieving a higher load-bearing capacity.

In an FZG pitting test, one plasma nitriding process exhibited five times less roundness deviation, and seven times better planarity than gas nitriding on a 2-meter diameter ring gear. Another potential application for plasma nitriding is for treating the surfaces of large bearing cages used with wind turbine bearings. This increases the sliding wear resistance against the rollers, and can be used on components up to 3 meters in diameter, 10 meters in length, and weighing up to 40 tons. Compared to gas nitriding, the tolerances for roundness, planarity and parallelism can be adhered to much better, even with such large parts as the ring gears – vital for the service life of a system in which enormous forces are at work simply because of its size.

*Dr. Rovere is the Director of Precision Components for North America for Oerlikon Balzers Coating USA. The company develops high performance PVD & PACVD coating solutions and surface technologies to improve the performance and durability of precision components and tools for the metal and plastics processing industries.*



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# Renewables Turn to Innovation Amid Growing Uncertainty in 2018

by Ryan Blitstein



## THE RENEWABLE ENERGY SECTOR CAN COUNT ON ONE THING IN 2018:

uncertainty. The wake from last year's proposed changes in policy and taxes by regulators and Congress, will continue to ripple across the industry—an industry already undergoing significant change. But in this uncertain environment, renewable energy sources are turning to innovation to stay competitive, and to continue growing their share of electricity generation.

At the center of that innovation is data. Once largely confined to the consumer world, the internet has expanded its reach into industrial machines and equipment, over the last five to ten years. Today's wind turbines and solar panels are outfitted with dozens of sensors. Data generated from those sensors can now be transmitted over an ever-faster wireless spectrum, and housed in cheap cloud storage. Combined with additional data from a number of other sources, this information helps owners and operators of renewables achieve greater transparency, reliability, and energy production.

In the Midwest, one fleet operator had a wind turbine reporting it was unavailable to produce energy because there was no wind. Initially, the site supervisor had no reason to doubt the turbine's declared status. Turbines within the same park can be spread across acres of land, which means that each turbine experiences different weather conditions that affect wind speeds. Upon further investigation of this particular turbine, however, and when geospatial data was layered on top of the turbine data, something appeared off.

The turbine that reported no wind was next to another turbine that was producing energy. The culprit turned out to be a miscalibrated anemometer on the turbine. An anemometer measures wind speed - this single error prevented the turbine's control system from allowing it to produce energy.

The service provider didn't spot the problem, likely because the data was located in separate, disparate systems. Integrating different sources of data together allows for more accuracy, which gives the owner of the turbine more transparency and control. That capability alone has the potential to lead to better operations, and more energy production. It also allows operators to independently confirm that the machine is performing to its potential.

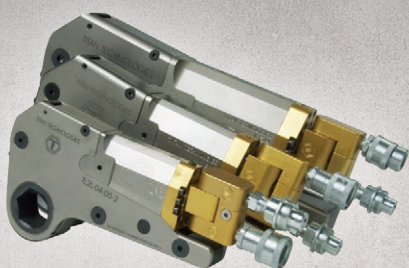
While data can better describe what's happening today, it can also predict what will happen tomorrow. By combining the massive amounts of information from machines with data science models, operators can see predictions of a component failure before it happens. Having more time and flexibility allows the repair to be made when the sun isn't shining or the wind isn't blowing. This significantly increases energy production and savings, while decreasing downtime.

Beyond increase energy production, data helps increase the reliability and predictability of intermittent energy sources, weakening the argument that wide scale adoption is not possible. When utilities know that they can count on this renewable wind energy, they don't have to fire up as many coal or gas plants to maintain base load energy levels. Greater reliability also leads to more profitable power purchasing agreements for renewable energy sources.

These changes have provided opportunities for renewable energy that, even a few years ago, seemed out of reach. Across the United States, energy utilities have received

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## Night vision for bird- and bat-friendly offshore wind power

The same technology that enables soldiers to see in the dark can also help protect birds and bats near offshore wind turbines. Night vision goggles use thermal imaging, which captures infrared light that's invisible to the human eye. Now, researchers at the Department of Energy's Pacific Northwest National Laboratory are using thermal imaging to help birds and bats near offshore wind farms. PNNL is developing software called ThermalTracker to automatically categorize birds and bats in thermal video. Birds and bats fly over offshore waters, but they're difficult to track in such remote locations. The software can help determine if there are many birds or bats near an offshore wind project and if they could be affected by the project. If that's the case, officials can consider adjusting the location of a proposed project or modifying an existing project's operations. Biologists at the non-profit Biodiversity Research Institute have tested the system to determine how well it identifies birds compared to their field observations in Maine, one of the states considering offshore wind power.

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regulatory approval to retire coal-fired plants. In many instances, these are being replaced with renewable energy generation. A major energy utility plans to retire two of its Colorado coal plants ahead of schedule; in their place, a significant portion of the energy generation will come from wind. And in Texas, wind energy generation is projected to overtake coal generation, after a 2.3 gigawatt coal plant shuts down in 2018.

While 2018 will likely yield more stories similar to what is happening in Texas and Colorado, renewables' long-term success is not guaranteed. The levelized cost of renewable energy will have to continue to drop, and its reliability and production will have to increase even more.

The advances in technology that make it possible to use data to predict problems before they occur, and provide greater visibility into renewable asset performance, could not have come at a better time.

Just as the past success of renewables in North America has been built on constant innovation, so will its future. In 2018, that is the only thing that is certain.



*Ryan Blitstein is the Vice President of renewable energy at Uptake, a predictive analytics company in Chicago.*

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# The Cold Realities of Wind Development in Harsh Climates

by Lee Alnes



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Imagine that your team of wind technicians departed this morning to spend a few days addressing a series of met tower issues at a greenfield site in North Dakota. It's January, and when they arrive they will face eight-foot snow drifts, and minus 30 degree Fahrenheit temperatures - not even factoring in wind chill. Sending them out there for multiple days of field work will take a toll on your measurement campaign budget. An even bigger concern is the dangerous working environment.

The team will have to climb icy, 80- or 100-meter met masts, in high winds, to sort out problems with frozen anemometers and other equipment at the top of each tower. It's not easy work and you wish you didn't have to send them out there, but what alternative do you have? Data collection stopped weeks ago due to enduring arctic conditions; your development team has lost valuable time, and must now cope with measurement gaps when calculating wind estimates and evaluating whether or not to invest further in the site.

Your campaign already faced one major casualty this season - a met tower simply collapsed under the weight of heavy ice buildup, and the frozen ground and deep snow makes it prohibitively expensive to replace it. You know how essential these wind measurements are for reducing project uncertainty and making informed decisions. Understanding wind behavior during these stormy, peak winter months is critical; the conditions that make it dangerous for your team today are the same ones that could be powering the project at full capacity in a few short years.

Cold climates pose unique challenges to wind development, and the extreme conditions they bring are increasingly becoming more common. With many of the most favorable project locations already built, more developers are looking closely at areas like central Canada and the northern United States. Although challenging, these locations offer the dual advantages of low population density (and thus lower impact on neighboring communities) and some of the world's highest quality wind resources.

Wind power in cold, icy climates is a fast-growing area of the industry. According to research by international expert group International Energy Agency (IEA) Wind Task



19 "Wind Energy in Cold Climates," the cold weather market reached 127 GW at the end of 2015, and is projected to grow at a rate of 12 GW annually through 2020. This not only represents a market segment three times that of offshore wind power, but also an important mandate for the industry to resolve the logistical, safety, and cost challenges posed by these environments.

## Innovations for Cold Weather Measurement

The problems associated with the industry's traditional methods of wind measurement in winter conditions are well known. Met towers collapse. Anemometers freeze and create data gaps, and must be replaced if damaged. Heated sensors withstand extreme weather better, but require more energy to operate. Trenching in power at remote sites is costly, and adds complexity to your measurement campaign. Next-generation measurement devices like remote sensors can help overcome many of these challenges.

Remote sensing technologies calculate atmospheric conditions by measuring the Doppler shift of returning waves. The most



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common devices rely on sound waves (SoDAR) or light waves (LiDAR). The key advantage of remote sensing is that the technology can collect wind data at the hub heights of today's modern turbines. This ground-based equipment is safer, easier to deploy, and doesn't require tall towers or FAA permits. However, not all remote sensors are well suited for wintertime deployments, and performance varies significantly amongst the range of devices available in the market.



### Remote Sensing Considerations for Cold Climates

Power demands are the primary consideration when evaluating a remote sensing unit for wintertime wind resource assessment activities. What is your device's energy consumption? Will it require an external power supply or grid-connected power? Most greenfield sites are remote; if on-site electricity isn't an option, how will you power the device, and how frequently will you need to refuel a generator or fuel cell?

Deployment and maintenance are also crucial. In the wintertime, it is much simpler to install a remote sensor compared to a met tower. How much time it takes your manufacturer to ship and install the device will determine how far in advance you need to plan. Also, once installed at a remote wind site, what is your maintenance and repair plan? If something goes wrong, some units are too fragile or complex to be serviced in the field by a local technician. In these cases, you may need to return the device to the factory for repairs, and wait for a loaner unit from the manufacturer.

Shifts in season also call for special preparation. For example, solar-powered units (such as some SoDARs) may need adjustments to the panel tilt to account for the lower angle of the sun during winter, and could require a supplementary power source. LiDAR units have much higher power consumption (usually ten to fifteen times that of a SoDAR, depending on the device) and require either a generator, or some combination of solar panel and methanol fuel cell to stay powered up, unless a nearby energy source is available.

### Enduring Cold Weather Challenges

Collecting measurements to capture wind characteristics at hub height is a fundamental part of wind development. The heavy snow and icy weather in markets like central Canada and Scandinavia come with challenges and require special considerations for wind measurement. The good news is that our industry is innovative. We've developed reliable, proven technologies that can stand up to arctic environments, help reduce uncertainty, and accelerate growth.



*Lee Alnes is Global Manager of Energy Measurement Systems at Vaisala. He joined Second Wind in 2009, to promote the company's products and launch the*

*Triton Sonic Wind Profiler into new applications and markets. He previously served as COO and Vice President of Sales and Marketing at WindLogics Inc. in St. Paul, MN. During his tenure at WindLogics, he developed the company's wind energy strategy and service offerings, culminating in the acquisition of the company by FPL Energy (now NextEra Energy Resources) in 2006. He brings 10 years of experience in the wind energy market, and over 20 years of business-to-business sales, marketing, and business development experience in emerging growth companies and multi-national corporations.*



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### High performance tapping and thread milling solutions

Sandvik Coromant has launched new tapping and thread milling tools for ISO S materials (titanium and nickel-based alloys). The products have been specifically designed to deliver process security on high-value components, such as engine casings, thus providing reductions in scrap rates and machine downtime. Developed to offer consistent and repeatable results, optimized geometry on the new taps for titanium includes a small positive rake angle for challenging materials and an innovative, wear resistant ACN (aluminium chromium nitride) coating that helps prevent weld formations. To avoid chip jamming in challenging material, the taps also have a high flank clearance for reduced friction. For stable tapping, the tools for nickel-based alloys feature a reduced helix of 10°. The thread mills are produced with MJ thread forms with a 27° helix, the optimum angle for threading exotic materials. MJ thread forms are prevalent in the aerospace industry as they help reduce stress in the thread root of components.

**Sandvik Coromant** | [www.sandvik.coromant.com](http://www.sandvik.coromant.com)

## Nordic's Box Pad Solution for Pad-Mount Equipment

















# Innovative Renewable Power for Resource Projects in Northern Canada

by Beverly Brooks



**THE RAGLAN MINE IN NORTHERN QUEBEC, NEAR THE Arctic Circle, relies on a wind powered electrical system which was specifically constructed to provide energy for this nickel mining project. The mine's energy costs are substantially reduced because wind power displaces part of the mine's more expensive diesel fuel consumption. It is estimated this first-of-its-kind wind powered energy system will save the Raglan mine 2.4 million liters of diesel fuel annually.**

This three Megawatt wind turbine is an important aspect of controlling the underground mine's costs, as energy accounts for between 18 and 24 percent of its annual operating costs. Moreover, the mine site is very remote with no connections to the Hydro Quebec main power grid. This energy system was completed in 2015, and is expected to continue to operate over the mine's entire life.

The objective of this project was to construct a wind hydrogen/energy storage smart grid system at a remote northern mining location, in order to illustrate that this technology could successfully operate in severe arctic climate conditions, at an industrial scale, and achieve significant reductions in the cost of energy and in diesel consumption (compared to diesel only or wind-diesel alternatives).

The project includes three different energy storage technologies -- a high speed fly wheel, a lithium ion battery, and a hydrogen storage loop, complete with an electrolyzer and a fuel cell. The lithium battery technology powering this wind energy system is used in many electric and electric-hybrid automobiles, as well as in utility-scale energy storage applications, ranging from single-family homes up to utility-scale systems. Lithium batteries are designed with built-in safety features. When they overheat, they automatically shut down. The typical lead acid battery offers 50 percent of capacity, whereas lithium batteries provide 80 percent of usable capacity. Lithium batteries are usually half the size and a third of the weight of traditional batteries. The life of a lithium battery is typically more than thirteen years, and requires low maintenance. Moreover, lithium batteries reduce CO2 emissions and are recyclable.

The fly wheel system has a rotor which turns at a very high speed. The energy stored in the fly wheel system can be supplied back to the electricity system as needed, to smooth out rapid wind power variations.

Dramatic variations in wind power can cause variations in the grid power system frequency, so generated power is continually adjusted via the fuel valve, and the mechanical action of the valve is assisted by power from the energy storage components. A micro-grid controller has been designed to handle energy

management and power flow of the energy storage, to smooth out wind power variations, and ensure power system reliability and stability.

The system has successfully demonstrated the interplay of multiple storage technologies, and been able to respond effectively to the variability of wind power. The battery and flywheel combination have operated without tripping the security mechanisms of the Raglan diesel micro-grid. The turbine has achieved 97.3 percent availability since its installation in 2014, displacing over 6 million liters of diesel, and 17,899 tons of greenhouse gases over 38 months of operation.

The wind turbine uses an innovative foundation structure, which is elevated one meter above ground and mounted on piles 16 meters deep, to minimize environmental footprint, and adapt to permafrost degradation over the life of the turbine. The amount of concrete used in the foundation is dramatically lower compared to the amount used in the platforms of conventional wind turbines (30 instead of 450 cubic meters). This is an important factor, as concrete is significantly more expensive in the North compared to Southern Canada.

The Raglan Mine employs 950 workers. It has been awarded the "Coup de coeur" award for the Northern Québec region at the Prix Créateurs d'emplois du Québec. This award recognizes Glencore's contribution to maintaining quality jobs with a view to sustainable development. The Prix créateurs d'emplois du Québec event annually celebrates the principle job creators in each of the 17 administrative regions of Québec. Two prizes are awarded in each administrative region. First, the "Champion" category highlights the remarkable performance

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of a company in the region according to the number of jobs created or maintained. Second, the category "Coup de coeur" recognizes the exemplary contribution of a regional company to innovation, strategy, or impact of creating or maintaining employment in its sector.

Very few wind projects have been installed over the past 30 years in northern Canada. Conditions in the North can be challenging for rotating machines, and the variable nature of wind makes it difficult to integrate with diesel power plants in adapting to variable community loads. These conditions have resulted in high installation costs coupled with high operation and maintenance costs. For these reasons, wind powered energy systems in the North are rare.

Acting as a flagship site for future industrial-scale wind power development in the region, this energy project successfully demonstrates that wind energy can improve long-term economic stability and energy security, and reduce greenhouse gas emissions and the environmental footprint of Canada's northern mining operations and communities.

*Beverly Brooks, MA MBA, is an economist and writer, who has worked for the federal government and private sector companies on energy policy.*

*Hatch designed and implemented the Hatch Microgrid at Raglan, which monitors wind power production and load variations, and economically dispatches the charge and discharge from energy storage units to smooth out wind power variations and displace diesel generation.*

**Hatch** | [www.hatch.com](http://www.hatch.com)

*Tugliq Energy Company is the owner and the independent operator of the wind powered energy system. The photo has been supplied by Justin Bulota, Tugliq Energy Company/www.tugliq.com*



### High-tonnage ultra-flat cylinders for harsh conditions

Enerpac has released its new CUSP-Series and CULP-Series high-tonnage ultra-flat cylinders designed for harsh conditions which require low clearance, especially for industrial maintenance and construction applications. The CUSP-Series has an integrated tilting function with 10 to 1,000-ton capacity, 0.26-0.69 inches stroke, and maximum operating pressure of 10,150 psi. The CULP-Series has an integrated stop ring with 10 to 50-ton capacity, 0.24 inches stroke, and maximum operating pressure of 10,150 psi. CUSP-Series features include: up to 4% side load of maximum capacity, low collapsed height, integrated tilting function up to 4°, nitrocarburized surface treatment for harsh conditions, and "Red Line" for visual maximum stroke limitation.

**Enerpac** | [www.enerpac.com](http://www.enerpac.com)



### Energy harvesting components for electromechanical applications

POSITAL's Wiegand assemblies offer a compact and efficient way of harvesting power for electronic circuits in electromechanical devices, eliminating the need for backup batteries. The operating principle of POSITAL's Wiegand modules is straightforward. A "Wiegand wire" is a short length of specially prepared Vicalloy (vanadium-iron-cobalt) wire. When exposed to a changing external magnetic field (e.g. a nearby permanent magnet mounted on a rotating shaft) the Wiegand wire will initially retain its magnetic polarity, and then abruptly 'flip' this polarity when the change to the external magnetic field reaches a certain threshold. This sudden change in the magnetic state of the core induces a current pulse in a copper coil wound around the Vicalloy core. This current pulse is very short-lived, but the energy harvested from the mechanical motion of the magnet can be captured and used to activate a low-power electronic circuit. An important feature of the Wiegand effect is the amount of electric power generated with each reversal of the magnetic polarization is constant and completely independent of the rate of change of the external magnetic field, even if this happens very slowly. Wiegand assemblies are a core component in POSITAL's IXARC multi-turn absolute rotary encoders, providing a maintenance-free method for powering the counter that records the number of complete rotations that the device experiences.

**POSITAL-FRABA** | [www.posital.com](http://www.posital.com)

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### IPLEX® RT Wind Turbine Inspection Kit Take Your Inspections to New Heights



With exceptional imagery in a lightweight, portable package, Olympus' IPLEX RT Wind Inspection Kit includes everything you need for fast, accurate wind turbine gearbox inspections.

#### IPLEX RT Wind Turbine Inspection Kit

- IPLEX RT 4 mm diameter, 2 m length videoscope
- AT120D/NF oil clearing tip adaptor
- AT80D/FF tip adaptor
- 4 mm rigid sleeve set and handle/grip
- 12 ft (3.6 m) guide tube for 4 mm scopes
- Carrying case



Contact your Olympus sales representative for more information.

[www.olympus-ims.com](http://www.olympus-ims.com)

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# Safety & Fall Protection Equipment

According to the National Safety Council, falls are one of the leading causes of deaths in the workplace. Perhaps more than any other type of workers out there, those who erect and maintain wind turbines are exposed to some of the most serious, and potentially fatal, fall hazards. With many turbines reaching heights of well over 100 feet tall, wind farms are only growing upwards in many cases, and exposure to high winds can make work at high elevations even more hazardous. Here we highlight some of the latest in safety and fall protection equipment—a must for the growing industry.

SEE AD ON PAGE 13



## Snap-on Industrial

**Product:** Tools@Height Drop Prevention

**Application:** Elevated work

**Description:** Snap-on works with their customers to determine the tools, attachment points, lanyards, pouches, and holsters needed for a turnkey drop-prevention solution. Tools are configured to achieve a reliable system that meets individual safety standards. Snap-on engineers and certifies attachment points that maintain tool functionality and are significantly more durable than “add-ons” which require assembly, frequent maintenance, and replacement. With 70% of drops occurring during tool exchange, Snap-on Tools@Height employs independent tethering to eliminate exchanges. This practice allows tools to be removed from, and returned to holsters or pouches using one hand, maintaining “three points of contact” when working at height.



### Key Features:

- Engineered attachment points;
- Designs maintain functionality of tools;
- Attachment points are drop tested and certified;
- Independent tethering;
- Turn-key solutions.

[www.snapon.com/industrial](http://www.snapon.com/industrial)



## Hi-Line Utility Supply Co.

**Product:** Hi-Line Hi-Grip Xtreme Protectors

**Application:** Silicone grip glove protector

**Description:** The Hi-Grip Xtreme features a full, silicone-grip palm to deliver supreme control and enhanced productivity. Improved thumb fit increases dexterity and the ergonomic round, curved fingers offer the best fit and flexibility. The black wear guard provides additional protection on the top of the hands and all leather cuffs provide extra protection. All this awesomeness is stitched together with maximum strength Kevlar stitching for long-lasting quality. Available in 10", 12", and 14" lengths, in sizes 8-12.5.

[www.hilineco.com](http://www.hilineco.com)



## Dakota Riggers & Tool Supply, Inc.

**Product:** Petzl Vertex Best Hard Hat

**Application:** At height head protection

**Description:** With its strong chinstrap, the Vertex Best helmet has six-point textile suspension to ensure comfort for workers at height. Its unventilated shell protects against electrical hazards and molten metal splash. The Vertex Best helmet is designed for use with optional headlamps for work in low light environments.

[www.dakotariggers.com](http://www.dakotariggers.com)



## Motion Industries

**Product:** Tools@Height, Tethered Tool System

**Application:** Drop prevention

**Description:** When professionals use tools while working at height, bad things can happen: tools can fall, damaging equipment, interrupting work, and injuring people. In response to the dangers presented by dropped objects, Snap-on Industrial Brands developed Tools@Height, a tethered tool system for applications involving work being performed at height, and anywhere dropped or lost objects are a concern.

[www.motionindustries.com](http://www.motionindustries.com)



## Corgo Industries

**Product:** COR-60045

**Application:** 45 gallon drum bag

**Description:** The 25" x 25" x 36" lifting bag is a solution for lifting grease or oil drums up tower. This wind turbine maintenance lifting bag is especially designed for oil or grease jobs required in the maintenance of wind turbines. It can also be used as a larger version of the COR-600. This wind turbine lift bag can also be used in any location for work at heights such as bridge work, transmission towers, or stack maintenance.

[www.corgoind.com](http://www.corgoind.com)



## Power Climber Wind

**Product:** IBEX 1000P Climb Assist

**Application:** Intelligent climb assist for wind turbine technicians

**Description:** The IBEX 1000 climb assist system delivers personalized performance, increased safety, and better productivity. The IBEX 1000 allows user-adjustable support settings from 50 to 125lb (25 to 55kg), and provides constant load support, in both the up and down directions, regardless of climbing speed. These ride settings are stored in a load sensing EasyClimb Controller (ECC), attached between the climber and the belt, and can be changed at any time and anywhere. Motor power is controlled by signals from the ECC, which communicates climber behavior to adapt motor output for a consistent, comfortable climb. The motor responds to the climber rather than the climber responding to a constant speed and torque motor.

[www.powerclimberwind.com](http://www.powerclimberwind.com)



## Sterling Rope Company, Inc.

**Product:** PDQ System

**Application:** Self-rescue system for use in work-at-height environments.

**Description:** The PDQ is Sterling's lightweight tower evacuation system. The CNC-machined PDQ descent-control device and heat-resistant 6mm Technora rope are the core of this system and keep the total weight under 10lbs, while achieving a user rating of up to 310lbs. The kit comes fully assembled and its slim profile allows it to be stored compactly until needed. The addition of the Raise and Rescue kit converts the PDQ to a mechanical advantage system that can be used for simple and efficient victim pick-off and multi-directional transfer procedures.

[www.sterlingrope.com](http://www.sterlingrope.com)



## Hammerhead Industries

**Product:** Gear Keeper Super Coil anchored tool tethers

**Application:** 42" anchor tether creates spacious 18ft diameter work area.

**Description:** Gear Keeper's ergonomically constructed Super Coil anchored tool tethers are manufactured with a low-force polyurethane elastic core which is woven throughout the entire body of the webbing. Designed for tools weighing up to 25lbs, Gear Keeper's proprietary manufacturing process minimizes “extension” arm fatigue while in use but equally important, minimizes entanglement issues when climbing or working in confined areas. Load tested beyond the drop weight, other safety and strength features of the Super Coil tethers include a lanyard cord that is sewn lengthwise into the webbing to avoid damaging the integrity of the cord and insuring longer durability and strength.

[www.gearkeeper.com](http://www.gearkeeper.com)



## Petzl

**Product:** VOLT LT and Seat

**Application:** Fall arrest and work positioning harness for the wind power industry

**Description:** A lightweight, breathable harness and seat combo for many work at height environments. It's easily put on due to an integrated vest which ensures the harness keeps its shape, and the FAST buckles allow quick sizing adjustments.

[www.petzl.com](http://www.petzl.com)



# Training

The wind energy industry is developing more projects than ever and needs a skilled and qualified workforce to produce America's clean wind power. Workers and technicians may need specialized training to succeed and advance in their careers. Check out some of the training opportunities, professional certifications, workshops, and events offered across the country and online.

SEE AD ON PAGE 22



## Abaris Training Resources

**Training Program:** Composite Windblade Repair

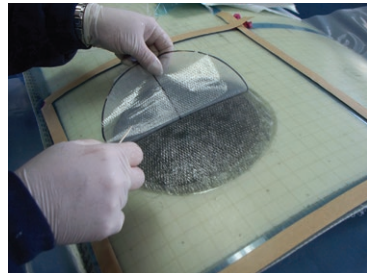
**Hours:** 36

**Classroom/Online:** Classroom and workshop, at Abaris' facility or client's

**Number of Participants:** 12

**Certifications:** Abaris Certificate of Completion

**Course description:** This 5-day course is designed for field technicians, inspectors, and supervisors responsible for performing structural repairs to composite wind blades. In this course the students will first be challenged with determining the extent of damage to Fiber Reinforced Plastic (FRP) sandwich panels and then will perform damage removal and proper repair preparation. Finally the student teams will perform repairs to reconstruct the damaged areas in order to match structural fiber axial loads through the damaged area in the blade structure. This process is repeated with various panels, so that the students obtain solid hands-on skills that they can immediately put to work in the field.



### Key Features:

- This course promotes and utilizes multi-person team repair concepts similar to those repairs done in the field;
- The student teams will be introduced to the latest hot-bond repair equipment specifically designed for the industry;
- Learn how to position, secure, and control large area heat blankets in accordance with standard industry procedures;
- Custom courses available for groups.

[www.abaris.com](http://www.abaris.com)



## Wind Access Engineering

**Training Program:** Suspended Scaffolding Safety

**Hours:** 10 hours

**Classroom/Online:** Classroom or on site

**Number of Participants:** 10-12

**Certifications:** Kaeufer Blade Access Systems, Asmus Wind, Tractel, Bee Access Products

**Course description:** Wind Access's Suspended Scaffolding Safety course is designed to exceed OSHA's training requirements for Suspended Scaffolding under CFR 1926.451. Topics covered include hazard assessment, OSHA standards, topside rigging, wind platforms, fall arrest and self-rescue systems, and more.

[www.windaccessengineering.com](http://www.windaccessengineering.com)



## TEAM-1 Academy Inc.

**Training Program:** Working/Rescue at Heights - Wind Turbine Series

**Hours:** 8 - 16 hours

**Classroom/Online:** On their site, or on client's site

**Number of Participants:** 6

**Certifications:** GWO (Global Wind Organization), MOL WAH

**Course description:** TEAM-1 Academy provides safety and rescue training in North America. This course is the global standard for getting wind turbine technicians trained to work safely and effectively using the on-site rescue/evacuation equipment.

[www.team1academy.com](http://www.team1academy.com)

# Lighting

The marking and lighting of wind turbines is primarily intended to provide high visibility and to assist pilots identify and avoid the structures. The FAA recommends wind turbines be lit with red or white lights which flash simultaneously. Listed below are some of the options available on the market today.



## TWR Lighting

**Product Name:** L550-864-G

**Effective Intensity:** 2000cd

**Horizontal Coverage:** 360°

**Vertical Beam:** 3 years minimum

**Expected LED Life:** 15 - 20 years

**Input Voltage:** 120-230Vac

**Operating Voltage:** 120/230Vac

**Overvoltage Protection:** Built in overvoltage protection designed to meet Class III according to IEC61643-1, Class D

**Frequency:** 50-60Hz

**Power Consumption:** 2W (Day) / 20W (Night)

**Operating Temperature:** -67°F to +130°F (-55°C to +55°C)

**Weight:** 26lbs (11.8kg)

**Dimensions:** 20.6" x 20.6" x 9.4" (52.3cm x 52.3cm x 23.9cm)

**Cable/Connection:** Combined power and alarm connection cable

**Warranty:** 5-year warranty

**Rating/Certifications:** United States Federal Aviation Administration AC 70/7460-1K; Obstruction Marking and Lighting

[www.twrlighting.com](http://www.twrlighting.com)



## Hughey & Phillips

**Product Name:** HORIZON 2000/3000

**Effective Intensity:** Day White 2000cd; Night White 2000cd; Night Red 2,000cd

**Horizontal Coverage:** 360°

**Vertical Beam:** 3°

**Expected LED Life:** 10 years

**Input Voltage:** 120-240Vac 50/60Hz, +/-48Vdc

**Operating Voltage:** 120-240Vac 50/60Hz, +/-48Vdc

**Overvoltage Protection:** H&P patented design

**Frequency:** 50/60Hz

**Power Consumption:** <25W

**Operating Temperature:** -40°F to +131°F (-40°C to +55°C)

**Weight:** 17lbs (7.71kg)

**Dimensions:** 14" x 9.5" (35.6cm x 24.1cm)

**Cable/Connection:** 120ft Pigtail of #18-8C Tray Cable

**Warranty:** 5-year warranty

**Rating/Certifications:** FAA Type L-864, L-865, L-864/865

[www.hugheyandphillips.com](http://www.hugheyandphillips.com)



## Technostrobe

**Product Name:** LED-RED-Standard

**Effective Intensity:** 2000cd

**Horizontal Coverage:** 360°

**Vertical Beam:** 3°

**Expected LED Life:** 10 years minimum

**Input Voltage:** 24Vdc or 90-250Vac

**Overvoltage Protection:** In both the Beacon and the Control enclosure

**Frequency:** 50/60hz

**Power Consumption:** Beacon is 9W, at 30 FPM, 16% duty cycle

**Operating Temperature:** -40°F to +131°F (-40°C to 55°C)

**Weight:** Beacon 7.05lb (3.2kg)

**Dimensions:** 6.69" x 4.92" (17cm x 12.5cm)

**Cable/Connection:** 16AWG, 2 conductors

**Warranty:** 5-year warranty

**Rating/Certifications:** Compliant with TC, FAA and ULc

[www.technostrobe.com](http://www.technostrobe.com)



## Phoenix Contact

**Product Name:** LED Tower Lighting

**Expected LED life:** minimum 50,000 hours

**Power consumption:** +/- 10W (for 230VAC)

**Operating temperature:** -40°F to 158°F (-40°C to 70°C)

**Weight:** 1.51lbs (.687kg)  
**Dimensions:** 3.16" x 3" x 12" (9.17cm x 7.62cm x 30.7cm)

**Cable/Connection:** QPD fast connection, IP67 degree of protection

**Rating/Certifications:** UL and ENEC approval

[www.phoenixcontact.com](http://www.phoenixcontact.com)





## AWEA WIND PROJECT O&M AND SAFETY CONFERENCE 2018

February 27<sup>th</sup>-28<sup>th</sup>, 2018  
Hotel Del Coronado — San Diego, CA

As the wind energy industry continues to expand, so does the need for an evolving approach to operating the nation's growing number of wind projects. Fortunately, there is no shortage of experience to draw from in this arena. Individuals from across industry sectors and across functional disciplines will join in San Diego in February to set a vision and plan for continued and expanded operational excellence in the wind industry. Be a part of the largest North American gathering of wind energy operational professionals and technicians, as they combine the essential elements of O&M, health and safety, workforce development, and quality assurance to develop a successful partnership for today and beyond.

[www.awea.org](http://www.awea.org)

show in print

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



### Versatile torque tester

SmartCheck is a newly launched, small sized, versatile, and easy-to-use torque tester that will find a home in any workshop and service vehicle. Due to its compact dimensions, the ability to mount it horizontally or vertically, and the rotatable display, it can be used virtually anywhere. Display and keypad are splash-proof and it can be operated through power supply or battery. SmartCheck quickly provides information on whether or not a torque wrench is still within the prescribed tolerances or whether it requires adjustment. The integrated visual and audible overload protection mechanism, and impact resistant plastic housing ensure the durability customers expect of STAHLWILLE.

**Stahlwille Tools, LLC**

[www.stahlwille-america.com](http://www.stahlwille-america.com)



### Energy and environmental services

Established in 2002, Run Energy is a full-service provider to the North American wind industry. Run's 225 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](http://www.runenergy.com)



### Wind inspection kit

With advanced imagery in a lightweight, portable package, Olympus' IPLEX RT Wind Inspection Kit includes everything required for fast, accurate wind turbine gearbox inspections; IPLEX RT 4mm videoscope, AT120D/NF oil clearing tip adaptor, AT80D/FF tip adaptor, 4mm rigid sleeve set and handle/grip, guide tube for 4mm scopes (12ft), and carrying case. The IPLEX RT complies with internationally recognized Military Standards (MIL-STD-810F/G and MIL-STD-461F) as well as IP55, passing a range of severe environmental tests such as blowing rain/dust, high humidity, and icing rain. A low-reflection, daylight view monitor displays clear images even under bright sunlight.

**Olympus** | [www.olympus-imc.com](http://www.olympus-imc.com)



### Confined space torque from 74 to 5100 ft-lb

The small footprint of Snap-on Industrial's Compact Manual Torque Multipliers allow Wexcellent access and easy handling, suitable for Tower Flanges. Multiple sizes cover torque ranges from 74 ft.-lbs. to 5100 ft.-lbs. Anti Wind-Up Ratchet (AWUR) fitted as standard to keep multiplier loaded for easier operation. Calibrated to give exact multiplication ratio and each multiplier is issued with a unique calibration certificate. Always provides true torque multiplication; accuracy guaranteed better than +/- 4%. Supplied in a compact carrying case with a variety of alternative reaction fixtures available.

**Snap-on Industrial**

[www.snapon.com/industrial](http://www.snapon.com/industrial)

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### Battery powered torque wrenches

The new B-RAD Select battery series torque wrenches comes with two simple buttons to increase or decrease the value by 10ft. lbs. At the four-digit display, the set torque value is displayed. The B-RAD select remembers the last set torque value even after the battery has been removed. The B-RAD is suitable for pre-torque and service jobs where electricity or compressed air are not available. Torque ranges up to 3,000ft. lbs, equipped with the latest Lithium-ion Standard.

**Rad Torque Systems**

[www.radtorque.com](http://www.radtorque.com)



### Oil filters

C.C. Jensen is a trusted partner for providing clean oil for wind turbines. They manufacture offline oil filter systems, gear flushing filters, and oil contamination monitoring systems. Clean oil is the lifeblood of a wind turbine. With C.C. Jensen's Fine Filters, they will systematically remove particles, oil degradation products, and water from the oil, which means longer life, greater reliability, and significant savings.

**C.C. Jensen, Inc.**

[www.ccjensen.com](http://www.ccjensen.com)



### Carbon brushes and brush holders

Helwig Carbon is a manufacturer of carbon brushes and brush holders used on wind turbine generators. American made ISO certified. Their products are designed to provide long life and low maintenance costs.

**Helwig Carbon Products, Inc.**

[www.helwigcarbon.com](http://www.helwigcarbon.com)





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RACKING & MOUNTING SYSTEMS  
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Associations  
Capacitors  
Civil Engineering  
Construction  
Equipment Manufacturer  
Power Engineering & Consulting  
Project Management & Asset  
Development  
Protective Solar System Barrier  
PV Design | Build  
Radiant Heating  
Rock Crusher and Milling  
Snow Removal Systems  
Solar HVAC Equipment Manufacturer  
Solar Radiometer Calibration  
Solar Screen Manufacturing  
Solar Slip Sheets and Block  
Valve, Measurement, & Control Systems



**Adhesives, Sealants, Tapes & Pastes**



**FLEXcon**

FLEXcon SA6000 Series Adhesives are tacky silicone adhesives providing the pressure-sensitive characteristics of traditional pressure-sensitive adhesives, but with the added benefit of continued performance in extremely low or high-temperature applications where acrylic adhesive performance would not suffice. The FLEXcon SA6000 Series includes product constructions developed for automotive, aerospace, electronics, and other high-temperature applications.

[www.flexcon.com](http://www.flexcon.com)



**BUILDING TRUST**

**Sika Corporation**

Sika supplies a full range of engineered silicones, polyurethanes, and modified silane adhesives and sealants that meet the stringent performance demands of customers in the solar energy industry. They offer solutions that have been optimized to provide for long-term performance, curing speed, and increased process throughput capabilities. Sika continually strives to exceed standards in terms of their product assembly operations and field installation services, as well as in terms of the global engineering support they provide customers.

[www.sikausa.com](http://www.sikausa.com)

**Aluminum Extrusion & Metal Fabrication**



**Alexandria Industries**

Alexandria Industries offers OEMs a one-stop-manufacturing-shop to design, produce, assemble, and deliver a range of components. The company relies on current technology and a skilled workforce to create extruded aluminum products, precision machining of ferrous and non-ferrous products, heat sinks, plastic injection and foam molding components, fabrication and bending, TIG/MIG welding, and mechanical and chemical finishing.

[www.alexandriaindustries.com](http://www.alexandriaindustries.com)

**Backsheets**



**KREMPEL GmbH**

With more than 20 years of experience, the KREMPEL-GROUP manufactures backsheets for use in photovoltaic solar modules. In addition to providing electrical insulation, they protect against harmful environmental influences such as UV radiation, moisture, temperature fluctuations, microparticles, and corrosive gases. KREMPEL's back sheets help extend the service life of the module.

[www.krempe-group.com](http://www.krempe-group.com)

**Balance-of-Systems (BoS)**



**Hammond Power Solutions**

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

[www.hammondpowersolutions.com](http://www.hammondpowersolutions.com)



**MidNite Solar, Inc.**

The MidNite SOB is a simple to install, low cost, rapid shut down system solution. It's designed to comply with NEC 2014 and NEC 2017. The system uses a receiver at the module and a transmitter near the inverter. The system is fail safe, if it doesn't sense the signal from the transmitter, it turns off and opens the circuit. All SOB's are TUV listed to UL1741 and are NEC2014, 2017 690.12 compliant. MidNite Solar's Bleed Down Unit ensures all systems comply with the NEC 2017 690.12(B).

[www.midnitesolar.com](http://www.midnitesolar.com)



**Shoals Technologies Group**

Shoals' combiner-less BLA harness has helped streamline installation while creating between 20 and 60% material savings. The newest addition to this is the introduction of BLM which adds current and voltage monitoring along with autonomous I/V curve measurement. I-V curve measurement provides more information about the performance of a PV module or array than any other measurement method and is coupled with the fastest possible measurement tools. The entire system is plug and play and completely wireless - allowing for maximum functionality.

[www.shoals.com](http://www.shoals.com)

**Battery | Energy Storage**



**Crown Battery Manufacturing Company**

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

[www.crownbattery.com](http://www.crownbattery.com)



**EnerSys**

EnerSys has a range of batteries designed to provide high cycling performance and a safe, uninterrupted supply of energy in renewable energy applications. They have experience with deploying batteries in a variety of applications from small off-grid solar to large-scale energy storage for commercial solar and wind farms. Their application specialists can provide the right technology from their portfolio to provide a low total cost of ownership, while meeting the technical demands of any site across the globe. They continually research ways to make their stored energy solutions more environmentally friendly.

[www.enersys.com](http://www.enersys.com)

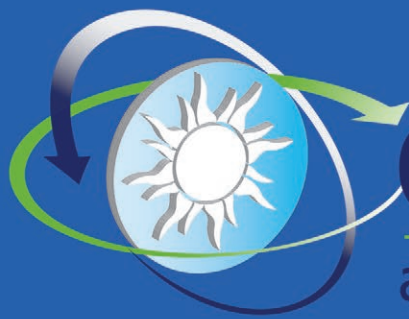


**Fullriver Battery**

Fullriver's DC400-6 true deep cycle AGM batteries are built specifically for cyclic use in demanding solar applications. Their thick plate design and AGM construction combine for a robust, maintenance-free battery, delivering optimal performance in both fair weather and extreme climate conditions.

[www.fullriverbattery.com](http://www.fullriverbattery.com)





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**GS Battery USA**

GS Battery (USA) Inc. manufactures a wide variety of premium batteries for grid-tie or off-grid renewable energy applications and energy storage projects. Their line of advanced lead-carbon batteries are suitable for residential, commercial, and industrial renewable energy projects. These sealed, maintenance-free batteries deliver a cyclic performance of 5000 cycles at 70% DOD. GS Battery also manufactures lithium-ion, AGM lead-acid, and nickel-cadmium battery chemistries. [www.gsbattery.com/renewable](http://www.gsbattery.com/renewable)



**Harris Battery Company**

Harris Battery offers a full line of Discover OPzS (Serviceable) Tubular Plate Cells and Batteries, and Premium OPzV (Maintenance-free) Tubular Plate Gel Cells and Batteries. Tubular Plate technology provides a low cost of lifetime kWh. Construction design with tubular grids and multi-tube gauntlets which encapsulate the positive plate active material provides cyclic stability, long life, and high capacity. Harris Battery provides engineering support and system design for off-grid, hybrid, and back-up system configurations to maximize battery cycle life, minimize maintenance, and ensure operational safety. [www.harrisbattery.com](http://www.harrisbattery.com)

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- Approved by panel manufacturers
- Effective biodegradable cleaner



[www.polywater.com/solarpanelwash.html](http://www.polywater.com/solarpanelwash.html)



**Leoch Battery Corp.**

Global manufacturer of lead-acid batteries, Leoch now offers Advanced Pure Lead Punched Grid + Carbon Technology. These batteries offer high performance in partial-state-of-charge conditions with high power and energy density, super fast recharge time, and long cycle life (2500+ @ 60% DoD). ABS-poly-carbonate jars enable wide operating temperature range (-30°C to +60°C). Their PLH+C and OPzV tubular plate GEL batteries are a solution for solar energy storage systems. [www.leoch.us](http://www.leoch.us)



**Narada USA**

Narada is an Energy Storage System manufacturer with experience in microgrid and other ES systems. Narada manufactures lithium, advanced lead-carbon, and pure lead batteries for the energy storage market. [www.en.naradapower.com](http://www.en.naradapower.com)



**Nel Hydrogen, Inc.**

Nel Hydrogen generators utilize alkaline and proton PEM technology to produce high volume hydrogen consistently on-site. With efficiency in mind, they sense demand and automatically adjust production accordingly. Featuring a scalable modular design, these systems are well-suited for a variety of renewable energy applications. [www.nelhydrogen.com](http://www.nelhydrogen.com)



**NEXTracker**

NX Drive by NEXTracker is a flexible and reliable energy storage system, providing safety features for tough environmental conditions. Designed for utilities, developers, and energy partners, NX Drive supports multiple battery technologies and provides flexible configurability for a wide range of storage applications, project sizes, and future needs. Engineered to maximize energy and power density in a standardized package, NX Drive applies best practices for lean and robust system integration to drive safety, quality, flexibility, and efficiency while lowering BOS and operating costs. [www.nextracker.com](http://www.nextracker.com)



**Nuvation Energy**

Nuvation BMS is a highly configurable and MESA/Sunspec conformant off-the-shelf battery management system that can be used in both small- and large-scale energy storage systems. With over 1000 configurable settings, Nuvation BMS drastically reduces an energy storage project development effort with a BMS that has been designed from the ground up to utility-grade standards. Product options range from an 11- 60VDC BMS for low-voltage applications, to a modular 1250VDC battery management system that can manage megawatt-scale containerized storage. [www.nuvationenergy.com](http://www.nuvationenergy.com)



**Rolls Battery Engineering**

Specifically designed to deliver reliable capacity in a heavy duty, dual-container design, Rolls 5000 Series 6 volt model 6 CS 27P offers customers thick plate design for extended durability and cycle life, modular cell construction, and a high Amp-Hour capacity. Used in residential and larger commercial installs, Rolls' 6 CS 27P is backed by a 10-year warranty. [www.rollsbattery.com](http://www.rollsbattery.com)



**Storage Battery Systems, LLC**

SBS Battery provides batteries, battery systems, chargers, racks, and battery testing equipment and accessories. [www.sbsbattery.com](http://www.sbsbattery.com)



**Sun Xtender Batteries**

Sun Xtender's 12V Group 31 batteries, manufactured by Concorde Battery Corporation, now include a flat top cover and lifting handles. The flat top cover was designed to be compatible with standard hold down configurations and eliminates the need to modify hold down apparatus or revise cable routing as the terminals are now more accessible. The new cover also incorporates removable ergonomic lifting handles to reduce installation difficulty without causing interference. This upgrade affects the following 12V part numbers: PVX-890T PVX-1080T PVX-1180T PVX-1290T PVX-1530T. SunXtender Batteries ship Hazmat Exempt via land, sea or air. 100% Recyclable. [www.sunxtender.com](http://www.sunxtender.com)



**Tabuchi Electric Company of America**

Tabuchi manufactures residential hybrid solar-plus-storage systems. The Eco Intelligent Battery System (EIBS) is an all-in-one, easy-to-install DC-coupled solar-plus-storage system. The bi-directional solar and battery inverter works together with an embedded auto transfer switch for a seamless transition from on-grid to off-grid functionality. Four fully integrated modes make it easy to switch between Time-of-Use, Self-Consumption, Demand, and Backup which optimizes energy management and cost performance. In 2017, Tabuchi released the EIBS16GU2 with expanded storage and output capability. [www.tabuchiamerica.com](http://www.tabuchiamerica.com)



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### Trojan Battery Company

The Trojan Battery Solar product line features both true deep-cycle AGM and flooded batteries which are specifically designed for solar and other renewable energy applications. Trojan Solar AGM features a non-spillable, maintenance-free design which enables installers to customize the use and position of the batteries in various applications. Trojan's Flooded Solar batteries leverage their 90 years of deep-cycle flooded technology expertise and are engineered to provide high cycling. Trojan's Solar AGM is certified for non-hazardous shipping per U.S. DOT/IATA regulations and tested to an eight-year design life under the IEC 61427 standard for solar batteries. Both the Solar AGM and Solar Flooded lines are manufactured in the U.S. and are optimized for frequent cycling in harsh environments.

[www.trojanbattery.com](http://www.trojanbattery.com)



### U.S. Battery Manufacturing

U.S. Battery Manufacturing has been building flooded lead acid batteries since 1926 and manufactures deep cycle batteries specifically for many industries, worldwide. The company's RE Series batteries are designed to provide high peak capacity, long cycle life, and reliability for use in industrial or residential renewable energy applications. RE Series batteries utilize the company's XC2 formulation and Diamond Plate Technology to create an efficient battery plate, delivering high watt-hours per liter and watt-hours per kilogram.

[www.usbattery.com](http://www.usbattery.com)



## Your Magnetics Partner for Solar applications

HPS has developed a reputation as one of the most capable manufacturers of standard and custom dry-type magnetics in the world. With multiple manufacturing facilities located throughout North America, Italy and India, HPS offers a broad range of products for many demanding and diverse industries.

Our extensive and durable line of VPI and Cast Resin transformers and reactors provide you with a complete magnetic solution for all your solar energy needs.

[www.hammondpowersolutions.com](http://www.hammondpowersolutions.com)



### Valence Technology

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

[www.valence.com](http://www.valence.com)

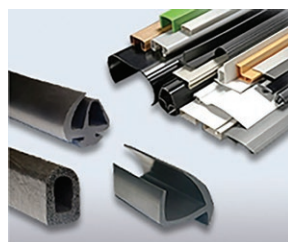
### Components | Electrical Protection



### Bal Seal Engineering, Inc.

Bal Seal Engineering, Inc. works with OEMs and tier suppliers to design and produce sealing, connecting, conducting, and EMI shielding solutions which improve the performance and reliability of equipment used in solar power, wind, and other alternative energy production. Their solutions enable engineers to protect precision components, design more compact, efficient electrical connectors, and ensure consistent current/signal transmission.

[www.balseal.com](http://www.balseal.com)



### Clark Rubber & Plastic

Clark Rubber & Plastic is a custom manufacturer of UL extruded and molded rubber and plastic components used in the solar industry. Clark Rubber & Plastic develops and manufactures custom rubber and plastic quality components such as clamp inserts, grommets, rub strips, and fastening applications.

[www.clarkrandp.com](http://www.clarkrandp.com)



### EMA Electromechanics, LLC

In Texas, EMA Electromechanics produces the VDH/GSMI, which combines a circuit breaker and a high-speed grounding switch. Concerning PRC-024-1/2, the VDH/GSMI supports differentiation between internal and external faults, signaling the inverter in a fraction of the 150ms required by the standard, and providing valuable information to take the decision to shut down.

[www.emaelectromechanics.com](http://www.emaelectromechanics.com)



### Gigavac

Designed and manufactured in the USA, GIGAVAC offers the smallest UL508 recognized contactors for high current switching at 1000Vdc. The patented series includes HX EPIC contactors rated to 350A+ and the cost effective GIGAVAC MiniTACTOR series rated up to 50A. GIGAVAC's patented sealing technologies provide complete protection beyond what is offered by traditional hermetic seals. Sealed switching technology means these contactors can safely be used in nearly any harsh environment, and at temperatures up to 85°C. They are not position sensitive and can be mounted in any axis. The HX series includes models with optional auxiliary contacts.

[www.gigavac.com](http://www.gigavac.com)



Expertise Applied | Answers Delivered



### Littelfuse

The Littelfuse SPXI 1500 Vdc solar fuse is designed to integrate into an in-line assembly within a wire harness. The fuse provides string protection that meets UL2579 for photovoltaic applications. The SPXI can be electrically insulated by either over-molding or using approved heat-shrink. Also available in 1000Vdc (SPFI), the products protect solar strings from 2 to 30 amps. Littelfuse offers numerous DC circuit-protection products uniquely suited to protect the equipment and systems subject to the harsh environments of PV installations.

[www.littelfuse.com/solar](http://www.littelfuse.com/solar)



### Mersen

Mersen's HP10M, HP15M, and HP15G photovoltaic (PV) fuse series were engineered and designed specifically for the protection of photovoltaic systems. In addition to the standard ferrule terminal, a unique wire crimp terminal (CC option) permits solderless wire-to-fuse connection for overmold encapsulation of fuse and wiring, specifically designed for in-line fuse applications. UL Listed.

[ep.mersen.com](http://ep.mersen.com)





### Morgan Advanced Materials

Brush springs are one of the most neglected critical components of a turbine generator. Springs replaced only when there is obvious damage can lead to mixing and unequal spring forces. Unequal spring forces = unequal brush pressure = unequal current distribution between brushes = catastrophic failure. Sluggish springs are slow to react allowing longer loss of contact between the brush and slip ring, arcing is the result, damaging brushes and slip rings. Change springs as a set every 3 to 5 years, a good maintenance practice for longer slip ring & brush life. Morgan provides complete generator spring kits. One box contains all new phase and ground brush springs of proper and equal forces.

[www.morganelectricalmaterials.com](http://www.morganelectricalmaterials.com)



### Phoenix Contact

Phoenix Contact's new UNO Solar DC-to-DC power converter connects directly to a solar array. The UNO Solar converts high voltages from DC strings to 24VDC, eliminating the costs and hassle of trenching for combiner, re-combiner, and inverter control for anti-islanding applications. The UNO Solar accepts the 300 to 1000VDC input generated by the array and converts it to electrically isolated 24VDC/2.5A output voltage. For higher current applications, the UNO Solar can be wired in parallel with the use of a decoupling diode.

[www.phoenixcontact.com](http://www.phoenixcontact.com)



### Priority Wire & Cable

Priority Wire & Cable stocks a large inventory of aluminum DC feeder cables PV 2KV, 4 awg thru 1000 MCM, plus 8 and 10 awg copper 2KV string wire in black, white, red, and green. They also stock a variety of medium voltage cable, all of which can be cut to length. They have supplied wire to over 5GW of projects and can assist in eliminating unexpected costs, and reducing lead time, waste, and labor.

[www.prioritywire.com](http://www.prioritywire.com)



### SIBA Fuses

SIBA Fuses are available for protection of PV panels, sub-arrays, arrays, energy storage (ES) systems, inverters, filters, transformers, and switchgear tied to the grid. Their specialized energy storage (ES) fuses are available from 400V to 1500V with high breaking capacity and low L/R.

[www.siba-fuses.us](http://www.siba-fuses.us)



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**STEGO, Inc.**

For over 35 years, STEGO, Inc. has produced products for energy efficient thermal management of electronic components. Convection heaters, fan heaters, and filter fans are just a few of the products STEGO produces which keep enclosed electronics on small and large scales running safely, economically, and reliably, from corporate server racks to wind turbines in extreme environments. With locations in 13 countries and partnerships around the world, STEGO serves a global customer base engaged in a large portfolio of industries.

[www.stegousa.com](http://www.stegousa.com)



**Tenmile Labs**

Tenmile Labs offers a comprehensive line of AC/DC current and voltage sensors for use in PV and energy storage systems up to 1500V. Model CTx-R is a high-sensitivity, 5A or 20A current sensor that can be used to directly measure ground fault current in central inverters, or as part of a residual current detector for measuring current imbalances in both string inverter input and output circuits. CTx is a split-core AC/DC current transducer for measuring large diameter feeder cables, at currents up to 400A. The VTx is a fully isolated (5.4kV,rms) linear voltage transducer, with full-scale ratings of 600V, 1000V, or 1500V. All products have excellent accuracy over temperature, and are compatible with a wide range of supply voltages.

[www.tenmile.io](http://www.tenmile.io)



**Thomas & Betts (T&B)**

Thomas & Betts (T&B), a member of the ABB Group, is a solar-power system component and connections supplier. Some of T&B's products that are available for the solar power industry include metal framing, current-limiting fuses, connectors, conduit and fitting systems, and UV-resistant cable ties. T&B also provides training for the correct installation and maintenance of these products.

[www.tnb.com](http://www.tnb.com)

**Concentrated Solar Power (CSP)**



**Accuratus Corporation**

Accuratus' Accuflect ceramic diffuse light reflector does not yellow over time and is non-flammable. It can be used in conventional or concentrating systems.

[www accuratus.com](http://www accuratus.com)

**Consulting Services | Business & Environmental Consultants**



**DNV GL**

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

[www.dnvgl.com/solar](http://www.dnvgl.com/solar)



**Natural Power**

Natural Power is an independent renewable energy consultancy with hands-on, in-house expertise throughout the development, construction, and operations cycles. Their operations experience, full lifecycle services, and products yield perspective for solar energy project developers, owners, and financiers alike. They take a practical, proactive, and engaged approach to conducting technical due diligence and prioritizing customer care.

[www.naturalpower.com](http://www.naturalpower.com)



**The C Three Group**

The C Three Group offers subscriptions to cloud-based databases with up-to-date project-tracking for North American infrastructure projects in transmission, generation, oil and natural gas, and telecomm. Add-on services include custom reporting, market forecasts, and deep dive segment analysis.

[www.cthree.net](http://www.cthree.net)



**Westlake Consultants, Inc.**

Westlake Consultants provides solutions for solar energy clients through land surveying and mapping, civil engineering, land use consulting, and 3D measurement services. Their projects include solar grid construction staking, topographic mapping and layout for design and installation, site permitting, civil site design, and 3D laser scanning and precision as-building services. 3D scanning and industrial measurement services can provide as-built data for structures, utility penetrations for rooftops, and building curtain walls that could impact solar panel installation design. 3D solutions offer advantages related to tolerance and precision, accuracy, and speed of data collection.

[www.westlakeconsultants.com](http://www.westlakeconsultants.com)



**Westwood Professional Services**

Westwood is a national multi-disciplined surveying and engineering firm with experience gained from supporting more than 7GW of utility-scale, commercial and industrial, and solar-plus-storage across the US. Their in-house expertise includes: environmental permitting, electrical, civil, geotechnical, structural, surveying, aerial mapping, and construction administration. Westwood has offices across the US and is licensed in nearly every state.

[www.westwoodps.com](http://www.westwoodps.com)

**High Precision Instruments for Solar Energy and Meteorological Research.**

[eko-usa.com](http://eko-usa.com)



**Electrical Consultants, Inc.**

Electrical Consultants Inc. (ECI) is a power delivery engineering firm which brings power delivery services through 500kV to their clients. ECI provides services including: overhead and underground transmission engineering, substation and switchyard design, industrial power systems design, land survey and construction staking, right-of-way services, environmental planning, project management, construction management, and procurement services to utilities.

[www.electricalconsultantsinc.com](http://www.electricalconsultantsinc.com)





### Whitham Group Executive Search

Whitham Group is an executive search firm with a niche in renewable energy, construction, and utilities. They are a Certified Women Owned Business and certified by the CPUC as a preferred diverse supplier.

[www.whithamgroup.com](http://www.whithamgroup.com)

### Contractors | EPC



#### Black & McDonald, Inc.

Black & McDonald offers solar energy construction management and execution, having provided construction services for solar farms producing over 200MW of power. Their first photovoltaic solar farm was completed in 2010 with an installed capacity of 80MW. The plant covers 950 acres and contains approximately 1.3 million thin film panels. Their knowledge, experience, multi-trade capabilities, and resources allow for project efficiency with minimal exposure to risk.

[www.blackandmcdonald.com/us](http://www.blackandmcdonald.com/us)



#### Black & Veatch

Black & Veatch provides comprehensive bankability, planning, siting, design, and full EPC and also construction only services for all types of renewable resource development. Black & Veatch also brings expertise in all energy storage technologies, including batteries, compressed air, flywheels, and pumped storage hydro. From utility to small-scale projects, their services span the life cycle from planning and development to installation and grid integration.

[www.bv.com](http://www.bv.com)



[www.BlattnerEnergy.com](http://www.BlattnerEnergy.com)



#### Blattner Energy

Blattner Energy is an EPC contractor in renewable energy construction with more than a century of large-scale project experience and over 30,000 megawatts of renewable energy installed across North America. Blattner provides EPC services for solar, energy storage, wind, and high voltage transmission and substation projects. Within the solar market, Blattner's services include: project feasibility; engineering and design capabilities; material procurement and management; pre-construction activities; full-service construction; testing and startup; operations and maintenance (O&M); and collaborative construction management. Blattner delivers a construction experience with added value throughout all phases of the project lifecycle.

[www.blattnerenergy.com](http://www.blattnerenergy.com)

# YASKAWA

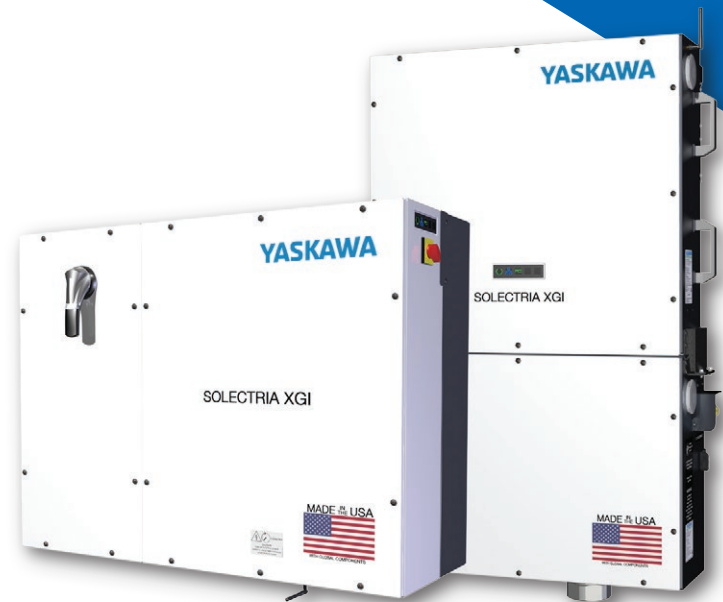
## Introducing Solectria XGI

### The Next Generation of Inverters

Yaskawa Solectria Solar presents the latest innovation in inverter technology with the XGI Inverter Series. The XGI 1000 Commercial String Inverter and XGI 1500 Utility-Scale Inverter set a new standard for quality and reliability in the PV industry. Backed by Yaskawa's quality standards, the XGI Inverters are built to last with each component tested and verified to last well beyond 25 years.

- Made in the USA with global components
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- Lowest O&M cost
- Advanced grid features
- Remote diagnostics and upgrades

**Contact the Yaskawa Solectria Solar team today to learn how the XGI Inverter Series' unrivaled quality can help meet your project needs.**



Yaskawa Solectria Solar | 1-978-683-9700 | [solectria.com](http://solectria.com)

## SOLECTRIA SOLAR





**Fagen, Inc**

Fagen, Inc. is a full service industrial contractor headquartered in Granite Falls, MN. Utilizing a database of over 10,000 direct-hire employees, Fagen, Inc. has constructed a variety of successful projects including solar power, wind power, and other industrial process facilities. The company's standard for quality, safety, and service has led Fagen, Inc. to be consistently listed in the Top 400 in ENR's largest contractors in the United States.

[www.fageninc.com](http://www.fageninc.com)



**Infrastructure & Energy Alternatives, LLC (IEA)**

IEA is an EPC / BOP construction firm building renewable energy projects throughout North America. With over 13,000MW of wind power experience and 677MW of utility scale solar, the renewable team at IEA self-performs on the job, which is the key to their success and client satisfaction. IEA's portfolio of energy infrastructure service companies includes White Construction and IEA Renewable Energy, contractors with more than 100 years of combined experience.

[www.iea.net](http://www.iea.net)



**Quadra Power, Inc.**

Quadra Power Incorporated provides engineering, procurement, and construction (EPC) services to its clients at every level of the industry. QPI is a self-performing EPC contractor and has over 200MW of project development experience across Ontario, Canada, and internationally. Established supply chain partnerships with leading cleantech manufacturers and financiers enable them to provide their clients with upfront, timely, and reliable service.

[www.quadrapower.ca](http://www.quadrapower.ca)



**Rosendin Electric**

Rosendin Electric provides turnkey design-build services covering all aspects of renewable power solutions for utility scale and distributed generation clients throughout North America. Rosendin's experience and capabilities allow them to take on challenging renewable energy and Battery Energy Storage Solution (BESS) projects in various locations and environments ranging from commercial, hospitals, schools, universities, and government facilities, to utility scale solar and wind projects. Single project sizes range from 500kw to more than 600MW utilizing applicable solar PV, wind turbine, and BESS technologies.

[www.rosendin.com](http://www.rosendin.com)



**Signal Energy, LLC**

Signal Energy has more than 8,000MW of utility-scale renewable project experience and 1500MW of solar project experience. Their customers receive the support of Signal Energy's in-house Pre-construction Solutions Group during the pre-construction phase of their project. In addition, Signal Energy's internal mechanical installation resources and high voltage engineering and design capabilities allows them to control and coordinate the critical project components reducing schedule risk for their customers.

[www.signalenergy.com](http://www.signalenergy.com)

**Economic Development**

**Pampa Economic Development Corporation**

The Pampa EDC works to help start-up companies develop, existing companies expand, and recruit new companies to the community. They provide business counseling at no charge. The Pampa EDC Board of Directors will also consider providing low interest loans and forgivable loans. The Pampa Energy Center industrial park, is in a reinvestment zone of almost 4,000 acres. Clean energy is quickly becoming a major player in Pampa and surrounding counties. They invite clean energy related companies to consider locating in Pampa/ Gray County and experience the development of the renewable energy industry.

[www.pampaedc.com](http://www.pampaedc.com)

**Education | Research Development**



**Appalachian Energy Center**

Appalachian Energy Center holds a series of clean energy workshops every year on the campus of Appalachian State University in Boone, NC. The series includes two solar photovoltaic classes and one solar thermal class. Introduction to Photovoltaic System Design and Construction Workshop introduces participants to the fundamentals of solar energy, types of solar energy systems, system sizing principles, and the electrical and mechanical design of photovoltaic arrays. Classes are geared towards existing professionals, and include continuing education credits for architects, engineers, and electricians.

[www.energy.appstate.edu](http://www.energy.appstate.edu)



**Interplay Learning**

Interplay's immersive training program delivers 3D solar training via a Virtual Reality (VR) headset, tablet, or laptop focused on helping employees become better at their jobs. Interplay believes in creating a system of learning to help employees build careers in their company and ensure the company delivers the best possible work for their customers. Interplay's online software platform features 3D simulations, gamification, and a smart system of learning delivered to engage and educate employees. The courses range from Mechanical and Electrical Install, to System Commissioning and O&M. Interplay's training platform also enables manufacturers to deliver VR ready, engaging, simulation-based training on their latest equipment. This scalable learning helps installers deliver quality installs on all types of equipment.

[www.interplaylearning.com](http://www.interplaylearning.com)



**Solar Rollers**

The Solar Roller is a high-tech, customizable solar-powered radio-controlled car. Typically built by high school aged teams, they demand knowledge and hands-on know-how. To make a functional, competitive vehicle, teams design key components such as the chassis and the solar array, plus build the Solar Roller from scratch. Solar Rollers come as a complete materials kit, with all pieces needed to build a basic vehicle. Included is access to the comprehensive online course and registration in one of the regional races. Build as a family, with Girl Scout troops, local high schools, or just for fun. Regional races in Denver, Dallas, San Francisco, and New York.

[www.solarrollers.org](http://www.solarrollers.org)

**Electrical Wire, Cable & Connectors**

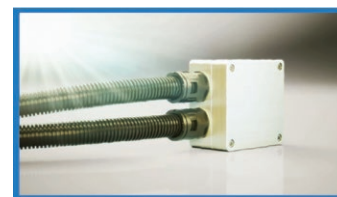


**4SProducts**

With over 42 years of manufacturing experience in the wire and cable industry, 4SProducts produces solar, low, medium, and high voltage power cables, fiber optic cables, copper telecommunication cables, aluminum conductors, and copper wires. Their manufacturing facilities continually develop and deliver a broad range of cables to over 110 countries meeting a wide variety of specifications and industry standards, and they are committed to offering top quality cables for the energy and telecommunication industry.

[www.4sproducts.com](http://www.4sproducts.com)

**AEROSUSA INC.**



**AerosUSA**

AerosUSA offers high UV-stabilized conduits and cable protection systems, rated to last upwards of 40 years in solar applications and outdoor environments. These conduit systems are characterized by their resistance to high-impact forces, along with their ability to protect and secure control cables. These systems are resistant to chemicals, and are free of silicone, cadmium, and halogen. They also have flame-retardant and self-extinguishing properties. AerosUSA's 1-piece integrated IP68/69K fitting system ensures a quick, safe, and reliable installation designed to save time and money, while eliminating potential failures. Accessories include straight, 90, 45, Y, and T's.

[www.aerosusa.com](http://www.aerosusa.com)



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- Return On Investment = 1 Day\*



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### American Wire Group

American Wire Group (AWG) is a global supplier of wire and cable to the solar, wind, and utility industries. Specific to the solar power industry, AWG offers PV, power, control, transmission, and fiber optic cables. Handling large, utility-scale, as well as smaller, residential projects, AWG offers a variety of products to meet wire and cable needs, including the following: 15kV to 35kV TR-XLPE/EPR; ACSR/AAAC/AAC; PV AL cable; bare copper, aluminum, or copper clad steel; static/guy wire; OPGW; and related hardware.

[www.buyawg.com](http://www.buyawg.com)



### Cameron Wire & Cable, Inc.

Cameron Wire & Cable provides UL 4703 PV 1kV/2kV (aluminum and copper) cables and UL 1072 MV cables. Cameron offers affordable pricing and high performance cables for all applications and will customize the cable package, offering cut-to-length or bulk cables, accessories, labels, and lugs supplied in kits. They also offer inventory management, will warehouse planned goods at no charge, and offer same-day shipping to satisfy tight job deadlines.

[www.cameronwire.com](http://www.cameronwire.com)

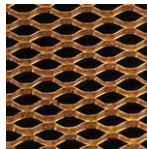
## CTC GLOBAL



### CTC Global

In association with 24 authorized manufacturing partners, CTC Global produces the high-capacity, low-sag ACCC conductor. The ACCC conductor carries twice the current of other bare overhead conductors with 25 to 40% less line losses. The use of ACCC can help reduce upfront capital costs for the tie line and also improve the overall economics of the generation project as reduced line losses translate into more power delivered for any given investment. The ACCC conductor has been deployed to more than 550 projects in 50 countries.

[www.ctcglobal.com](http://www.ctcglobal.com)



### Dexmet Corporation

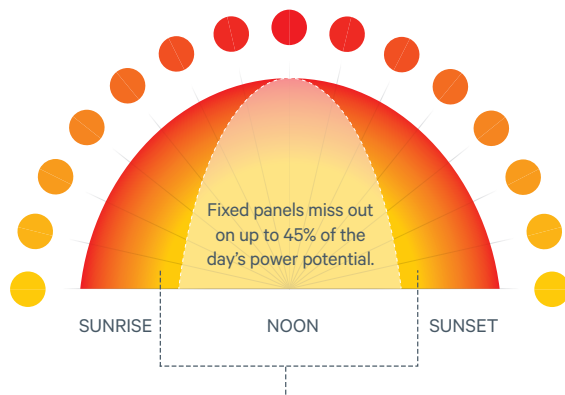
Dexmet provides a range of micro mesh materials, products, and capabilities for foil gauge metals and thin polymer films. Dexmet manufactures thin, light-weight precision expanded copper and aluminum from .001" thick and widths reaching over 48" which can meet specific weight, conductivity, and open area requirements required by aerospace, power storage, or wind generation applications. MicroGrids can be configured to meet the shielding and conductivity needs of power generation applications.

[www.dexmet.com](http://www.dexmet.com)

# Make More Power



*Our dual-axis trackers follow the sun to produce up to 45% more energy than fixed solar. Now the new Gen 4 solar tracker makes it even easier!*



AllEarth Solar Trackers follow the sun's energy-producing rays throughout the entire day.

### Maximized Net Metering

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

### Complete Solution

Pre-engineered, complete system: Tracker now comes complete with panels and an inverter — everything you need to install.

### Improved System Monitoring

Expanded communication options: Tracker is now WiFi, cellular and SD card enabled to check the power generation and mode status with ease - making maintenance a breeze!

### Self Powered Smart Design

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

***Learn more at [allearthrenewables.com/partners](http://allearthrenewables.com/partners)***



AllEarth Solar is a division of AllEarth Renewables, Inc.  
[allearthrenewables.com](http://allearthrenewables.com) | 802.872.9600

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**Electrotech Sales Group, LLC**

Electrotech is offering a DIY wire harness using plug & play technology with the Woertz Flat Cable System. These systems can easily be configured on-site during installation or modified as needed for various industrial uses. The cable profiles ensure proper polarity of connections and changes can be made under power. Systems with higher degrees of protection such as IP68 or FE180 can be especially efficient when used on work sites and other rigging operations for a simple method of bringing power and light to where it is needed.

[www.esgllc-usa.com](http://www.esgllc-usa.com)



**General Cable**

**General Cable**

General Cable is a global wire and cable solutions provider for solar applications from the sun to the outlet. Engineered to withstand the harsh operating environments of solar applications, their full line of SunGen PV copper and aluminum wire is made in accordance with UL 4703 and CSA RPV90/RPVU90, offers superior resistance to UV sunlight, and meets the requirements for direct burial. From low-voltage DC and AC connections and EmPowr Link CL Advantage medium-voltage underground distribution, to high-voltage overhead and underground transmission lines, General Cable has the offering to comprise a complete cable solution for solar power applications.

[www.generalcable.com](http://www.generalcable.com)



**Kris-Tech Wire**

Kri-Tech produces all material at their Rome, NY headquarters where they draw, anneal, and twist copper rod into multiple wire gauges, which are then insulated with various plastic compounds. They serve commercial building, water and gas, solar, and explosives industries, among others. Conductors: AWG and metric, solid or stranded, soft or hard drawn; Metals: copper, aluminum, tinned copper, copper clad steel, and stainless steel. Single or multi-conductor, flat or round, twisted or parallel wire marking; stripping, dying, private label, custom legends; Insulation/jacketing: ECTFE (HALAR), PVDF, HMWPE, PE, PVC, XLP. Manufactured to UL, ASTM, IMSA, CSA, NEMA, NEC, and ICEA standards.

[www.kristechwire.com](http://www.kristechwire.com)



**Nexans AmerCable**

Nexans AmerCable supplies AmerSol dual-certified (UL/ETL) PV cables including: 2000V/1500V, 2000V/1000V, 600V/1000V, Type PV UL4703 2000V, and Type TC Multiconductor 2000V. Applications include connection to module junction boxes and required cable routing in balance of system (BOS) integration. Compatible with all major connectors. Coming in 2018 - the next generation of TUV certified PV cables.

[www.nexansamericable.com](http://www.nexansamericable.com)



**Southwire Company, LLC**

Southwire's Super Sunlight Resistant SSR Type PV cables feature enhanced UV stability, color permanence, and aged physical properties, providing reliable solutions for PV wiring systems. The cable is available in sizes 6 AWG through 1000 kcmil. The product is approved for use in solar power applications per the NEC article 690 and is rated 90°C for exposed or concealed wiring in wet or dry locations. Individual conductors are stranded aluminum alloy covered with a cross-linked polyethylene (XLPE) insulation and is rated for direct burial. The cable is sunlight resistant, RoHS compliant, passes -40°C cold bend, and is VW-1 rated.

[www.powergen.southwire.com](http://www.powergen.southwire.com)

**Enclosures | Combiner Boxes**



**Allied Moulded Products**

Allied Moulded Products offer a full line of NEMA type 4X nonmetallic enclosures made from UV and corrosion resistant materials, both fiberglass reinforced polyester and polycarbonate. They also have enclosure accessory products available for application solutions: back panels, hinge front panels, hole plugs, HMI cover kits, inspection windows, and outdoor pole mount kits.

[www.alliedmoulded.com](http://www.alliedmoulded.com)



**AttaBox Industrial Enclosures**

The AttaBox Heartland (AH) Series are high performance, polycarbonate enclosures applicable for heavy industrial conditions, but with a refined style suitable for commercial, industrial, and OEM design applications. The polycarbonate resin in the Heartland Series attained an F1 rating, having passed critical tests for UV exposure and water immersion. Heartland Series enclosures are rain-tight and watertight rated for use in both interior and exterior applications. Material ratings, as well as product ratings, assure the user that polycarbonate is designed to perform, without adverse affects, in cold weather applications.

[www.attabox.com](http://www.attabox.com)



**Ensto USA LLC**

Ensto's UL-listed 4X, nonmetallic enclosures are designed for harsh outdoor environments and a solution for solar applications. Their new Ensto Polybox is robust, tightly sealed, and made from top quality polycarbonate. A wide range of configurations can be customized with multiple features. The Ensto Clampo Pro 1000 V terminals are suitable for 1000VAC and 1000VDC, aluminum and copper conductors, are compact in size, short circuit tested class A terminals, and have a higher temperature range of 194°F.

[www.ensto.com](http://www.ensto.com)



**Fibox**

Fibox is a global manufacturer of corrosion-resistant polycarbonate enclosures for the electronic and electrical industry. Fibox enclosures are designed not only to protect and insulate components and controls in the harshest of environments, but also to provide a stylish, more robust alternative to metallic and fiberglass enclosures. Fibox polycarbonate enclosures offer a stronger, yet lighter and more flexible solution, which can easily be modified to exact needs and specifications. Fibox can also customize enclosures in advance, providing customers with a ready-to-use product right out of the packaging.

<http://fiboxusa.com>



**SunWize Power & Battery**

SunWize manufactures aluminum enclosures for a wide range of solar and industrial applications. Their NEMA3R enclosures fit a variety of battery sizes and feature white powder coating, mounting for electrical back panels, key lockable doors, and OEM integration with their pre-wired solar control panels. SunWize Power & Battery designs and builds reliable, stand-alone industrial power solutions and electronic assemblies for integration into OEM products and off-grid field applications. Their solar, battery backup, and hybrid power systems are pre-engineered, assembled, tested for easy installation and minimal maintenance, and are reliable in extreme environments.

[www.sunwize.com](http://www.sunwize.com)



**Telergon**

Telergon's UL98B listed S6000R 1500Vdc load break switch is used in string combiner boxes for load-break switching of up to 400 amps. The design of the S6000DC load break switch allows for a smaller footprint in photovoltaic combiner boxes. The elimination of bridging link accessories reduces the total installation space, cost of building the unit, and saves on the amount of required labor.

[www.telergon.es](http://www.telergon.es)

**wöhner®**



**Woehner USA, LLC**

Woehner produces DIN-rail and busbar-mounted fuse holders rated for 1000Vdc PV applications. These fuseholders are targeted at North American solar combiner box manufacturers who build to the UL1741 standard. The products offer a UL4248 marking at 1000 volts DC for 10x38 fuses as large as 30 amps. They are available with or without LED-indicator lamps. The busbar mounted holder clips directly to UL-listed metric dimension busbar, eliminating the need for fabricated comb-style busbars.

[www.woehner.com](http://www.woehner.com)



# wöhner®

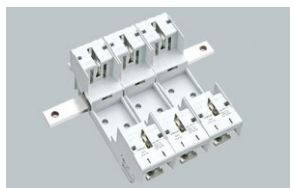


## Woehner USA, LLC

SECUR Panel is for North American solar combiner box and inverter manufacturers who build to the UL1741 standard. The product offers a UL4248-18 listing at 1500 volts DC for 10x85 and 14x85 fuses as large as 30 amps. The 10/14x85 fuse holder is suitable for use with both 1500Vdc rated UL2579 listed PV fuses or IEC60269-2 certified gPV fuses. The SECUR Panel is IP20 touch-safe and provides a safe, tool-free fuse insertion and extraction, for easy fuse installation and replacement. This fuse holder uses an advanced grade plastic material in the fuse carrier to satisfy the higher operating temperatures associated with PV fuses.

[www.woehner.com](http://www.woehner.com)

# wöhner®



## Woehner USA, LLC

QUADRON Panel for photovoltaics is a family of 1500Vdc fuse holders suitable for mounting NH1XL fuses from 50 to 250 amps and NH2XL or NH3L fuses up to 600 amps. Available in bolt-to-bolt configurations, for connecting lugged cables to M10 or M12 bolts on either side of the fuse; or bolt-to-busbar configurations, allowing current to be combined to a metric dimension busbar on the secondary of the fuse, in combiner box and inverter applications.

[www.woehner.com](http://www.woehner.com)

## Energy Storage System



## Atlas ESS

Atlas Energy Storage Systems are inexpensive, high performing lithium ion based systems. All Atlas ESS products have approvals from nationally recognized test labs. Atlas products comply with the new provisions for energy storage systems in the 2017 edition of the National Electric Code (NEC). Professionals and DIYers alike can assemble NEC compliant Energy Storage Systems using Atlas components. Cabinets, BMS, and controls are available separately or in pre-assembled systems.

[www.atlas-ess.com](http://www.atlas-ess.com)



## Bender, Inc.

Designed specifically for large scale ungrounded energy storage and photovoltaic systems, the iso1685P ground fault detector provides early indication of ground faults before leakage current may even be present. The device detects both AC and DC ground faults by monitoring the entire electrical system for ground faults. The iso1685 can connect to systems up to 1000VAC / 1500VDC. Two separately adjustable response values are available. RS-485 communication is integrated for connection to Bender's remote communication system. The iso1685 also supports connecting to Bender's ground fault location system for ungrounded systems.

[www.bender.org](http://www.bender.org)

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6-VOLT AGM BATTERY



2-VOLT AGM BATTERY

# PREMIUM DEEP-CYCLE AGM BATTERIES

[fullriverbattery.com](http://fullriverbattery.com)





### Dynapower

Dynapower offers hybrid, AC-coupled and DC-coupled solutions for utility-scale solar plus storage. Dynapower has introduced the patent-pending DPS-250 and DPS-375 UL-listed 250kW and 375kW DC converters for DC-coupled utility-scale solar plus storage applications. Dynapower also offers the BTM-250, a fully integrated AC-Coupled solution for solar plus storage. The BTM-250 mates Dynapower's UL1741 SA MPS-250kW smart inverter with Samsung batteries in scalable 2, 4, and 6-hour configurations. The BTM-250 features Dynapower's patented Dynamic Transfer technology which monitors the grid and seamlessly transitions from grid-tied to battery backup power in the case of a grid disturbance.

[www.dynapower.com](http://www.dynapower.com)



### ElectrIQ Power

The IQ System is a complete home energy solution which stores energy, automates cost-reduction, provides backup power and insight with access from anywhere in the world. Solar isn't necessary, but, for those who already have solar, this system integrates for easy retrofits, or it can be the complete solution for a brand new solar installation. Just add panels, no other inverters are needed. It's capable of 120/240V Split Phase and 208V 3-Phase for homes and small commercial applications, and is scalable in 10kWh increments.

[www.electriqpower.com](http://www.electriqpower.com)



### Hydrogenics

Hydrogenics provides design, development, and manufacturing for commercial hydrogen generation, energy storage, and fuel cell products. With over 65 years of experience, Hydrogenics provides safe, sustainable, and emission free energy. They help customers shift power by developing the technologies needed to serve the growing industrial and clean energy markets of today and tomorrow. Their solutions are based on two main platforms, fuel cells for power, and electrolysis for hydrogen generation and storage. Their PEM fuel cells apply hydrogen as a power source for everything from heavy duty mobility including buses, trains, planes, and commercial fleets to backup, stationary, and continuous power. They are a supplier of PEM and alkaline electrolyzers for on-site and on-demand renewable hydrogen production, fueling stations, and Power-to-Gas energy storage systems.

[www.hydrogenics.com](http://www.hydrogenics.com)



### Mornsun America, LLC

Mornsun's PV Series power modules (CE approval) offer an ultra-wide input voltage range of 100-1500VDC and a temperature range of -40°F to +70°F, which enables the control systems to get power from the solar panels directly and ensures reliable operation. The modules feature an isolation voltage of 4000VAC, multiple protections such as output over-voltage protection, short circuit protection, and anti-reverse connection protection, which ensures the stability of the circuit. Moreover, this PV series is available in multiple packages; PCB mount, DIN-Rail mount, and Chassis mount.

[www.mornsunamerica.com](http://www.mornsunamerica.com)



### Sentinel Solar

Sentinel Solar's Wave-ESS is a true, all-in-one, plug & play energy storage system that integrates battery and power inverter technology into a single unit. Energy can be stored in the Wave-ESS from solar PV, the grid, or any fuel generated power source, allowing for functionality and application support. The base model provides a 14.8kWhr usable capacity with 4, or 8kW continuous AC output. The modular architecture allows for future expansion by adding battery, or power modules as energy demands change. The Wave-ESS provides the benefits of energy storage with ease of installation and operation.

[www.sentinel-solar.com](http://www.sentinel-solar.com)



### SimpliPhi Power

SimpliPhi Power storage creates energy security with a 98%+ efficiency charge/discharge rate, 10,000+ cycles, and 10-year warranty. Its plug-and-play AccESS system, PHI 2.6 and PHI 3.4kWh batteries scale up to hundreds of kWhs and seamlessly integrate into residential and commercial systems, both on and off grid. They feature a safe, non-toxic, Lithium Ferro Phosphate chemistry with proprietary architecture and power electronics. The operating temperature of the PHI batteries range from -4 to 140 degrees and do not require heat mitigation, nor pose a risk of thermal runaway. SimpliPhi has more than 23.5MW of products deployed around the world, including for the US Army and Marine Corps.

[www.simpliphipower.com](http://www.simpliphipower.com)



### Sinexcel Electric Co., Ltd.

Sinexcel offers their 30kW ETL/CPUC listed storage inverter according to UL1741SA. The PWS2-30K-NA storage inverter has a wide DC range of 250-750V and with its compact size for wall-mount installations, it could be used for various battery types. With different battery vendors and energy storage system integrators, Sinexcel is offering indoor and outdoor applications for commercial and industrial users. The MESA compatible MODBUS protocol is Geli compatible and also offers easy integration with other control systems.

[www.sinexcel.com](http://www.sinexcel.com)



### Socomec, Inc.

Socomec's UL 9540 certified Energy Storage System Architecture, SUNSYS XTEND ESS, includes: SUNSYS PCS2 bidirectional power converters, batteries, AC distribution cabinet, and string battery coupling panel (SBCP). It is a solution for commercial and industrial applications with extendable installation, customer oriented services, and easy management of the components.

[www.socomec.us](http://www.socomec.us)

### Engineering | Operations & Maintenance (O&M)



#### Allied Industrial Marketing, Inc.

Allied Industrial Marketing can analyze power quality problems and perform predictive studies such as power factor and harmonic distortion analysis. They can perform harmonic distortion analysis to the 100th harmonic (and beyond) based on their client's linear and non-linear loads, and make recommendations to help comply with international power quality standards IEEE-519, IEEE-1547, EN 61000-4-7, AS2279, BS G5/4, etc. In many cases, they can diagnose the power quality problem based on a review of a single line diagram, and analysis of collected data combined with the description of the problem, right from their office.

[www.alliedindustrialmarketing.com](http://www.alliedindustrialmarketing.com)

## Our Expertise

Preliminary Design and Engineering	Detailed Design and Engineering	Strategic Procurement Services from Asia	In-house Combiner Box Manufacturing
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## Our Experience

<p><b>INDIA</b> 100 Projects+ across 18 States</p>	<p><b>USA</b> 1 GW+ of designs delivered</p>	<p><b>SOUTH EAST ASIA &amp; AFRICA</b> 100 MW+ of executed /underdevelopment</p>
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Visit Us [www.sunsource-energy.com](http://www.sunsource-energy.com)





### Buffalo Turbine

Buffalo Turbine manufactures a turbine style debris blower for touch-less snow removal from solar panels. Available models include a double stacked hydraulic and a single hydraulic. Both models include standard and high speed options. With a built-in flow and pressure control system, it allows the unit to fit a wide variety of skid steer style vehicles. Also available is a PTO unit, which incorporates a direct drive gearbox in place of belts, pulleys resulting in a light and powerful turbine style blower.

[www.buffaloturbine.com](http://www.buffaloturbine.com)



### EDF Renewable Services

EDF's full range of O&M services begins prior to commissioning and goes through decommissioning. During the warranty period, they provide scheduled and unscheduled maintenance options such as balance-of-plant management, remote monitoring, and OEM oversight. They also provide total project operations and maintenance during the post warranty period. EDF's Asset Administration Services include managing projects and their commercial agreements to optimize returns over a project's lifecycle.

[www.edf-renewable-services.com](http://www.edf-renewable-services.com)

### Evergreen Engineering, Inc.

Evergreen specializes in mechanical, civil/structural, chemical, environmental, and electrical engineering. Their services encompass all project phases from planning through construction, including scheduling, feasibility studies, preliminary engineering, capital estimates, detail engineering, process design, environmental permitting, purchasing, commissioning and start-up assistance, construction, and project management. Their engineers, process specialists, technical designers, and support staff have the experience and creativity to provide their clients with engineering solutions and cost-effective designs for both large and small projects.

[www.evergreenengineering.com](http://www.evergreenengineering.com)



### Exactus Energy

Exactus provides aerial engineering and optimization services for solar projects. Using drone technology, Exactus conducts site surveys, inspections, and assessments for rooftop and ground mount projects. Data from the drone is processed into a 3D model and a full shadow analysis is conducted to produce an optimized panel layout. Exactus provides structural engineering and stamping to ensure a complete permit-ready package. Their services also include topographical surveys, where their drone-based technology, combined with conventional methods produces accurate results safely and efficiently.

[www.exactusenergy.com](http://www.exactusenergy.com)



### Heliolytics

Aerial inspections services from Heliolytics provide actionable information on system quality and performance. Aerial infrared inspections discover hidden system faults over 100% of a PV system, and can completely replace I-V tracing and manual DC inspections in an O&M scope. Heliolytics' clients are able to improve system output by an average of >1%, decrease on-site labor, and increase site safety while detecting serious systemic defects and serial component faults. The output of the inspection service is a digitized site map with the exact location and classification of all site DC faults.

[www.heliolytics.com](http://www.heliolytics.com)



### E8 Energy Group, Inc.

E8 Energy Group develops new sites and engineers, procures, and builds renewable energy projects. They operate in the industries of PV, solar thermal, biomass plants, hydroponics, and green houses.

[www.e8energygroup.com](http://www.e8energygroup.com)

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## Industry's Fastest Just Got *Faster*

Waterproofing | Cost-effective | Single-bolt Installation

L-Mount with  
Elevated Water Seal Technology™  
Works with all leading racks

Quick Mount PV®

[quickmountpv.com](http://quickmountpv.com)

# So you can install solar, *faster.*





**Larson Engineering, Inc.**

Larson Engineering, Inc. is a consulting engineering firm specializing in structural, electrical, mechanical, and civil engineering. Larson is licensed in all 50 states as well as 11 Canadian provinces, and Puerto Rico. They have been working in the solar industry for almost 10 years. Their structural services include roof and ground mounted racking system design, and peer review and analysis of existing structures for new photovoltaic array loads. Their electrical services include panel and inverter selection and layout, and AC/DC system design. Their civil experience includes civil site design for solar farms. They strive to provide a fast turnaround while maintaining quality services.

[www.larsonengr.com](http://www.larsonengr.com)



**Mott MacDonald**

Mott MacDonald has contributed to more than 13GW of solar power generation in over 40 countries, from the Ivanpah power plant in California to the world's largest concentrated solar power facility in South Africa. For more than a century, Mott MacDonald has helped clients meet demand with cost-effective, environmentally responsible solutions. Mott MacDonald's advisors can handle everything from yield assessment to 3D layout and construction monitoring.

[www.mottmac.com](http://www.mottmac.com)

**NORTHWIND**  
A SPARKPOWER COMPANY



**Northwind Solutions Group, Inc.**

Northwind is a progressive, customer-focused service organization delivering asset monitoring, performance analytics, and operations & maintenance (O&M) services to the renewable energy industry. Their mission is to minimize asset down time and maximize the value of renewable energy assets today and for the long term. Established in 2004, Northwind is a Spark Power Company. Founded in 2010, Spark Power is an integrated, end-to-end energy solutions provider, delivering technical innovation, project development, contracting, maintenance, service, and operational support to the ICI, renewable energy, and utility markets.

[www.northwindsolutions.com](http://www.northwindsolutions.com)



**POWER Engineers, Inc.**

From U.S. urban centers to remote African villages, POWER Engineers delivers solar PV systems that meet complex on-the-ground needs across the globe. Their experienced staff provides owner's engineering, environmental, and engineering design services for medium voltage collection systems, site civil, communications, SCADA, substations, and transmission interconnect lines. They perform upfront interconnection support and complete electrical system studies, as well as construction management, inspection services, and testing and commissioning. Their team lays the foundation to help make the most of an investment by designing reliable and cost-effective plant systems which also minimize O&M costs.

[www.powereng.com](http://www.powereng.com)



**Sargent & Lundy LLC**

**Sargent & Lundy, LLC**

Helping clients evaluate and implement solar technologies is an integral part of Sargent & Lundy's leadership mandate. The firm supports developers, owners, investors, contractors, manufacturers, and research organizations with diverse projects. Experience includes: solar resource assessments; owner's engineer; due diligence and conceptual/detailed facility design; as well as grid interconnection for PV, trough, tower, and dish technology. Sargent & Lundy offers complete engineering, project services, and consulting for power generation and transmission projects.

[www.sargentlundy.com](http://www.sargentlundy.com)

**SunSource ENERGY**  
SOLAR FROM THE CORE

Preliminary And Detailed Engineering Design  
With Quick Turnaround Without Affecting Quality  
At Reasonable Cost



**SunSource Energy**

SunSource Energy, a global solar design and engineering firm, provides engineering services from preliminary proposal stage to detailed construction drawings. In the US, SunSource Energy has delivered over 1GW of designs across residential, commercial, industrial, and utility segments. They have also delivered designs with PV + storage or hybrid options.

[www.sunsource-energy.com](http://www.sunsource-energy.com)



**TRC**

TRC works with developers, utilities, and government agencies to provide efficient, cost-effective support for utility and distributed generation-scale solar projects. They offer the expertise and resources necessary to plan, permit, engineer, and support construction with services including: site selection and evaluation; environmental impact and permitting; infrastructure and civil engineering; power delivery engineering and interconnection; procurement and contract management; construction management; and commissioning and testing. They ensure full compliance with federal, state, and local designs, and a seamless transition through all phases of a project, from conception to closeout.

[www.trcsolutions.com](http://www.trcsolutions.com)



**Ulteig Engineers**

Ulteig supports the development, performance, and design of medium to large (10MW and above) grid-connected, solar electric projects. In addition to medium and high voltage collection systems, distribution design, substation, SCADA, transmission, civil, and GIS services, they also specialize in performance evaluation and plant design. Ulteig leverages the latest in research and meteorological resources, as well as proprietary solar instruments, to ensure site-specific precision.

[www.ulteig.com](http://www.ulteig.com)

**Financial Services**



**EnerBank USA**  
America's home improvement lender of choice

**EnerBank USA**

EnerBank USA is a specialized bank providing unsecured home improvement loans through strategic business partners and independent home improvement contractors throughout the U.S. EnerBank works hand-in-hand with manufacturers, distributors, franchisors, and major retailers of home improvement, remodeling, and energy-saving products and services. Its mission is to grow contractors' businesses by increasing sales leads, sales close rates, average job size, and referrals while helping homeowners fulfill their home improvement dreams. Financing residential solar PV projects is a key proficiency. EnerBank also makes receiving approvals and funding quick and easy through its mobile loan app.

[www.enerbank.com](http://www.enerbank.com)

**RODMAN CPAs**  
COLLABORATIVE APPROACH. PRACTICAL ADVICE.



**Rodman CPAs**

Rodman CPAs provides tax advisory, accounting, and business strategy services to small and mid-sized emerging and established businesses. They combine the strategic approach associated with large accounting firms with the personal touch of a smaller CPA firm. Rodman's "Green Team" provides renewable energy producers and businesses pursuing energy efficiency initiatives with expertise in renewable energy tax accounting and business strategy. They specialize in renewable energy, offering tax advisory, financial, and accounting services for companies involved in solar, wind, biomass, waste-to-energy, and energy efficiency projects.

[www.rodmancpa.com](http://www.rodmancpa.com)



## Ground Screws | Anchors

### Almita Piling, Inc.

Almita Piling has been providing the engineering, manufacturing, and installation of helical piles since 1991. Turnkey solutions include engineering design, load testing, and site probing. Almita is a fully certified ISO 9001 Fabricator and all products meet strict fabrication and engineering standards.

[www.almita.com](http://www.almita.com)

 **NORDIC**  
FIBERGLASS, INC.



### Nordic Fiberglass, Inc.

Nordic Fiberglass has been manufacturing products for the underground electrical industry since 1971. Nordic manufactures 35kV 600Amp junction cabinets for solar projects and wind farms. Nordic also manufactures box pads for pad-mount equipment, like single and three phase transformer box pads, and box pads for air and oil-filled switchgear.

[www.nordicfiberglass.com](http://www.nordicfiberglass.com)



### American Earth Anchors

American Earth Anchors introduces the PE46-Hex8 to their line of penetrator earth anchors. The Hex8 has been field tested to 9,000lbs. of downward pressure and up to 14,000lbs. of pullout strength, and was designed to fit a 2" schedule 40 pipe, making it an option for solar panel ground mount racking. The Hex8 can save time and money by replacing concrete footings providing the advantage of no digging, no forms, no pouring, no waiting, and easy leveling by screwing up or down. American Earth Anchors can also make custom brackets for any pipe size.

[www.americanea.com](http://www.americanea.com)

## Handling | Manufacturing



### GfE Metalle und Materialien GmbH / GfE Fremat GmbH

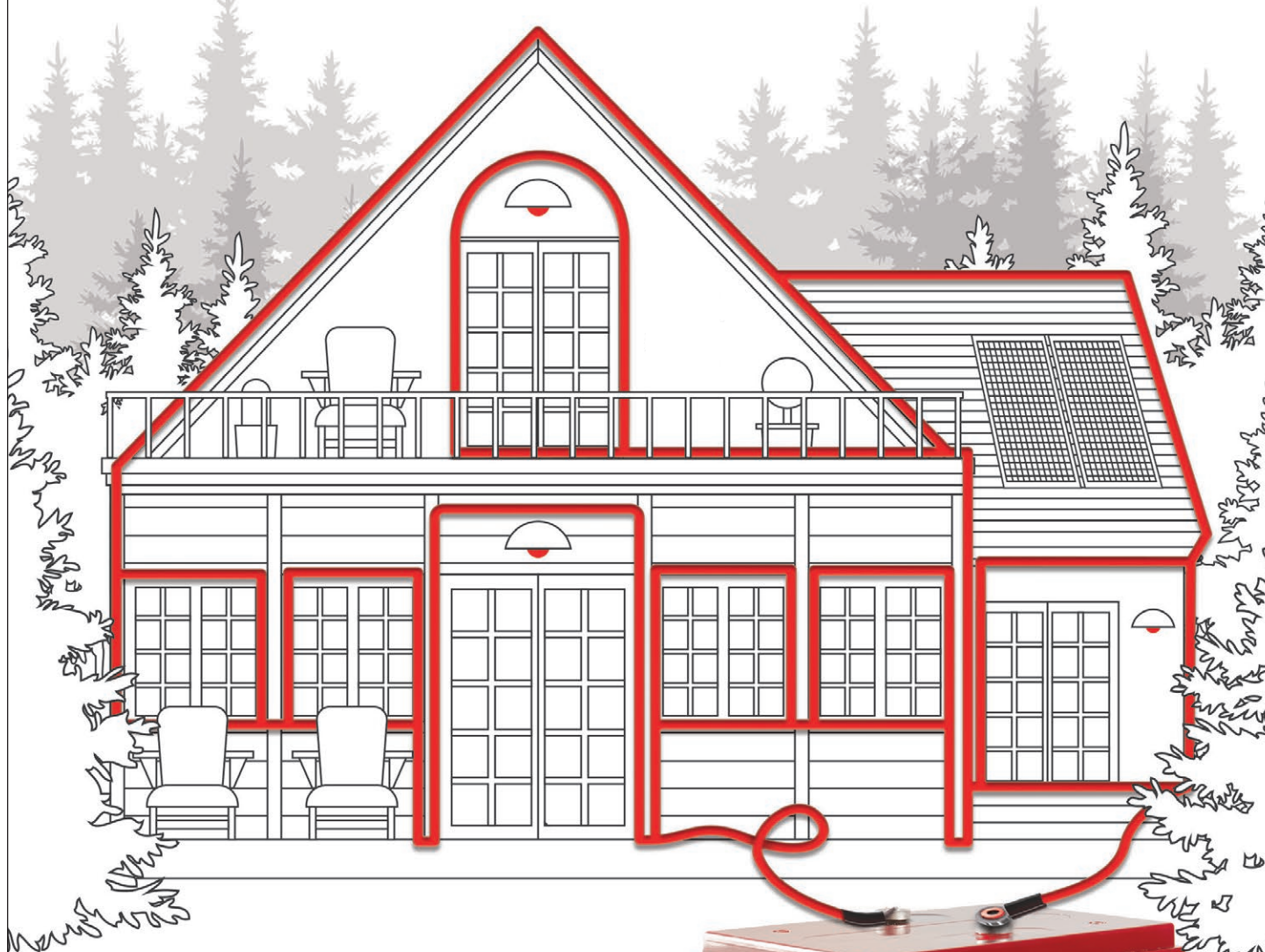
GfE produces and offers a wide range of planar and rotatable sputtering targets for thin film photovoltaics such as CIGS, a-Si, a-Si/ $\mu$ c-Si, CdTe, and Si wafer based cells. Standard materials include ZnO/Al<sub>2</sub>O<sub>3</sub>, i-ZnO, high purity Si, Mo, TiO<sub>x</sub>, and Cr in different qualities as well as numerous other materials as per specific customer requests. GfE's rotatable bonding technology enables them to offer a variety of materials to be bonded stress-free onto stainless steel carrier tubes.

[www.gfe.com](http://www.gfe.com)

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**Insurance Services**



**York Alternative Risk Solutions**

The Renewable Energy Captive is a captive insurance company created to provide a Workers Compensation, General Liability, and Auto Liability insurance alternative for business owners engaged in the renewable energy industry. Captive insurance gives members the ability to turn their insurance premium into a profit center. The members of the captive have successfully created a program where the members take control of their insurance program. By owning their own insurance company, they tailor their risk management to their needs, not an insurance company's needs. Members have the ability to recoup up to 60% of their paid in premium, based on their company's loss experience.

[www.renewableenergycaptive.com](http://www.renewableenergycaptive.com)

**Inverters**



**Analytic Systems**

Analytic Systems provides Pure Sine Wave Inverters from 300 to 3600W for indoor or exposed locations. Their inverters are digitally controlled transformer based designs for low emi and high reliability. Analytic Systems offers 100A solar charge controllers for arrays up to 230V, and open circuit and battery banks of 24, 48 or 96VDC.

[www.analyticsystems.com](http://www.analyticsystems.com)

**COTEK**



**COTEK The Americas**

COTEK offers five unique series of pure, sine-wave inverters and inverter chargers for off-grid and backup applications. Each series delivers features to satisfy the needs of the solar power market. COTEK inverters models range from 150W-4000W, with a DC input of 12V, 24V, or 48V. The new SD series, is available in 2500W and 3500W models, with full parallel function and redundant capabilities up to 14 units. Also new is the SP series. SP models range from 700W-4000W. Both series are UL safety approved, and include advanced features unavailable on existing product lines.

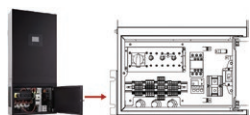
[www.cotek.ca](http://www.cotek.ca)



**CyboEnergy**

The On/Off-Grid CyboInverter has an on-grid AC output port and an off-grid AC output port. Each inverter has 4 input channels that can connect to solar, wind, or batteries and produce 1150W AC power. Each input channel has its own MPPT to eliminate partial shading issues. It can work in either on-grid or off-grid mode, and switch between the two modes automatically depending on the grid condition. The system can generate power to the grid when the grid is on and can provide backup power when the grid is down. The product is patented, UL1741 certified, NEMA 6 (IP67) rated, and made in the USA.

[www.cyboenergy.com](http://www.cyboenergy.com)



**Darfon America Corp.**

Darfon's H5001 hybrid inverter was designed to make things easier for installers and cut installation time. The H5001 includes built-in charge controllers, PV combiner boxes, distribution box for breakers, disconnect switches, to land PV wires, and generator support circuitry, which eliminates much of the labor and cost. The H5001 was intended for energy storage solutions, but it can also be installed as a string inverter in PV systems that don't need immediate battery storage. The H5001 supports a wide range of applications, including off-grid, self-use, net-metering, backup, and time-of-use.

[www.darfonsolar.com](http://www.darfonsolar.com)



**Delta Products Corporation**

The M80U is a grid-tied, 3-phase transformerless inverter for commercial applications. A two-stage design allows a wide input operation range spanning from 200 to 1000VDC. The M80U provides a peak efficiency of 98.8% and a California Energy Commission efficiency of 98.5%. The device's all-in-one design integrates up to 18 strings with fuse protection as well as arc fault detection circuits. It employs a NEMA 4X Enclosure to protect personnel and operate under extreme environmental conditions. The M80U is equipped with two MPP trackers. Ergonomic handles and eye bolt locations make installation easy.

[www.delta-americas.com](http://www.delta-americas.com)



**Dynapower**

Dynapower offers hybrid, AC-coupled and DC-coupled solutions for utility-scale solar plus storage. Dynapower has introduced the patent-pending DPS-250 and DPS-375 UL-listed 250kW and 375kW DC converters for DC-coupled utility-scale solar plus storage applications. Dynapower also offers the BTM-250, a fully integrated AC-Coupled solution for solar plus storage. The BTM-250 mates Dynapower's UL1741 SA MPS-250kW smart inverter with Samsung batteries in scalable 2, 4, and 6-hour configurations. The BTM-250 features Dynapower's patented Dynamic Transfer technology which monitors the grid and seamlessly transitions from grid-tied to battery backup power in the case of a grid disturbance.

[www.dynapower.com](http://www.dynapower.com)



**Fronius USA**

The Fronius SnapINverter line offers integrated Wi-Fi and SunSpec Modbus interfaces, NEMA 4X rating, wide voltage windows, multiple MPP trackers, and easy installation in 15 minutes or less. With the identical look and feel, the Fronius SnapINverters reduce cost for training and servicing. Power classes range from 1.5 to 24.0kW. In addition, Fronius offers the Fronius Rapid Shutdown Box, which provides an NEC 2014 and 2017 (array shutdown) compliant solution while enhancing rooftop and firefighter safety. For online monitoring, the Fronius Solar web portal provides a complete set of tools beyond basic monitoring.

[www.fronius-usa.com](http://www.fronius-usa.com)



**Huawei Technologies USA, Inc.**

Huawei Smart PV Solution's latest utility scale solar inverter, the SUN2000-95KTL, is a 95kVA, 1500 VDC string inverter. The smart grid string inverter offers a high power-to-weight ratio for ease of install. The 95KTL produces an 800 VAC output with six MPPTs. The 95KTL will result in a high energy harvest for plant owners, and offers layout versatility. The 95KTL unit builds on the reliable Huawei string inverters which capture the benefits of simple installation and reduced O&M costs, with its fanless and fuse free design.

[solar.huawei.com](http://solar.huawei.com)



**Ingeteam**

Ingeteam's IS PowerStation U 1500Vdc (610-7200 kVA) has been specially developed for the North American market. Featuring one, two, three, or four UL1741-compliant outdoor central PV inverters from the INGECON SUN PowerMax product range, this flexible solution can be configured to suit each customer's requirements. All the equipment is suitable for outdoor installation, eliminating the need for any kind of housing. With a pad-mounted MV transformer which integrates the oil deposit and MV switchgear, the PowerStation not only provides a versatile solution, but also a power density of 5.2 W/in<sup>3</sup>.

[www.ingeteam.com](http://www.ingeteam.com)



**Magnum Energy, a product brand of Sensata Technologies**

Magnum Energy Storm Kits from Sensata Technologies provide everything but the subpanel and batteries to add battery backup, ensuring a home has power during storm season, while providing options including: battery choice, a lightweight, easy install design, maximum energy harvest, and indoor or outdoor installation options. Storm Kits come in 4000 or 4400 watt AC output and 24 or 48VDC battery input, and is easy to maintain. For larger systems, Magnum Panels provide up to 17.6kW of AC output power.

[www.sensatapower.com](http://www.sensatapower.com)





### Power Electronics

HEM Series Power Station is the latest addition to Power Electronics inverter family. Available in Q1-2018, HEM combines advantages of both String and Central inverter topologies, while providing a complete Power Conversion Station including internally connected inverter, MV transformer, MV switchgear, and aux. power in a single cabinet. HEM is UL1741SA certified and designed to meet NEC 2017 requirements. 3.3MW HEM platform is built on field replaceable 6 power modules based on V1500 design. Unique filterless forced air cooled design with dry type transformer provides savings in O&M cost, while rated output at medium voltage provides protection and reduced system cost.

[www.power-electronics.com](http://www.power-electronics.com)



### Rhombus Energy Solutions

Rhombus DC-Series, Multi-Port, Bi-Directional Universal Power Converter (UPC) is a one-size-does-more concept, and the latest addition to their Power Conversion System products. The UL Approved DC-Series provides reliability and flexibility with two power stages that can be configured in multiple ways and an integrated transformer lowers installation costs while providing grid isolation. The DC-Series includes a user interface software test suite for battery development and validation, while the compact footprint provides easy single point DC and AC installation.

[www.rhombusenergy.com](http://www.rhombusenergy.com)



### Schneider Electric Solar

The intelligent, reliable cloud-connected inverter for utility-scale renewable power, The Conext SmartGen, is a 1500V cloud-connected power conversion platform for utility-scale renewable power and energy storage with high reliability, low total cost of ownership and a fast return on investment. The integrated solution features built-in sensors and intelligence for connectivity to the entire plant, and optional monitoring and control using Schneider Electric's SCADA system, Conext Advisor 2. The Conext SmartGen inverter meets North American (UL) and International (IEC) safety and EMC standards.

[www.sesolar.com](http://www.sesolar.com)



### SMA America

Now available with the Sunny Boy-US residential line of inverters, SMA Smart Connected is a proactive service package integrated into Sunny Portal, a PV monitoring database, that automatically detects and evaluates system events and initiates remediation or repair activities. This solution decreases truck rolls, lengthy service calls, and system downtime, saving installers time and money and maximizing homeowner power production. SMA Smart Connected is activated via Sunny Portal. Once operating, SMA Smart Connected monitors a residential system and initiates the repair and replacement process in the rare event that an inverter needs to be replaced.

[www.sma-america.com](http://www.sma-america.com)

/ Perfect Welding / Solar Energy / Perfect Charging



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## A NEW GENERATION OF SOLAR SYSTEMS THE FRONIUS SMART SOLUTION

### COMMERCIAL AND RESIDENTIAL SNAPINVERTERS AVAILABLE FROM 1.5 - 24.0 KW

- / Experience high quality power conversion from a privately owned, bankable technology leader.
- / Fully integrated features include Wi-Fi, SunSpec Modbus, free lifetime monitoring, AFCI, and DC disconnect.
- / Maximize system design and flexibility with dual MPPT, streamlined technology and multiple grid connections.
- / The only truly field serviceable option for long-term sustainability and security.
- / Conveniently installed in under 15 minutes on a pole, rooftop, or ground mount.
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**SolarEdge**

SolarEdge provides an intelligent inverter solution that changes the way power is harvested and managed in solar photovoltaic systems. The SolarEdge DC optimized inverter system maximizes power generation at the individual PV module-level while lowering the cost of energy produced by the solar PV system. Supporting increased PV proliferation, the SolarEdge system consists of power optimizers, inverters, smart energy management, and a cloud-based monitoring platform. SolarEdge's solutions address a broad range of solar market segments, from residential solar installations to commercial and small utility-scale solar installations.

[www.solaredge.com](http://www.solaredge.com)



**Steca Elektronik GmbH**

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

[www.steca.com](http://www.steca.com)

**TMEiC**



**TMEiC Corporation**

TMEiC's Solar Ware Samurai series of photovoltaic inverters are UL1741 certified. The Samurai is available in multiple power classes, 833kW to 1833kW (1000V), 2500kW to 3200kW (1500V). TMEiC's power plant controller provides overall coordination and control of utility-scale PV plants, providing access to compete information about an entire plant's power production.

[www.tmeic.com](http://www.tmeic.com)

**YASKAWA SOLECTRIA SOLAR**



**Yaskawa Solectria Solar**

Yaskawa Solectria Solar, a wholly-owned subsidiary of Yaskawa America, Inc., offers a wide range of inverters, string combiners, and web-based monitoring solutions for commercial and utility-scale PV systems. Solectria's commercial product offering includes two lines of 3-Ph transformerless string inverters: PVI 14-60TL and the XGI 1000-60/65. For utility-scale applications, Solectria's products include central inverters, the SGI 500/750XTM, and string inverters, the XGI 1500-125/166. Solectria's suite of string combiners includes the RSDCOM (commercial rapid shutdown box), ARCCOM, DISCOM, and the DISCOM 1500 for 1500V applications. All of these inverter solutions can be coupled with SolrenView, Solectria's in-house monitoring system.

[www.solectria.com](http://www.solectria.com)

**Legal Services**



**McCauley Lyman, LLC**

McCauley Lyman advises people about energy law and represents them in business-related transactions. They help negotiate contracts, arrange financings, buy and sell energy-related businesses and their assets, as well as resolving disputes. They have particular expertise in the energy industry, including energy regulatory agencies, and have done a great deal of work with energy project financing. They understand the need for timeliness, cost control, and practicality. McCauley Lyman is in a strategic alliance with Barclay Damon, LLP, a National Law Journal Top 250 Firm, which provides their clients with access to Barclay Damon's 33 practice areas.

[www.mccauleylyman.com](http://www.mccauleylyman.com)

**Lightning & Surge Protection**

**Raycap**



**Raycap, Inc.**

Raycap provides lightning and power surge protection products specifically developed for photovoltaic (PV) power systems and other DC applications with operating voltages up to 1500VDC. Raycap's surge protection devices can reduce repair expenses and eliminate downtime and revenue loss resulting from electrical emergencies. Raycap's power protection solutions are compliant to the EN50539-11, IEC 61643-11, and UL 1449 4th edition standards.

[www.raycap.com](http://www.raycap.com)



**SAE Inc.**

SAE is a design and build engineering firm specializing in Cathodic Protection, AC Mitigation, and Electrical Grounding. SAE manufactures the patented EnvirAnode CP System, approved for use in deep anode beds by environmental regulatory agencies and a variety of specialty products such as Conducrete (conductive concrete) and ConduFlow (a solidifying conductive liquid backfill). SAE's innovative products are currently used to prevent the theft and corrosion of buried metallic electrodes.

[www.saeinc.com](http://www.saeinc.com)

**Microinverters**



**APsystems**

The all new APsystems YC600 is a dual-module solar microinverter, providing up to 300W per channel and is Rule 21 certified for California. It accommodates 60 and 72-cell PV modules from 200W-365W+, compliance with NEC 690.12 Rapid Shutdown, and offers a wide MPPT voltage range for a greater energy harvest.

[www.usa.apsystems.com](http://www.usa.apsystems.com)



**Enphase Energy**

The high-powered, smart grid-ready Enphase IQ 6 Micro and Enphase IQ 6+ Micro dramatically simplifies the installation process while achieving high efficiency for module-level power electronics. Part of the Enphase IQ System, the IQ 6 and IQ 6+ Micro integrate seamlessly with the Enphase IQ Envoy, Enphase Q Aggregator, Enphase IQ Battery, and the Enphase Enlighten monitoring and analysis software. The IQ 6 and IQ 6+ Micro extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide a warranty of up to 25 years.

[www.enphase.com](http://www.enphase.com)

**Modules**



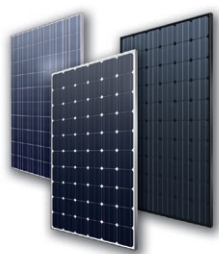
**Aplus Energy Co., Ltd.**

Aplus Energy is a solar module manufacturer with a factory located in Taiwan. They produce a patented BIPV product which is solar corrugate steel panel suitable for carport and other installations. Their products are UL1703, IEC61215 and IEC61730 certified.

[www.apluspvt.com](http://www.apluspvt.com)

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The best screw you will have in the dirt™  
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Field-tested to 9,000 lbs downward pressure  
**REPLACES CONCRETE FOOTINGS**  
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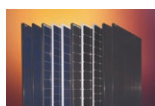
[www.axitecsolar.us](http://www.axitecsolar.us)

**AXITEC**<sup>®</sup>  
high quality german solar brand

**Axitec, LLC**

Axitec's product line includes 60- and 72-cell modules to benefit any size installation. Poly- and monocrystalline modules are available with black and silver frame for implementation on residential or commercial solar applications.

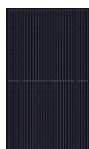
[www.axitecsolar.us](http://www.axitecsolar.us)



**Boviet Solar USA**

Boviet Solar USA's polycrystalline and monocrystalline solar modules are available in 60-cell and 72-cell, positive power tolerance of 5W, 5400 Pa snow load, and 2400 Pa wind load. They are internationally tested and certified; Type 1 rating per UL 1703, high salt and ammonia resistance certified, and come with a 12-year product warranty and a 25-year linear power performance warranty.

[www.bovietsolarusa.com](http://www.bovietsolarusa.com)

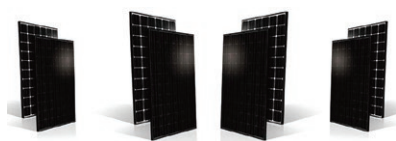


**Canadian Solar, Inc.**

Canadian Solar's new dual-cell KuBlack CS3K-MS High Efficiency Mono-PERC modules feature low internal current for low module operating temperature, high reliability, and more power output. Their all black module provides improved aesthetics on residential rooftops and offers high power classes for equivalent module sizes and improved shading tolerance.

[www.canadiansolar.com](http://www.canadiansolar.com)

**CertainTeed**  
SAINT-GOBAIN



**CertainTeed**

CertainTeed Solar's US Series Solar Modules are available in 60 and 72-cell configurations, with maximum outputs of 305W and 365W, respectively. All US Series modules are American-made using domestic and foreign components, and are efficient solar modules manufactured in the United States. The modules are available individually or as part of CertainTeed's Solstice system, which includes the full balance of system components needed for rooftop installation.

[www.certainteeted.com](http://www.certainteeted.com)

**wiley**



**Wiley ACC Cable Clips are a high-quality wire management solution**

# Clipping Right Along

Long-lasting, Customizable Wire Management Clips

Wiley Cable Clips simplify wire management and create a cleaner look to solar PV arrays. Able to last a lifetime, the corrosion resistant 304 stainless steel clips are a durable solution for all environments. Coined edges prevent damage to cable insulation. The design is easy to install and no tools are required. Clips can be used in a wide variety of mounting configurations (including 90-degree) for module and rail applications. Custom designs are available upon request.

 **BURNDY**

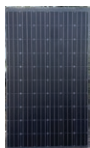
**Connecting Power to Your World**



[www.burndy.com](http://www.burndy.com)

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### Giga Solar

Giga Solar modules provide the benefits of high-performance c-Si modules, but weigh less than 35% of a same size standard glass module. Because the modules are glass-free and frameless, they are not subject to breakage and do not corrode or suffer PID. The all-polymeric construction eliminates the need for grounding, making installations faster and operation safer. The thick composite back support provides environmental protection for the cells and offers many mounting options. The modules are available with mono or poly c-Si cells. Standard powers are from 140Wp to over 500Wp. Application specific cell configurations (e.g. 12V or 24V systems) are available upon request.

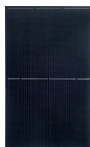
[www.gigasolarpv.com](http://www.gigasolarpv.com)



### Global Solar Energy

PowerFLEX™ CIGS (Copper Indium Gallium DiSelenide) flexible thin film Building Applied Photovoltaic (BAPV) modules range from 90 to 300W dc, and can make installation quick, easy, and less costly for commercial and industrial rooftops. No racking system is required when bonding these modules with a simple peel and stick process to clean TPO and EPDM membranes, coated steels (such as standing seam metal roof), and elastomeric-coated modified bitumen. This installation process provides high wind resistance and no penetrations for roofs with at least a two degree slope, curved roofs, and roofs which can only handle a light load.

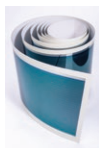
[www.globalsolar.com](http://www.globalsolar.com)



### Hanwha Q CELLS

The new Q.PEAK DUO BLK-G5 from Q CELLS has an aesthetic visual appearance and provides high performance on a small surface due to its Q.ANTUM DUO technology. Q.ANTUM's cell concept has been combined with circuitry half cells and a six busbar design, providing high performance under real conditions, with low-intensity solar radiation, as well as on hot, clear summer days. With power classes up to 320W on an all-black design, it is a solution for residential rooftops. Hanwha Q CELLS also provides a 98% power guarantee during the first year, and less than 0.54% annual degradation afterwards, with a 25-year degradation of lower than 15%.

[www.q-cells.com/us](http://www.q-cells.com/us)



### Heliatek GmbH

HeliaFilm, the lightweight, flexible solar film invented by Heliatek, generates electricity and weighs only 1 kg/m<sup>2</sup>. Heliatek's solar films can be directly applied to facades or roofs, or integrated into building materials, while no extra cooling or ventilation system is needed. The flexible, thin, and lightweight solar films are a solution for large area building elements such as steel-sandwich-panels, corrugated metal sheets, pre-casted concrete panels, roof membranes, and many others. There are no toxic materials in the clean production process nor in the end-product.

[www.heliatek.com](http://www.heliatek.com)



### Itek Energy

The Itek Energy Smart Module integrates high-quality PV module craftsmanship with the Tigo TS4 platform, offering flexibility and value. The Smart Module's integrated J-Box covers enable plug-and-play installation, so a site can be easily enhanced without added rooftop devices and electronics. Safety, monitoring, optimization, and long string functionality maximize energy harvest and increase potential site usage, reduce truck-rolls with remote monitoring, and offer NEC-compliant Rapid Shut Down for peace of mind. Itek's modules are certified PID-free, and incorporate high-power-density five-busbar PERC Monocrystalline cells. Available in 60 and 72 cell.

[www.itekenergy.com](http://www.itekenergy.com)



### Lumeta Solar

Lumeta Solar's modules are attached with adhesive, substantially reducing installation time, eliminating roof penetrations, and offering competitive economics. With low weight and no need for racking, there's less risk to the roof, fewer parts, and simplified logistics. Their low-profile, high-efficiency monocrystalline silicon modules streamline solar without compromising power output. Lumeta Lynx comes in a 60-cell 300W format for composite shingle and flat or curved concrete tiles, and a 72-cell 360W format for most low-slope or flat roof surfaces. An integrated wire-management system improves aesthetics and ensures a simple installation process.

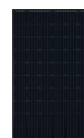
[www.lumetasolar.com](http://www.lumetasolar.com)



### PowerFilm Solar

PowerFilm specializes in custom solar solutions meeting design, power-output, and timeline needs of customers. Controlling each step in engineering, design, and production, PowerFilm delivers high quality and performing systems. Their amorphous silicon functions at low light levels making it a solution for IoT, indoor, and many outdoor applications. Modules have been used for a wide range of applications including solar tents for the Army, powering electronics on a space exploration vehicle, and custom asset tracking solutions. PowerFilm has been developing and manufacturing its flexible solar technology for nearly three decades in the United States.

[www.powerfilmsolar.com](http://www.powerfilmsolar.com)



### Seraphim Solar USA Manufacturing

Seraphim USA recently introduced new product innovations, including an attractive black-on-black module for residential and small commercial customers. The modules feature use of four-busbar, Passivated-emitter rear contact (PERC) cell-based modules. PERC modules are produced in 60- and 72-cell formats for residential, commercial, industrial, government, and military customers in the United States.

[www.seraphimusa.com](http://www.seraphimusa.com)

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### Solaria Corporation

Solaria PowerXT module is an advanced high performance module. Aesthetic, all-black PowerXT modules offer 20% greater efficiency to maximize power. Proprietary, patented cell-cutting process and module assembly technology eliminates inactive space between cells, reducing power losses and enhancing module aesthetics. A highly-rated module, sleek PowerXT is optimized for residential and commercial sectors. Manufactured efficiently and cost-effectively, Solaria's PowerXT maximizes energy yield from rooftop deployments and ensures low costs.

[www.solaria.com](http://www.solaria.com)





## SUNTEGRA®

### SunTegra

SunTegra's solar roof systems integrate solar with any new roof or reroof project. They offer homeowners a low-profile, roof-like appearance, and replace roofing materials, enabling added savings. A SunTegra Shingle or Tile solar roof system is a solution for builders, roofers and, solar integrators. SunTegra products are designed with proven materials, are easy to install, and feature a patented design which promotes cooling through ventilation.

[www.suntegrasolar.com](http://www.suntegrasolar.com)



### Yingli Green Energy Holding Co., Ltd

Yingli's solar panel manufacturing process utilizes high quality materials, sourced through their global supply chains, to ensure their solar panels will generate long lasting value. Yingli Solar has delivered more than 18GW of solar panels for homes, businesses, and power plants around the world. As the foundation of any successful solar project, Yingli's solar panels perform in diverse climates and environments. They provide solar panels in a range of formats and efficiencies to meet the needs of their customers, for projects ranging from residential rooftops or in sun-soaked deserts.

[www.yinglisolar.com](http://www.yinglisolar.com)

### Performance Monitoring



### Apogee Instruments

Apogee Instruments introduces the new PV monitoring package designed to work with an SMA cluster controller. The package includes a silicon-cell pyranometer with a mounting bracket, Class A PRT back-of-panel temperature sensor with Kapton tape, fan-aspirated solar radiation shield with 24 V-12 V DC converter, and Class A PRT air temperature sensor with TS-100 port adapter.

[www.apogeeinstruments.com](http://www.apogeeinstruments.com)



### Campbell Scientific, Inc.

Campbell Scientific's CR-PVS1 Soiling Index RTU provides solar-energy professionals who are responsible for managing the performance of a PV power plant with the information needed to evaluate and manage the impact of soiling. Soiling loss indices are calculated using industry standard methodologies. Raw data is stored and available for additional post-processing. The CR-PVS1 can be the heart of an independent soiling measurement station or included as an add-on peripheral to any MET station.

[www.campbellsci.com](http://www.campbellsci.com)

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25 YEAR WARRANTY



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**CAS DataLoggers**

CAS DataLoggers provides data loggers and data acquisition equipment for all aspects of solar performance monitoring including solar intensity, DC voltage and current, AC voltage and current, temperature, and much more. They offer stand-alone, wireless, and remote monitoring systems.

[www.dataloggerinc.com](http://www.dataloggerinc.com)



**Draker**

Draker V7 Software provides a customizable, mobile-optimized energy asset management platform through monitoring and data analytics, supported by customer service experts. With instantaneous reports tailored to specific data points, users can compare performance models with real-time site health to ensure hardware is running as expected. Remote on/off control capabilities help resolve problems once the platform detects priority concerns through site-specific hierarchical alarm systems. Other diagnostic features which reduce LCOE and system downtime include inverter heat mapping and live visualizations of portfolio-wide weather conditions.

[www.drakerenergy.com](http://www.drakerenergy.com)



**eGauge Systems**

The eGauge Core is a 15 channel energy meter with 0.5% revenue grade accuracy compliance and the ability to measure residential or commercial circuit panels, up to 3-phase 277/480VAC and 6900A. The meter has HomePlug AV powerline communication, an Ethernet port, and 2 USB ports for additional communication options, like WiFi and cellular. Users can access energy data using the free user interface, or with other systems using a published XML API, Modbus, or BACnet IP. The embedded web server allows users to connect to the interface over the internet or on a local area network. Each meter has a data logger that stores up to 64 data points for the lifetime of the hardware.

[www.egaugenet.com](http://www.egaugenet.com)



**Continental Control Systems, LLC**

Continental Control Systems provides economical and high accuracy measurement of electrical production and consumption, and has designed a new meter module for mass production, customizable for OEM metering design-in. The WattNode Meter Module is a bidirectional networked energy meter offering energy measurement parameters such as energy (kWh), power (kW), voltage, current, demand, kVAR, kVARh, power factor, frequency, etc. These energy values are communicated using the Modbus RTU communication protocol over RS-485. Revenue-grade accuracy is obtainable using the CCS Accu-CT family of current transformers, (Class 0.6 or Class 0.3 accuracy), otherwise the meter module utilizes any externally mounted or PCB mounted 0.333 Vac current transformers. Available as single and three phase modules, the meter is externally (instrument) powered from 12 to 24 Vac or 6 to 24 Vdc.

[www.ccontrols.com](http://www.ccontrols.com)

**EKO**



**EKO Instruments**

EKO Instruments introduces the MS-80 Secondary Standard Pyranometer. The MS-80 begins a new generation of pyranometer technology while remaining cost-effective for all applications. Major performance gains have occurred in response time (<1 sec) and reduction in zero-offset A. Users will also benefit from reduced maintenance costs by not needing to recalibrate or exchange desiccant for many years. Every MS-80 comes standard with an industry exclusive ISO 17025 calibration. The affordable MS-80 provides the lowest field measurement uncertainty.

[www.eko-usa.com](http://www.eko-usa.com)



**HuksefluxUSA**

**HuksefluxUSA, Inc.**

The new digital SR30 Secondary Standard pyranometer features an internal maintenance-free heated ventilation system. The circulation of heated air flow between the inner and outer domes suppresses the formation of dew and frost on the pyranometer optic. With < 2.1 Watts max power consumption, SR30 delivers a high level of performance and data availability. Critical sensor data, including irradiance, sensor serial number, and calibration data, are all available via RS485 RTU / Modbus connection. The sealed desiccant cartridge free design with internal ventilation translates into reduced sensor maintenance and cost of ownership.

[www.huksefluxusa.com](http://www.huksefluxusa.com)



**Kipp & Zonen**

Kipp & Zonen provides a wide range of products to measure and monitor solar radiation. An ISO certified company with more than 85 years of experience and expertise in solar radiation measurement equipment, Kipp & Zonen offers solar radiation sensors with an MTBF of greater than 10 years. ISO 9060:1990 - Secondary Standard, First, and Second class Pyranometers available for every application and come standard with a 5-year warranty. Kipp & Zonen also offers technical services which include calibrations, installation, and training.

[www.kippzonen.com](http://www.kippzonen.com)



**meteocontrol North America**

meteocontrol's new VCOM O&M app is available from the Google Play and Apple Stores. Whether on-site or on the move, their new app for the VCOM Solar Monitoring Platform helps users save time and money. With the app, it's possible to view and edit maintenance tickets offline, easily and fully document service calls by uploading comments and images, and always have access to important system data including site locations and contact details. Staff in the control room are automatically updated with the latest information entered in the field. The app is smartphone and tablet compatible. Use VCOM with the maintenance ticketing option to activate this powerful mobile tool.

[www.meteocontrol.com](http://www.meteocontrol.com)

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### Smappee

The Smappee Plus smart solar energy monitor measures real-time energy consumption and production down to the individual consumption of appliances. Through its unique Energy Traffic Controller function, it can direct surplus power to more intensive appliances in the user's order of preference. The product can be easily fitted into any home, with or without solar, and through remote monitoring turns any house into a smart home, bringing energy costs savings of up to 30%. Smappee Plus is the first energy monitor to adopt the virtual currency SolarCoin, enabling homes to become decentralized energy hubs that can produce, sell, and buy renewable energy among themselves.

[www.smappee.com/us](http://www.smappee.com/us)



### Solar Data Systems, Inc.

The Solar-Log 370 is a powerful residential revenue grade metering solution with inverter direct monitoring. Multiple connection options provide a flexible way to connect to PV equipment on-site including consumption meters and weather sensors. It supports power management functions like zero grid feed-in, feed-in capping, or remote disconnect. The Solar-Log 370 has integrated cellular communication and includes a 5-year cellular data plan, a 5-year Solar-Log WEB Enerest subscription, and a 5-year warranty.

[www.solar-log-america.com](http://www.solar-log-america.com)



### Trimark Associates, Inc.

Trimark develops, installs, and maintains turnkey solutions for utility-scale power sites. These systems measure, control and manage power production, energy storage, and utility interconnections. Trimark's integrated products: T1-S SCADA, revenue meters, data gateways, MET stations, CAISO NRI and NERC CIP consulting, battery energy storage, and microgrid management systems, optimize site performance resulting in increased revenue. T1-S SCADA's unique, advanced control and monitoring functions guarantee power characteristics at POI and regulate power production with Trimark's automated ISO directives. T1-S Vantage HMI provides real-time monitoring and control of devices at multiple sites.

[www.trimarkassoc.com](http://www.trimarkassoc.com)

## Position Sensors

### POSITAL FRABA



#### POSITAL-FRABA

POSITAL is an international supplier of position sensors with applications in the solar energy industry. The company's rugged and reliable TILTIX inclinometers and IXARC rotary encoders are a solution for monitoring and controlling the position of solar power systems, including photovoltaic arrays and concentrated solar power (CSP) systems based on parabolic trough collectors or tower/heliostat arrangements. POSITAL position sensors are designed for harsh conditions and are available with environmental protection up to IP69K. Communications interface options include analog, SSI, CANopen, Modbus, and Industrial Ethernet. With a wide variety of mechanical configurations and interface options available, POSITAL sensors are a good fit for projects of any size or budget.

[www.posita.com](http://www.posita.com)



## Calibrating to a higher standard

### Solar Radiometer Calibration Services

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

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

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- ✔ Net Radiometers
- ✔ Pyr heliometers
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- ✔ Spectroradiometers



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### SR30 | Digital Secondary Standard Pyranometer

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ev·o·lu·tion  
/,evə'looSH(ə)n/

#### noun

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

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

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

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- Highest data availability
- Low cost of ownership
- Most value added features standard
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- Compliant with latest ASTM & IEC standards



Internal ventilation port  
Easy-view bubble level

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



631-251-6963

[info@HuksefluxUSA.com](mailto:info@HuksefluxUSA.com) | [www.Hukseflux.com](http://www.Hukseflux.com)



**PV Distributors**



**BayWa r.e. Solar Systems, LLC**

BayWa r.e. Solar Systems is a national solar distributor, focused on providing reliable and convenient supply chain solutions to their partners.

[www.baywa-re.com](http://www.baywa-re.com)



**Belnor Engineering**

Belnor Engineering supplies Onyx Solar Photovoltaic Solar Glass Modules for all kinds of buildings. The PV modules are available in almost any size, shape, color, and textural finish possible. From pixelated facades, to skylights, to walkable PV floors, Onyx Solar's clean technology provides long-term renewable energy solutions which cut emissions, reduce the carbon footprint, and cut costs, all while adding to the aesthetic design of the facility.

[www.belnor.com](http://www.belnor.com)



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Since 2011, Can Solar, Inc. has designed and manufactured solar 2-strings and 4-strings combiner boxes. Now they present Solar Power Bank for Home. The Power Bank receives up to 2kW solar power, kept in 3kWh or 5kWh LiFePO4 batteries, with utility charging capability. An optional, on-site Android pad can display the status of the Power Bank is also available.

[www.cansolarenergy.com](http://www.cansolarenergy.com)



**Empire Clean Energy Supply**

ECES has been a solar energy equipment supply house providing solar equipment since 2004.

[www.empirecleanenergy.com](http://www.empirecleanenergy.com)



**SKY ENERGY, INC.**

SKY ENERGY (US) markets and sells new Lightray Solar photovoltaic systems and services to commercial and residential customers. Lightray Solar modules convert light from the sun into electricity used to power buildings, homes, communications, and electric vehicles through solid-state silicon solar cells. Services provided include: site analysis, energy output, benefit analysis, cost analysis, and project coordination including engineering, electrical, financing, developer, and installation contractors.

[www.sky-energy.com](http://www.sky-energy.com)



**SmartFlower Solar**

SmartFlower Solar's smartflower is a fully integrated solar system inspired by nature which tracks the sun throughout the day, producing clean energy for residences, schools, or businesses. Each morning, smartflower automatically unfolds when the sun rises and follows it at the perfect angle throughout the day with dual-axis tracking based on GPS coordinates. In the evening, as the sun sets, smartflower furls its panels and stows away for the night. The smartflower generates up to 40% more energy than a traditional rooftop system. Smartflower can easily be installed in a few hours and, because of its smart features, requires no effort once placed in service. Smartflower is TUV, SFEC, and CEC certified.

[www.smartflowersolar.com](http://www.smartflowersolar.com)



**Stellar Sun**

NABCEP certified Stellar Sun provides renewable energy products and services.

[www.stellarsun.com](http://www.stellarsun.com)



**The PowerStore (TPS)**

The PowerStore (TPS) is a national Tier 1 wholesale distributor for the renewable energy sector. They are a fully NABCEP trained organization: training, stocking, distributing, and supporting international manufacturers. From small residential to large commercial, they have the products, technical support, and pricing to meet all installations.

[www.thepowerstore.com](http://www.thepowerstore.com)

**PV Installers**



**Dovetail Solar and Wind**

Dovetail provides high quality design, installation, and O&M services for solar electric (PV) systems. They can work with new and existing buildings, ground mounts, and solar canopies. Established 1995, Dovetail is a commercial and utility scale solar implementation firms located in the greater Ohio area with offices in Cleveland, Columbus, Cincinnati, Toledo, and Athens. They have installed more than 20MW, (>70,000 solar panels), and provide safe, reliable, renewable energy systems and maintenance services in the Midwest.

[www.dovetailsolar.com](http://www.dovetailsolar.com)



**Hannah Solar Government Services, LLC**

Hannah Solar Government Services, LLC (HSGS) is a service-disabled veteran-owned renewable energy company with core expertise in providing solar energy solutions for government, utility, industrial, and commercial clients across the continental United States as well as overseas. HSGS is a solar PV project developer and an engineering, procurement, and construction (EPC) firm specializing in the development, design, installation, and maintenance of solar PV energy systems and microgrids.

[www.hsgs.solar](http://www.hsgs.solar)



**Ontario Solar Installers**

Ontario Solar Installers' website helps customers connect with professional solar panel installation companies in Ontario, and receive free quotes to supply and install their solar PV systems.

[www.ontario-solar-installers.ca](http://www.ontario-solar-installers.ca)



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[www.solarvast.com](http://www.solarvast.com)

### PV Manufacturers & Equipment



#### ABB, Inc.

ABB offers a complete line of electrical balance of components (EBOS) from residential to utility scale solar including integrated battery storage.

[www.abb.com](http://www.abb.com)



### Alencon Systems, LLC

Alencon's String Power Optimizers and Transmitters (SPOTs) are powerful DC-DC optimizers for utility scale PV applications. Alencon's SPOTs can be used in combination with either Alencon's central inverters, GrIPs, or central inverters built by any other manufacturer. Alencon's SPOTs offer the granularity of string inverters while allowing users to take advantage of the low cents-per-watt cost of a central inverter while maintaining fewer connections to the grid.

[www.alenconsystems.com](http://www.alenconsystems.com)



### all4-GP North America, Inc.

all4-GP provides equipment and turn-key lines for PV module assembly including: stringers, glass handling, laminators, IV Curve, EL testing, and framing systems. They also provide adhesives for module assembly including: 15-minute cure, two-part silicone adhesive for frame and j-box bonding, potting material, and electrically conductive adhesives for ribbon bonding and other electronics applications. Customizable solutions are available upon review of specifications. Support is provided to North American customers from their office in Glendale, California.

[www.all4-gp.com](http://www.all4-gp.com)



### ASYS Group Americas, Inc.

The ASYS Group, based in Germany, is a manufacturer of machines and production lines for the electronics, life-science, and solar industries. The ASYS SOLAR brand features metallization lines and next-generation technologies for the implementation of advanced cell concepts. Since its entry into the solar market in 2002, ASYS has delivered cell manufacturing equipment to its worldwide customer base with a production capacity in excess of 30GW. Offering both scalable production solutions and high-speed technologies, ASYS provides cost-efficient metallization lines.

[www.asys-group.com](http://www.asys-group.com)



### Edisun Microgrids, Inc.

PV Booster is a dual-axis solar tracker built for the commercial and industrial rooftop sector. By tracking the sun, PV Booster increases energy production by 30% and enhances project economics by 20% over conventional fixed-tilt installations. This boosts financial returns and makes solar economically viable at sites not previously feasible. Edisun's proprietary design and control algorithms for PV Booster overcome challenges including weight, size, mounting points, and wind resistance.

[www.edisun.com](http://www.edisun.com)



### LI-COR Biosciences

LI-COR is a solar radiation measurement provider. For solar resource assessment, LI-COR's LI-200 Pyranometer is a cost-effective alternative which compares with first class thermopile-type pyranometers. The newly redesigned LI-200R features a robust case that's designed to efficiently shed water. It also includes a modular, removable base and cable which allows the sensor to be removed for recalibration without affecting existing mounting architecture. This makes the sensor a solution for PV efficiency measuring systems with an extensive network of cables, that would otherwise make sensor removal difficult.

[www.licor.com/env](http://www.licor.com/env)



### Matenaer Energy Products

Matenaer Energy Products provides in-house stamping, machining, fabricating, and coating capabilities which allows them to provide their customers with a one stop solution. Their lasers, multiple robotic welding cells, and stamping presses up to 1000 tons produce high quality components. Matenaer's production is easily scaled from low volume prototype work to high volume production. With years of experience working in the alternative energy field they understand and are able to ramp up to production volumes quickly when a project hits.

[www.matenaer.com](http://www.matenaer.com)

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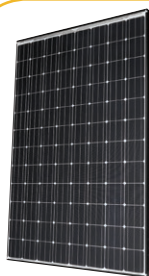




**Merlin Solar**

Merlin Solar (MST) FX Series PV Module line is a polymer flexible module designed for a wide range of photovoltaic applications, including commercial and residential rooftops, car ports, metal roofs, and other weight sensitive environments. Available in three different configurations: 6 x 6 cells, 2 x 18 cells, and 2 x 12 cells. GX Series PV module line is a glass front, flexible module, and the BR Series PV Module line is a glass front, back rail module. Both are designed for a wide range of photovoltaic applications, including commercial rooftops, ground mount, and residential.

[www.merlinsolar.com](http://www.merlinsolar.com)



**Panasonic**

**Panasonic**

After 20 years of producing high-efficiency solar modules, Panasonic's heterojunction HIT panels feature -0.258% /°C temperature coefficient and provide high efficiency throughout the day, even in high temperatures. This performance is due to a unique cell structure which reduces carrier loss, a panel surface which reduces reflection, and a bifacial design which captures sunlight from both sides. Strict durability and performance testing under extreme weather conditions guarantee decades of safe, efficient, worry-free operation. And Panasonic's complete warranty covers the entire system, including product and performance, for 25 years.

[www.business.panasonic.com](http://www.business.panasonic.com)



**OAI**

OAI designs and manufactures Class AAA Solar Simulators and I-V testers to be used in production or research and development for the testing of solar cells. Beam sizes include 52x52mm, 100x100mm, 156x156mm, 208x208mm, and 300x300mm. Solar Simulators can be upgradeable to DSSC, CPV, Multi-Junction, and Organic Solar Cells.

[www.oainet.com](http://www.oainet.com)



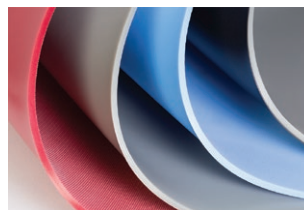
**Singulus Technologies AG**

SINGULUS TECHNOLOGIES builds machines for economical and resource-efficient production processes for solar, semiconductor, medical technology, consumer goods, and optical disc. SINGULUS TECHNOLOGIES focuses on deposition technology and the various surface treatment processes, on wet-chemical processes as well as the associated chemical and physical process processes. For all machines, processes, and applications SINGULUS TECHNOLOGIES draws upon its know-how in the areas of automation and process technology.

[www.singulus.de](http://www.singulus.de)



**SMARTTECH**



**Smartech International**

Smartech supplies North American PV module manufacturers with Steinbach Laminator Diaphragms and PTFE Sheets. Steinbach materials are consistent and durable. Steinbach's patented EVA-resistant Lamibran Diaphragm provides extensive cycle-life and low per-cycle cost. Steinbach's solid silicone diaphragms come in range of durometers, in seamless widths of 3 meters or more. PTFE release sheet and transport belt materials are available in a wide variety of thicknesses and surface treatments, including anti-static coatings.

[www.smartechonline.com](http://www.smartechonline.com)

**PV Washing System**



**American Polywater Corporation**

Polywater SPW Solar Panel Wash has solar panel manufacturer approvals, reduces water usage, and is biodegradable. Polywater FST seals out water, and prevents rodents and gasses from entering inverters, combiner boxes, and transformers. Polywater InstaGrout has been used on solar farms to keep rodents, snakes, and insects from burrowing under electrical apparatus pads and causing costly outages.

[www.polywater.com](http://www.polywater.com)



**Bitimec International, Inc.**

Bitimec's RoboKlin is a solar panel washing machine designed for utility size ground-mount PV power plants. The RoboKlin runs smoothly on an M&S Track Buggy rubber-track dumper undercarriage. With twin joystick controls, a telescoping boom, ultrasonic sensors, and a hybrid foam brush, feather-light and mechanized panel washing is done simply and gently. A new Snow Brush option will allow fast snow removal to restart the production of power shortly after a snowfall.

[www.wash-bots.com](http://www.wash-bots.com)

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[www.arisepipesupport.com](http://www.arisepipesupport.com)





### AceClamp by PMC Industries

AceClamp now offers solar solutions designed specifically for SSMRs. A rackless-type hold down, their Solar Kit is a low-cost alternative to secure PV panels.

[www.aceclamp.com](http://www.aceclamp.com)



### AllEarth Solar

The AllEarth Solar tracker is a complete grid-tied, dual-axis solar electric system that uses GPS and wireless technology to follow the sun throughout the day for optimal energy production. The tracker's 360° range allows it to produce up to 45% more electricity than fixed systems, resulting in more guaranteed savings from a solar installation. Made in America, the tracker comes with an industry-leading 10 year warranty, a 120-mph wind rating, and superior snow shedding. Its simple, durable design and complete system pallet simplifies costly procurement and installation time.

[www.allearthrenewables.com](http://www.allearthrenewables.com)

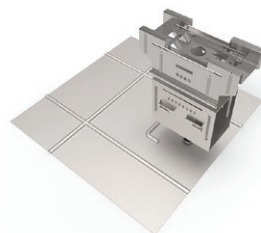


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### Allied Tube & Conduit

Allied Tube & Conduit provides in-line galvanized steel tube to assist with solar racking and tracking. Their Gatorshield is strong and has a reduced weight, with advanced corrosion protection and formability. Gatorshield also complies with UL2703. To ensure precision, they offer prototype and fabrication services. Allied is able to provide small and large O.D. sizes with heavy gauge, meet and exceed tube strength requirements, tool up for new profiles to meet customer specific needs, swage tube to help build a solar array, and various types of tube fabrication.

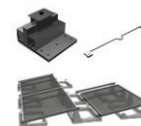
[www.atc-mechanical.com](http://www.atc-mechanical.com)



### Atlantic Clean Energy Supply (ACES)

ACES offers industrial renewable energy products such as residential rail-less racking systems, roof top mounting hardware, metal tiles, single/dual trackers, battery energy storage, batteries, string/micro inverters, and C&I LED products. They also offer a full set of UL/IEC PV laboratory instruments.

[www.atlanticces.com](http://www.atlanticces.com)



### DynoRaxx

DynoRaxx offers flat and pitched roof solar racking solutions as well as a UL2703 approved grounding product. The Evolution FR ballasted racking system requires no tools during assembly and is made of fiberglass, making it durable under extreme heat, avoiding thermal expansion and corrosion. The lightweight fiberglass also reduces shipping costs. The Evolution PR mount is designed for asphalt shingled roofs and comes as a preassembled single component. The DynoBond is a UL Recognized tin-plated copper wire used for module to module grounding. With two stainless steel spring clamps, the DynoBond jumps from module to module using the metal frames as the means of electricity.

[www.dynoraxx.com](http://www.dynoraxx.com)



### EcoFasten Solar

SimpleBlock-PV can be used as a rail-based mounting system, or as a rail-free racking solution for solar arrays. The addition of the End Spacer and Mid-Clamp facilitate a rail-free installation, conforming to UL 2703 First Edition and featuring integrated bonding. Testing performed by Nationally Recognized Testing Laboratory TUV Rheinland. SimpleBlock-PV with integrated T-Slot for N-S adjustability is used to rail-mount solar modules to standing seam metal roofing. SimpleBlock-PV is compatible with any Manufacturer's L-Feet.

[www.ecofastensolar.com](http://www.ecofastensolar.com)

[www.WASHPANEL.com](http://www.WASHPANEL.com)

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[info@washpanel.com](mailto:info@washpanel.com) – Phone: +39 0422 618644



Treviso - Venice



Bakersfield







### Ecolibrium Solar

EcoX Universal Rail-less is a one-size-fits-all solution of trill, composite, metal, and low slope roofs. One SKU for each component boosts the already easy, fast, safe, low cost-per-watt, and well-organized installation process of EcoX to a new level. Installers can switch modules with ease, ending project delays. Skipping the rails cuts installation time, increasing productivity from one installation a day to two. Project speed is accelerated due to 33% fewer penetrations, the elimination of awkward rails, easy wire management, and the elimination of rough inspections. Dedicated project support and an extensive list of UL2703 certified modules are provided.

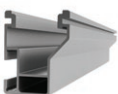
[www.ecolibriumsolar.com](http://www.ecolibriumsolar.com)



### Ecolibrium Solar

Ecolibrium Solar's EcoFoot technology is available in 5- and 10-degree systems. The new EcoFoot5D 5-Degree Racking System delivers 18.4% more power, combining a small 7ft x 16.7ft modular base and dense 9.9ft inter-row spacing. The tightly packed array enables maximum power density on flat roofs. Bases fall into alignment easily and preassembled parts eliminate module prep. The result is an organized workflow and fast, non-stop installation. In 10-degree systems, the installer-centric EcoFoot2+ provides simplicity and an install speed of 13.5 modules per installer-hour, as rated by DNV-GI. An extensive list of UL2703 certified modules is provided.

[www.ecolibriumsolar.com](http://www.ecolibriumsolar.com)



### Everest Solar Systems

Everest Solar's new rail profile, CrossRail 48-X, is optimized for the CrossRail System, a residential roof solution designed to reduce roof attachments and install time while maintaining the integrity of the structure. The CrossRail 48-X pairs with the Structural Rail Connector which saves time and money by reducing the amount of roof attachments needed per rail run. Additionally, the Structural Rail Connector allows the installer to safely and quickly preassemble rails on the ground. Everest keeps roof integrity with the EverFlash Comp Kits which reduce the chance of water intrusion. The system is made to last with Marine Grade Aluminum and a 20-year warranty. The CrossRail System is tested and approved to ensure homeowners high performance and reliability.

[www.everest-solarsystems.com](http://www.everest-solarsystems.com)



### GameChange Solar

Pour-in-Place Ballasted Ground System features: self leveling technology with adjustable feet and slots allowing fast install and more than 7" vertical adjustability to navigate sloping ground prior to concrete pouring; up to 4ft. high ground clearance to allow for snow and vegetation; 5° to 35° tilt with multiple inter-row spacing options; full layout and engineering analysis for every project; integrated grounding and wire management; no gravel beds or other expensive ground preparations required for leveling as needed for precast.

[www.gamechangesolar.com](http://www.gamechangesolar.com)



### GameChange Solar

Max-Span Post System is a value-driven system which supports all double-sided glass thin film and other modules. Its galvanized Z purlins have integrated trays for easy wire management, and it's rugged beam and brace rapidly attach to pile with just six bolts. The Max-Span Post System provides 5° to 35° tilt with multiple inter-row spacing options, and with up to 4 ft. ground clearance, it eliminates snow and vegetation shading issues. GameChange Solar offers stamped layout and engineering analysis for every project. The system's earth screws and helicals are StickyPile G235 galvanized steel (HDG available), HDG, purlins, beams, and braces are G90 galvanized steel, and integrated grounding with star washers or teethed module clamps is included and approved under ETL /UL 2703.

[www.gamechangesolar.com](http://www.gamechangesolar.com)



### GameChange Solar

GameChange Solar's Grid-Lite Roof System is a cost effective, low weight ballasted roof system with an interlocking grid design combined with next-gen wind deflector which reduces ballast to minimal amount. This system can handle the most severe seismic conditions and offers 5° and 10° tilts. Providing a fast install with minimal and durable G90 and stainless steel components, the integrated wire management trays enable string wiring throughout entire array prior to panelizing.

[www.gamechangesolar.com](http://www.gamechangesolar.com)



### Genmounts

Genmounts' racking systems are designed to be installer friendly and easy to assemble, all while maintaining high integrity in quality and design. Their engineering teams adhere to strict design standards to ensure projects pass review and move forward, even in tough design scenarios. They offer utility scale post driven or ballasted ground mount systems along with their LT ballasted roof mount racking.

[www.genmounts.com](http://www.genmounts.com)



### KB Racking

EkonoRack 2.0 is a simple, non-penetrating solar mounting solution for commercial flat rooftops. The system's design is composed of only one major component, acting as a ballast tray, windshield mount, and multiple panel support.

[www.kbracking.com](http://www.kbracking.com)



### Kinetic

The watertight flashing kit made by Kinetic includes a baseplate that flush-mounts to the roof, a 9" x 12" black flashing that maximizes coverage of the penetration points, as well as stainless steel hardware. The baseplate is secured to the roof with up to two lag bolts and has a separate blind stud on top for L-Bracket attachment, eliminating the through-hole that may cause water leakage and lead to dry-rot. The unique raised channel provides an ideal place for sealant application on the underside, while also diverting water off the top of the flashing. The black textured, powder-coated flashing blends well with all asphalt roofs, and easily slides under shingles during installation.

[www.kineticsolar.com](http://www.kineticsolar.com)





### Kinetic Solar Racking and Mounting

Kinetic Solar Racking and Mounting's Aerocompact S (south oriented), is the solution for mounting framed modules on flat roofs. It's the fastest and least expensive mounting system on the market, with excellent installation features. With Aerocompact S, an assembly time of 10 minutes per kilowatt can be achieved. With the Aerocompact+, an assembly time of five minutes per kilowatt can be achieved. These systems are wind-tunnel tested, conform to UL 2703, and are delivered fully pre-assembled, with protective matting and a barrier to prevent diffusion of the plastic softener. An analysis of the flat-roof design is also included for accurate ballasting.

[www.kineticsolar.com](http://www.kineticsolar.com)



### Nuance Energy Group, Inc.

Osprey PowerPlatform Nuance Energy's patent-pending Osprey PowerPlatform affords advances in ground mount solar EPC practices by minimizing the engineering required, adding modular scalability to the procurement and installation process, and reducing construction costs and effort. This earth anchor foundation system satisfies permitting requirements for virtually any site and soil type without any need for geotechnical reports or special inspections. It eliminates the need for heavy equipment or cement by enabling small, unskilled crews to install the entire platform quickly and easily using only handheld tools.

[www.nuanceenergy.com](http://www.nuanceenergy.com)



### OMCO solar

The OMCO Field Fast Rack comes straight from the manufacturer, and is designed with features which reduce installation costs, streamline supply chain, and ensure proper construction. As the OEM and one source to partner with, they have integrated pre-assembly of components in the factory, few parts to manage in the field, and the nationwide manufacturing footprint (Arizona, Ohio, Indiana, and Alabama) tooled and ready to optimize freight and logistics costs, and shrink lead time. OMCO's team also provides turnkey installation for any size project.

[www.omcoracking.com](http://www.omcoracking.com)



### OMG Roofing Products

PowerGrip Universal (PGU) is an attachment anchor for mounting solar racking systems and other products to any type of commercial roof. It's designed to reduce or eliminate ballast in commercial solar racking systems, so there's less weight on the roof. PGUs are made of heavy-duty cast aluminum, and include a base ring and a protective cover plate to keep water from infiltrating the roof assembly. PowerGrip Universal units transfer the load to the structural roof deck and do not require membrane welding. Typical installation time is less than five minutes and each unit provides up to 3300lbs of tensile strength, 2500lbs of shear strength and can support compressive loads up to 2000lbs.

[www.omgroofing.com](http://www.omgroofing.com)



### Magerack Corporation

MageMount is a rail-less solar mounting system which is installed like a rail-based solar mounting system with separate roof attachments and interlocking module connectors. It provides a complete solar mounting solution with roof attachments for all roof types at a low cost and reduced installation time with familiar and fewer components. The system is UL 2703 certified with Class A fire rating. The components have integrated bonding capability so the system is bonded and grounded without using any bonding devices. Magerack is also the inventor and manufacturer of the L-foot with flashing. Magerack L-foot with flashing is a cost-effective, easy-to-install, reliable system.

[www.magerack.com](http://www.magerack.com)



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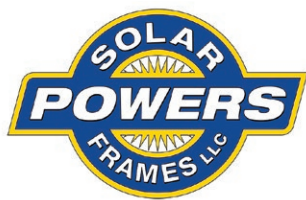
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**Powers Solar Frames** *(waiting for confirmation from Ian)*

Powers Solar Frames is a manufacturer of Solar Carport systems, 5-High posted, and Ballast Ground Mount systems that consist of up to 5 modules high in landscape mode, all utilizing their patented Super Solar Purlin and Gator Clamp for securing modules to their Super Purlin. Each of these systems are efficient to install saving time, labor costs, and material costs. The design of Powers Solar Frames Solar Carport systems allows for a reduction of up to 42% less purlin usage, providing ease of installation. The Gator Clamp is certified to meet all relevant bonding requirements of UL Subject 2703.

[www.powersolarframes.com](http://www.powersolarframes.com)



**PREFORMED LINE PRODUCTS**  
The connection you can count on

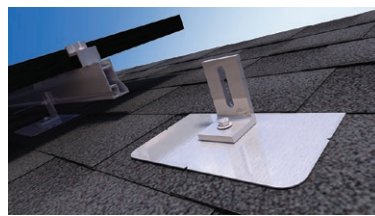


**Preformed Line Products**

Preformed Line Products Introduces the POWER MAX Ballasted Roof Mounting System. The POWER MAX solar mounting system is engineered to maximize energy output on commercial flat roofs. Developed with the professional installer in mind, this system features 50% fewer components and a simplified design resulting in faster assembly rates and labor savings on every project. Available in a flush mount, 5° or 10° tilt or higher density dual tilt design, the POWER MAX base arrives stacked on pallets providing easier transport to the roof. Engineered as a fully ballasted, non-penetrating system, it accepts standard concrete blocks and is qualified by wind tunnel testing.

[www.preformed.com](http://www.preformed.com)

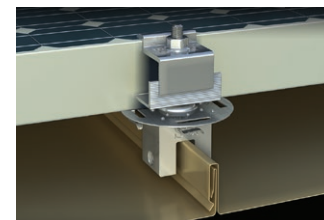
**Quick Mount PV®**  
RESPECT THE ROOF



**Quick Mount PV**

Quick Mount's L-Mount Series for Comp/Asphalt Shingle Roofs is engineered with its patented Elevated Water Seal Technology into an integrated L-foot and flashing for cost-effective, super-fast, single-bolt installation with waterproofing. Available in single- and double-slot options for versatility and works with all leading racks. Featuring a 9x12-inch aluminum flashing with alignment notches and rounded corners to easily slide under shingles and speed installation. No shingle cutting required. Meets or exceeds roofing industry best practices, and comes with a 25-year warranty. Available in mill or black finish.

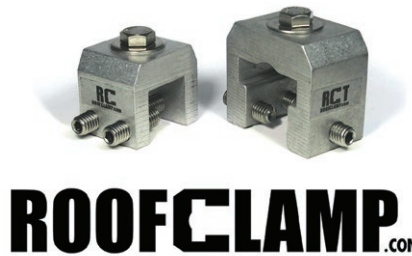
[www.quickmountpv.com](http://www.quickmountpv.com)



**S-5!**

The S-5! PV Kit is an ANSI UL 2703 listed solar module mounting solution, as well as ETL listing UL 1703 grounding/bonding device. 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, adding additional support rails, and ultimately saving time and materials by providing the entire attachment system.

[www.s5.com](http://www.s5.com)



**ROOFCLAMP.com**

**Roof Clamp**

Roof Clamp's two models replace dozens of other clamps. Made of 6061-T6 aluminum with all stainless steel hardware, the 3-point attachment system guarantees strength for parallel and perpendicular loading. Their clamps feature anti-seizing, coarse thread set screws which allow for unlimited re-torquing and re-attachment. Over 95% of today's standing seam profiles are compatible with the universal for Roof Clamp system.

[www.roofclamp.com](http://www.roofclamp.com)



**SCHLETTER**  
The Solar Mounting Group

**Schletter**

G-Max is a fixed-tilt ground mount system suited for utility-scale and large commercial ground mount installations. Schletter engineering has optimized components for strength, safety, and ease-of-installation. With G-Max, there is a 20% reduction of piles, creating an overall reduction in manufacturing times, improved shipping costs, simplified site deployment, and faster installation time. The purlin design eliminates the fourth purlin in portrait, resulting in a 25% reduction in material. Additionally, G-Max includes visual quality assurance measures designed into the system.

[www.schletter.us](http://www.schletter.us)



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INSTALLATIONS



[EP.MERSEN.COM](http://EP.MERSEN.COM)

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### SnapNrack

SnapNrack RL, for residential solar mounting, provides a fast, intuitive install experience. RL is designed to achieve a low installed cost without compromising performance, quality, or aesthetics. The RL System requires only 4 components for complete assembly with A Mounts, B Mounts, C Links, and Flash Tracks. A Mounts allow modules to drop-in with no tightening required, B Mounts secure top of modules through a single fastener, and C Links clamp modules together to provide a fully bonded rigid structure. SnapNrack's wire management is still maintained with innovative wire management accessories for RL.

[www.snapnrack.com](http://www.snapnrack.com)



### Solar Clam-P

The Snap-Skirt from Solar Clam-P provides an attractive array cap that snaps into the Solar Clam-P A-Beam and BEAST. Comes in Black Anodize standard, but custom color options, as well as customer lettering are available. No tool is required, and can be installed on any type of panel frame or any standard rail system. Can also be used as a barrier against pests.

[www.solarclam-p.com](http://www.solarclam-p.com)



### Solar Connections International

The Solar Connections PowerMount for R-Panel Metal Roof Systems features a high grade, fully EPDM gasketed mount to help form a water-tight seal with the roof. Cross Stitch Attachment Technology secures the system to the roof with 4 custom screws angled to provide maximum strength and uplift. The stainless fastener w/EPDM washer provides an additional layer of water protection. The PowerGlide Adjustment Technology provides 2" of adjustment as they go. Solar Connections' 6061-T6 Universal PV Cube features a robust design and is compatible with all of their PowerMounts.

[www.solarconnections.com](http://www.solarconnections.com)



### Solar Mounting Solutions, LLC

SMS Provides a Ballasted Low Profile System which arrives pre-assembled, requiring significantly less time and effort to install. It is designed to fully cover and protect the concrete ballast which can otherwise deteriorate when exposed to the elements. This system incorporates the patented THRU-ITT integrated wire management system allowing wiring to remain organized and protected. Since this racking design does not rely on the panel for integrity, installers can complete racking and wire installation independent of the panel. Solar Mounting Solutions' experienced engineering and support team also offers code-compliant designs for any locality.

[www.sms.solar](http://www.sms.solar)



### SolarRoofHook

SolarRoofHook's Low Profile QuickBOLT is an affordable, UL Certified Asphalt Shingle mounting system. The Low Profile QuickBOLT utilizes SolarRoofHook's Microflashing technology. The Microflashing is compressed by the collar on the bolt to create a 100% water-tight seal. Microflashing is installed directly over the Asphalt Shingles and does not require the installer to remove any nails, saving installers from voiding the roofing warranty or breaking code. With an installation time of less than one minute, the Low Profile QuickBOLT allows installers to commit to and complete more jobs.

[www.solarroofhook.com](http://www.solarroofhook.com)



### Sollega

Sollega specializes in commercial ballasted/hybrid flat roof racking. The FastRack (FR510) is injection molded, utilizing glass-reinforced nylon, and engineered to outlast the useful life of the array in extreme weather conditions (25-year warranty). The one-piece hybrid mounting system arrives ready to install. Quick to ship, stage, and install, the U.S. manufactured FR510 includes integrated features such as: wire management, grounding, optimizer/micro-inverter mounts, and all top down one size tool attachment which means less extra hardware and cost. FR510 supports all framed modules at 5° or 10° tilt angles. Inter-row spacing is 10" and 13". FR510 has a Class A Fire rating (Type I & II). Sollega provides full PE Engineering and design services.

[www.sollega.com](http://www.sollega.com)

# COTEK SD Series Pure Sine Wave Inverters



SD 3500

### KEY FEATURES:

- Available in 2500W and 3500W
- Built-in AC transfer switch
- Parallel and N+1 design for power expansion
- Hardwire and GFCI/Schuko versions
- Wide DC input range & operating temperature
- Light weight & low profile
- Intelligent software for power management
- Advanced protection features
- Adjustable power saving options

COTEK is a global leader in the manufacture of off-grid, battery-based pure sine wave inverters. This product-line enhances the reputation that COTEK has established since 1986 for innovative technology and total quality assurance. With a 2 year warranty and excellent customer support, the SD series will soon become the industry standard.

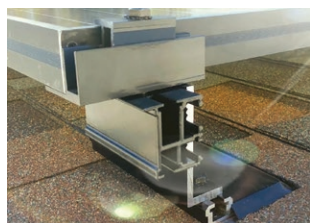


CR-10 Remote



**COTEK The Americas - now serving Latin America!**  
For complete product specifications visit: [www.cotek.ca](http://www.cotek.ca)





### Spider-Rax

The all new Black Widow Comp mount for composite shingle applications has been redesigned to improve aesthetics, adjustability, and installation speed. Needing only one part number to order improves job efficiency. The mid clamp and end clamp have a patented panel lock system fitting modules from 1.125" - 2" and the direct to plywood fastening system has a new 2-course aluminum flashing. This system is UL 2703 listed for integrated grounding, a leveling height adjustment of 1.5", snow load rating at 45 lbs/ft, Class A fire rating, and 50 state engineering reports are available.

[www.spiderrax.com](http://www.spiderrax.com)



### SunLink Corporation

SunLink delivers full-scope product+service+software for utility-scale and commercial roof and ground-mount solar projects of every size and complexity. With distributed and centralized tracker, fixed-tilt and roof-mount products, SunLink's full range of mounting products is able to meet the requirements of virtually any project site worldwide. The PowerCare field services team is also available to provide expert installation, geotechnical, and O&M services for all SunLink products. Further, SunLink's VERTEX project intelligence, monitoring, and control platform provides predictive and proactive O&M management, and improves system performance and overall project returns.

[www.sunlink.com](http://www.sunlink.com)



### SunModo Corp.

SunModo Corp can help transform sun-shielding awnings into attractive power-generating systems with their SunShield Awning System. The easy-to-install solar system does double duty, protecting the building and people from intense heat, while at the same time generating valuable solar electricity.

[www.sunmodo.com](http://www.sunmodo.com)



### TerraGen Solar

TerraGen Solar is a solar PV mounting system engineering and manufacturing supplier focused on client relationships and continuous improvement to develop PV racking designs and solutions. To date, TerraGen has supplied racking solutions including their standard TGR flat roof ballasted system, their TGT tilted pitched roof system, their TGP flush mount system, carport and ground mount systems, and custom designs for various customers. TerraGen is able to overcome site-specific challenges and offer solutions to the market with their experience in manufacturing, engineering, construction, project management, and solar power plant design.

[www.terragen.com](http://www.terragen.com)



### TRA Snow & Sun, Inc.

TRA Snow and Sun (TRA) is a manufacturer of solar racking and solar mounting systems. TRA's economical solar racking hardware is available direct to installers and project developers to ensure positively impacted profitability. TRA's solar racking and solar mounting systems are durable, code compliant, and price competitive.

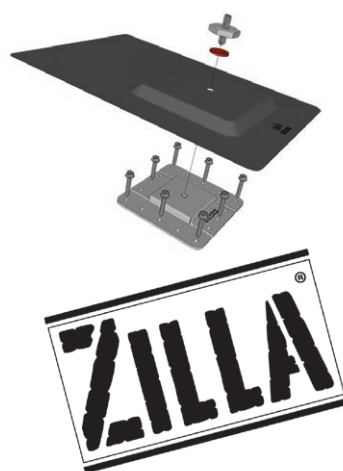
[www.trasnowandsun.com](http://www.trasnowandsun.com)



### Unirac, Inc.

In stock and ready to ship, UNIRAC GFT makes ground mount simple. With the speed and flexibility of utility scale arrays, GFT's engineered designs, kitted hardware, pre-assembled braces, and UNIRAC's project support make construction easy, all in a package of standard, lightweight components in stock at any UNIRAC distributor.

[www.unirac.com](http://www.unirac.com)



### Zilla Corporation

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

[www.zillarac.com](http://www.zillarac.com)



### Zimmermann PV Racking North America

Zimmermann PV has over 2.5GW of capability, supplying their solar photovoltaic ground mounted racking product line globally in Europe, Asia, and the Americas. With in-house technical services to support projects from design to execution, they are equipped with modern, high-tech machines and production equipment, 8000 tons raw material in stock, 4000 tons finished goods available for immediate supply, and 20,000 tons material turnover per year. Zimmermann PV has a supply capacity of up to 30MW of utility scale mounting systems per week.

[www.pv-stahlbau.de/en](http://www.pv-stahlbau.de/en)

## Residential or Small Office Solar | PV



BAKER ELECTRIC  
SOLAR



### Baker Electric Solar

San Diego-based, Baker Electric Solar has designed, engineered, and installed solar systems for over 8000 homes in Southern California. As the winner of the BBB International Torch Award for business ethics, they help people control of the way they generate, manage, and consume energy, enabling them to achieve cost-savings and energy independence.

[www.bakerelectricsolar.com](http://www.bakerelectricsolar.com)



### Sun City Solar Energy

Sun City Solar Energy designs, sells, and installs solar electric systems including off-grid, grid-tie, and grid-tie with emergency battery backup solar power systems.

[www.suncityenergy.com](http://www.suncityenergy.com)

## Robotics



### Washpanel Srl

Since 2010, Washpanel has provided PV plants washing technology, with more than 10 different robots for different plants such as solar parks, roofs, carports, greenhouses, and agriculture farms). Washpanel is an Italian company which designs and produces automatic and semi-automatic portable robots for PV plant washing, including: SERIE "EVO", a portable semi-automatic robot for PV solar parks or roofs for use in desert, water, or dry applications; SERIE "SEMOV" is a portable semi-automatic robot (max 8 Mt) for PV car port or flat roof, such as ranches, or greenhouses; and SERIE "AUTO" is a roof-fixed robot suitable for breeding farms and ranches (poultry, pig, cattle farming), and feed factories.

[www.washpanel.com](http://www.washpanel.com)

## Roll Forming



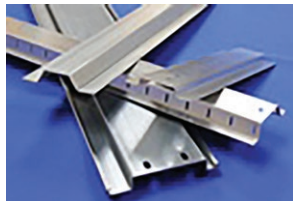
### Hynes Industries, Inc.

Hynes Industries provides roll formed solar components manufactured in Nevada, Ohio, and Indiana. Roll formed profiles are light, strong, reduce part costs, and eliminate secondary operations through in-line programmable punching of holes, slots, and other features. C-Channel, Z-Purlin, C-Post, and custom roll formed alternatives can be used in ground piling applications in place of I-Beams or T-Beams. The material-efficient shapes offer structural strength, flexibility, and reliable anchoring. Profiles can be nested for easy storage and transportation. A range of materials and standard or custom sizes are available.

[www.hynesindustries.com](http://www.hynesindustries.com)



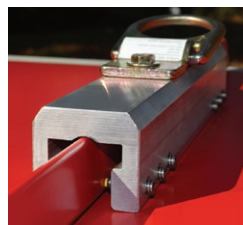
JOHNSON BROS.  
Roll Forming Co.



### Johnson Bros Roll Forming Co.

Johnson Bros Roll Forming is a manufacturer of panel frames and other solar energy components, such as the supports and structural components for panels, as well as reflector troughs for solar concentrators. They offer a wide variety of custom shapes for various different solar panel frames and structures.

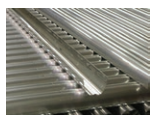
[www.johnsonrollforming.com](http://www.johnsonrollforming.com)



### Standing Seam Roof Anchor

The Standing Seam Roof Anchor allows homeowners, building owners, and contractors work safely on standing seam roofs without penetrating the panels. This patented, non-penetrating anchor is engineered to provide fall protection on standing seam roofs. It consists of a solid 6061-T6 aluminum body with 12 stainless steel set screws. The standard assembly also includes a 5,000 lbs certified d-ring for single man attachment. It arrives ready to use as a single seam, single user anchor.

[www.fallpd.com](http://www.fallpd.com)



### Samson Roll Formed Products Co.

Samson Roll Formed Products Co. produces channels used by the solar industry as brackets, photovoltaic array supports, and solar panel framing/trim, including a parabolic shaped channel, the main component in compound parabolic collectors, as well as custom shapes. Samson was founded in 1946 and is located in the Chicago metro area in a 200,000 sq/ft facility housing approximately forty roll form lines and an array of ancillary equipment to provide stamping, bending, assembly, parting, in-house design, and production of pre-notch, pre-punch tooling, as value-added services. Samson holds ISO9001:2008 Certification

[www.samsonrollform.com](http://www.samsonrollform.com)

### Safety



### Marking Services, Inc.

Marking Services, Inc. (MSI) improves and standardizes solar identification to promote safer work environments and minimize downtime due to errors or accidents. They enhance the overall efficiency of solar energy plants by providing photovoltaic solar labeling products and identification services which effectively communicate valuable information to all who need it. MSI offers a one-stop, comprehensive source for solar labeling with quality products, fast turnaround times, and on-time delivery.

[www.markserv.com](http://www.markserv.com)



### Nor-Cal Products, Inc.

Nor-Cal Products is a source for prototype and production quantity custom vacuum chambers and weldments. Spherical, cylindrical, or rectangular bodies can have single-wall, double-wall, or channeled construction and are value-engineered to reduce cost, and increase reliability and performance. All welds are reviewed for vacuum integrity, structural strength, heat resistance, and flange distortion to minimize or eliminate secondary machining. In-house fabrication capabilities allow exhaust weldments to be fabricated from a single piece of tubing, eliminating welds and manufacturing steps while improving cleanliness and fit.

[www.n-c.com](http://www.n-c.com)

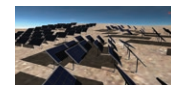
### Site Assessment & Forecasting



### GroundWork Renewables

The GroundWork Rey MET System is a rugged, revenue-grade weather station which accelerates solar adoption by providing MET data to reduce the uncertainty of energy production assessments. The Rey is smart and configurable with options for soiling measurement and diffuse irradiance. Designed for multiple redeployments, the value of the Rey MET System can be realized year after year. Together with GroundWatch, their data quality program, the Rey offers high measurement accuracy and availability to produce a ground dataset. When combined with satellite data, the result is a dependable resource assessment and correlated long-term solar resource dataset.

[www.grndwork.com](http://www.grndwork.com)



### Meteodyn

Meteodyn PV is a software used to assess solar resource, to validate the best PV panel layout, and to optimize energy production. Meteodyn PV is a professional software developed for large-scale solar projects including solar plants and industrial sites. From solar farm design to O&M, Meteodyn PV analyzes site suitability and layout design, helping to optimize production.

[www.meteodyn.com](http://www.meteodyn.com)

## Fast. Simple. Durable.



### No. 1 Universal Rail-less Racking

The only system that delivers unsurpassed installation ease. No rails are needed and one-size components fit any module thickness and attach to every roof.



## EcoFoot5D

### 5-Degree High Density Racking

The simplest way to max out your roof. Packs 18.4% more power in a small footprint. Watch at [www.ecolibriumsolar.com](http://www.ecolibriumsolar.com).



## EcoFoot2+

### 10-Degree Ballasted Racking

Impressive install time of 13.5 modules per installer-hour\* on flat rooftops. Installation couldn't be simpler.

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Simple Racking Systems for Commercial and Residential



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\*rated by DNV-GL ©2017 Ecolibrium Solar, Inc. EcoFoot2+® and Ecolibrium Solar® are registered trademarks of Ecolibrium Solar, Inc.





**NRG Systems**

NRG Systems' solar measurement products deliver the data needed to plan and successfully operate a utility-scale PV project, from pre-construction resource assessment to post-construction monitoring and forecasting. Their sensors, data loggers, and turnkey measurement systems are designed to work together for ease-of-use and are backed by their Technical Services Partner Network. NRG Systems also offers tools for wind resource assessment, wind plant optimization, and a range of atmospheric remote sensing applications. NRG Systems' products are used by electric utilities, turbine OEMs, project developers, research institutes, and government agencies around the globe.

[www.nrgsystems.com](http://www.nrgsystems.com)

**Software Supplier**



**DC Systems**

DC Systems is a developer of control system software for utilities, renewable generation, energy storage, and microgrids. Their microgrid management system is vendor, protocol, and data model agnostic. It has the capability to seamlessly integrate multiple DER technologies into a single cohesive system including varied control modes, data analytics, and performance monitoring. It supports both grid connected and island operation and the transition between them.

[www.dcsystems.com](http://www.dcsystems.com)



**Energy Toolbase**

Energy Toolbase is a software platform for modeling and proposing the economics of solar and energy storage projects. Their SaaS product is used by hundreds of distributed energy organizations nationwide to accurately, objectively, and transparently analyze their projects. Their newly launched energy storage software update gives users the ability to model, optimize, and propose the economics of any type of behind-the-meter energy storage project.

[www.energytoolbase.com](http://www.energytoolbase.com)



**Green IT Energy Applications**

Green IT Energy Applications is a smart software and services suite developed to help renewable energy companies expand the scope of their assets. Optimize integration and management of critical data across the enterprise, regardless of underlying technology. Green IT's range of IT, technical, and data solutions help industry leaders achieve complete independence regardless of generation type, manage multiple disparate systems, and gain more insight into their data. Green IT is a division of Ruby Renewable Resources LLC, which has provided high-value renewable energy Asset Management and related services to clients across North America since 2002.

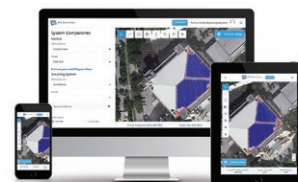
[www.greenitea.com](http://www.greenitea.com)



**PVBid, Inc.**

Enabling solar installers to dial in labor and material costs, PVBid provides fast and accurate estimating software and seasoned estimating service. PVBid offers pricing, indicative pricing, and bid reviews, as well as company cost trends, pipeline, and true project performance. Specifics for each bid can be viewed in graphs and customers can learn about the prime movers for each stage of a project.

[www.pvbid.com](http://www.pvbid.com)



**PVComplete**

PVSketch is solar design software for sales teams. It is an easy, intuitive design software for visualizing solar solutions, modeling energy production, and creating beautiful solar proposals, with little or no training. Sales professionals can quickly transfer PVSketch designs to PVCAD. PVCAD is the CAD for solar. Built on Autodesk technology, PVCAD is a solar drafting and engineering software for detailed solar plan sets. The PVComplete platform combines efficiency and accuracy. Together, PVSketch and PVCAD enable seamless design from concept to completion.

[www.pvcomplete.com](http://www.pvcomplete.com)



**Radian Lens**

The Radian LENS Technology Platform is Radian's proprietary cloud-based technology platform designed and built to deliver the best practices of industry experts. Their technology provides important efficiencies, redundancies, and superior results. LENS leverages cloud computing platforms, standard SQL databases, and focused business processes to enable asset managers to monitor and manage operations, contracts, finances, and field services in their projects and portfolios.

[www.radiangen.com/lens](http://www.radiangen.com/lens)

**PFP** PREFORMED LINE PRODUCTS

Preassembled Top Clamps  
Patent Pending

# BOOST YOUR ENERGY with POWER Max™

The new racking system that maximizes the number of solar modules and energy production on flat roofs.

- Fully Adjustable Inter-Row Spacing = Maximum Power Density
- Stackable Bases = Reduced Shipping
- Wind Tunnel Optimized = Less Ballast

Choose your application:

5°/10° Tilt

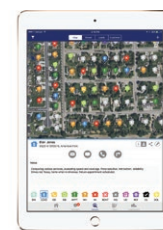
Dual Tilt

Flush Mount

Formerly **DPW** | SOLAR

[www.preformed.com](http://www.preformed.com)

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**SalesRabbit**

SalesRabbit optimizes every aspect of a sales and management process. Track leads, manage areas, collect data, and improve sales records with their approach. View demographic data and homeowner details, schedule appointments, and share leads and notes. Set and track personal and team performance records. Receive, upload, and create leads on the go. Leaders can also view real-time reports on performance metrics as well as assign territories, track rep locations, and identify behavior trends. It integrates with software and data providers, including Salesforce, JobNimbus, Faraday, and e-Original.

[www.salesrabbit.com](http://www.salesrabbit.com)





### Sighthen

Sighthen offers a comprehensive software platform for solar, covering the entire workflow from lead to install. Sighthen can help accelerate sales, access integrated financing, and streamline operations. Sighthen's powerful, solar-specific feature set includes utility bill and usage evaluation, system design with automated shading analysis, proposal and contract generation with e-signature, and post-sale operations management. All Sighthen subscriptions come with unlimited users, proposals, and contracts for a flat, low monthly fee.

[www.sighthen.io](http://www.sighthen.io)



### Valentin Software

The new version of the design software PVSOL premium 2018 makes the design of photovoltaic plants easy and efficient. For the input of object data, 3D models in different file formats can now be imported into the software via a new interface. This makes it possible to import realistic and detailed 3D objects created with photos taken from different perspectives (e.g. using a drone). This adds another important tool to the already existing possibility of importing floor plans, cadastral maps, and screenshots from web-based satellite maps, like Google Earth, directly into the 3D visualization and thus integrating them to scale into a project.

[www.valentin-software.com](http://www.valentin-software.com)

### Solar Fasteners

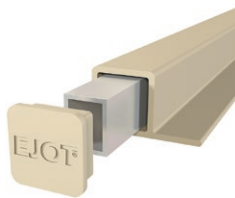


#### Arconic

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

[www.afsrhuck.net/us](http://www.afsrhuck.net/us)

## EJOT® Fastening Systems LP



### EJOT Fastening Systems L.P.

EJOT's new membrane friendly TPO EJObar, has been designed to create a non-penetrative fixing base for a wide range of applied systems, from mechanical and electrical essentials such as pipework and cable trays, through to lightweight solar PV and solar thermal installations. Almost anything that has to be secured to, or rest upon the flat roofing system works with this versatile and cost effective system. EJObar is comprised of a high quality membrane encapsulating a strong aluminum box insert. The profile is then sealed tight by two bonded endcaps at either end. The product's strength has been fully tested in EJOT's application labs.

[www.ejot-usa.com](http://www.ejot-usa.com)



### Gesipa

Since 1955, Gesipa has provided solar blind rivet fastening systems and battery powered, portable riveting tools to solar contractors world-wide. They feature the PowerBird Solar and PowerBird Gold Edition, both are portable and battery powered solutions for deep, difficult to access areas in solar applications. Their SolarGrip rivets are available in Alu/Steel & Alu/Stainless in 4.8 and 6 diameters. The hole filling body provides quality sealing. The BULBTITE 8mm rivets feature a 3-legged, blindside closing head for secure fastening in thin material applications to metal roof buildings. Gesipa's 8mm diameter, Aluminum/Steel Solar Rivet installs into holes up to 9mm, providing an alternative to 5/16" and 8mm screws.

[www.gesipausa.com](http://www.gesipausa.com)

## LECO SOLAR



### Leco Solar

Leco Solar provides a variety of quality wire management solutions to the solar industry. With cable ties at the core of Leco Solar, their company has increased its offerings through the years to include Cable Edge Clips, PV Wire Clips, Stainless Steel Solar Ties, Fir Tree Cable Ties, Mounting Base with Adhesive, Labels, and Placards. Leco Solar can meet customer requirements with a wide range of products and offer solutions and alternatives when needed.

[www.lecosolar.com](http://www.lecosolar.com)

## marine FASTENERS



### Marine Fasteners

Marine Fasteners is a global distributor of steel and stainless steel hardware. They are able to scale with project installations in the U.S. or overseas. They specialize in being a source to racking manufacturers of ground mount, fixed tilt and single axis trackers, as well as commercial and residential roof mount. Their customer support services include a well-qualified team which understands hardware and the importance of timely logistics.

[www.marfas.com](http://www.marfas.com)

### Solar Hot Water Installers



### Self Reliant Energy Company

Self Reliant Energy Company provides utility grade solar power for home, business, and commercial enterprises. As the Michigan 2016 pioneer of renewable energy, they have gained insight into the technology, companies, governments, and incentives. Their study of cell technology, inverter technology, manufacturing processes, U.L. standards, U.S trade policies, and site specific design has resulted in systems which can be installed by their Engineered Do-It-Yourself Packages.

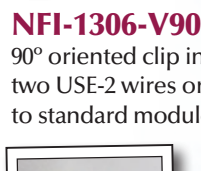
[www.selfreliantenergy.com](http://www.selfreliantenergy.com)

# SOLAR CLIPS



#### NFI-1701

Brand New rail mounted clip for use with Enphase IQ microinverters



#### NFI-1306-V90

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



#### DCS-1306

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



#### DCS-1307

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



#### NFI-1307-V90

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



#### NFI-1463

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



#### DCX-2452A

Designed to secure two Enphase trunk cables on to most rail/racking systems.



**For FREE product samples,  
please reach out to Vin Marino  
[vin@ninefasteners.com](mailto:vin@ninefasteners.com) or 800.539.3939**

## NINE FASTENERS INC.

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[www.ninefasteners.com](http://www.ninefasteners.com)



**Solar Integration**



**Koolbridge Solar, Inc.**

Koolbridge Solar designs, develops, and sells electrical products which allow solar energy to be integrated into homes more efficiently and economically, potentially reducing energy bills, providing greater energy supply reliability, and promoting clean energy. The SMART LOAD CENTER was designed to allow a customer with solar power to use both solar and utility-based energy in a complimentary fashion by maximizing the use of solar energy when the sun is shining and only pulling power from the electrical power grid when solar energy, either direct or from stored backup battery systems, is not available. It manages the homeowner's energy usage down to the individual circuit breaker level.

[www.koolbridgesolar.com](http://www.koolbridgesolar.com)

**Solar Support Structures & Carport Systems**



**Advanced Racking Solutions**

SKYPORT is a carport system designed to be pedestrian and vehicle friendly. The product features nearly 10ft of clearance for automobiles, and over 6ft of clearance for pedestrian paths. It's designed specifically for the tough conditions to which carports can be exposed. There are three standard models; the East West V, a Dual Mono slope, and a Single Mono slope. The product offering makes it easy to configure the optimal layout for parking facilities. SKYPORT is compatible with a variety of foundations to accommodate different soil conditions. The helical pile foundation option reduces the need for heavy equipment, concrete, and repair work of existing parking surfaces.

[www.advancedracking.com](http://www.advancedracking.com)



- AXIpower POLY up to 330 Watt
- AXIpremium MONO up to 350 Watt
- AXIblackpremium MONO ALL BLACK up to 290 Watt

AXITEC, LLC, 1819 Underwood BLVD, Suite 5, Delran, New Jersey 08075, Phone 856-393-7800, info@axitecsolar.com



**Baja Construction Co. Inc.**

Baja Construction specializes in design-build solar support systems for mainframe carports and shade canopies. Their patented product line is designed in-house by Baja engineers. Product structures are pre-fabricated from pre-galvanized high-tensile, light gauge steel, and installed nationwide and abroad by Baja Construction crews. Carports, RV/boat storage, EV stations, and ground mounts can be customized to meet customers criteria. Baja's objective for each solar support system is to leverage performance with optimal electric production while maximizing shaded coverage. Baja has produced cost-effective products for municipalities, offices, hospitals, schools, malls, and multifamily developments.

[www.bajacarports.com](http://www.bajacarports.com)



**Falcon Steel America**

Falcon Steel provides custom metal fabrication products, produced from recycled material. They provide solutions for residential, commercial, or utility-scale solar projects. Whether it be support structures, solar pedestals, or land access gates, Falcon Steel's engineering department provides custom tailored solar solutions. Falcon Steel has been designing and fabricating steel structures and custom products for over 52 years.

[www.falconsteel.com](http://www.falconsteel.com)



**M Bar C Construction, Inc.**

M Bar C Construction, Inc. provides reliable solutions for general contractors, corporate divisions, and government entities working on small or large scale projects. Using heavy and light gauge structural steel, they can incorporate solar efficiency into parking lot canopies, fixed and tracker ground-mount, and parking structure canopies. M Bar C installs approximately 40MW of solar canopies each year. Their solutions are designed to be cost efficient for the long term needs of the customer. M Bar C is licensed and compliant with Cal/OSHA safety programs and prevailing wage jobs. CSLB# 869960.

[www.mbaronline.com](http://www.mbaronline.com)



**RBI Solar, Inc.**

RBI Solar's customizable DSA pre-check (PC) design can reduce approval time for permitting on any project required to adhere to the DSA review process. RBI's design offers a catalog of options to fit the site specific needs of any project. No on-site field welding is required with this design, and minimum structure clearance heights can be adjust up to 14ft to accommodate school buses and other large vehicles. RBI's in-house Project Management and Engineering teams can provide SEOR/AOR services and OTC Meeting support to ensure the project is delivered on time and within budget.

[www.rbisolar.com](http://www.rbisolar.com)



**S:FLEX, Inc.**

S:FLEX PV Carports can be individually designed and engineered to meet all space requirements. Typically columns are spaced at 27' on center and a range of standardized designs for fast and cost-effective solutions is available upon request. S:Flex systems are designed for solar module attachments with grounding, and for any wind, snow, and seismic region. The foundations are completed prior to steel delivery on-site, and pre-assembly options reduce time on-site and working at height. Complete engineering services are also available.

[www.sflex.com](http://www.sflex.com)



**Structural Solar LLC**

Structural Solar LLC designs, manufactures, and installs solar carports on surface lots or parking decks, and solar pavilions or architectural solar structures for commercial, institutional, and government projects across the US including Hawaii and Caribbean nations. The cost-effective structural designs with integrated aluminum racking systems are engineered for 40 - 60 year durability and can be value engineered to accommodate a wide range of challenging conditions and applications. Structures are typically cantilevered up to 45' wide or long span moment frames. Services include engineering for foundations and structures, steel fabrication, coating, steel erecting, and mounting of modules.

[www.structuralsolarllc.com](http://www.structuralsolarllc.com)

**Solar Thermal Manufacturing & Equipment**



**Annealsys**

Annealsys designs and manufactures Rapid Thermal Processing (RTP and RTCVD) and Direct Liquid Injection deposition (CVD and ALD) systems. RTP systems with cold wall chamber, high temperature lamp furnaces (1450°C) and vacuum capability from 3-inch to 200mm for RTP and RTCVD processes. Applications include: rapid thermal annealing, RTO, RTN, contact annealing, CVD of graphene and h-BN, diffusion of dopants, selenization and sulfurization (CIGS) Direct Liquid Injection deposition systems for deposition of metals, oxides, nitrides, metals, 2D materials, etc. These systems can perform deposition processes with the widest range of chemicals including low vapor pressure and thermally unstable chemicals.

[www.annealsys.com](http://www.annealsys.com)





### Beijing Sunda Solar Energy Technology Co.,Ltd.

Sunda evacuated tube solar collectors have their own patents and feature high-tech, performance, durability, and long life-time. The products are widely applied in the water heating system, industry process heating, space heating and air-conditioning system, and other applications.

[www.sundasolar.com](http://www.sundasolar.com)



### Hyspan Precision Products, Inc.

Hyspan Barco Concentrated Solar Power (CSP) ball joints are commonly used to connect the heat transfer fluid piping of parabolic mirror solar collectors to the main header, and in the crossover piping between adjacent rows of the mirrors. These connections absorb the thermal expansion of the collector tube that extends the length of the mirrors, and allow the mirrors to rotate from the stowed position (facing down) and then rotate to track the sun during operation. Hyspan has been selling Barco Ball Joints for more than 30 years with hundreds of thousands supplied. Hyspan's exclusive technology allows rotation of mirrors and thermal expansion of collector tubes.

[www.hyspan.com](http://www.hyspan.com)



The new degree of comfort.®



### Rheem Water Heating

Rheem offers a variety of solar water heating solutions allowing use of the sun's power to provide hot water with great efficiency and low energy costs. A variety of options are available to store hot water and provide backup capabilities, if necessary.

[www.rheem.com](http://www.rheem.com)



### SunEarth

SunEarth provides a large selection of flat-plate solar thermal collectors, solar pool collectors, and solar electric options to both residential and commercial consumers. SunEarth also provides a broad line of balance of system components, including solar storage tanks with or without internal heat exchangers, vertical and horizontal ASME storage tanks up to 37,000 gallons, pump stations, advanced differential controls, circulating and pressure boosting pumps, mounting hardware, racks and roofing specialties, drainback tanks, side-arm heat exchangers and a versatile PV mounting system.

[www.sunearthinc.com](http://www.sunearthinc.com)

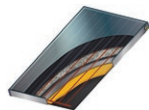


### Viessmann Manufacturing Company

Viessmann is a manufacturer of renewable energy and fossil fuel heating systems. A complete line of Viessmann solar thermal systems for residential or commercial applications includes: flat plate solar collectors featuring ThermProtect technology; vacuum tube solar collectors; pre-fabricated pumping and heat transfer stations; solar control units and communication accessories; DHW storage tanks with internal heat exchanger coils; mounting systems; and system accessories. Constructed from high quality materials, all Viessmann solar thermal system components are carefully design-matched to ensure performance and reliability throughout the system lifespan. Viessmann solar collectors and residential system packages are SRCC and CSA certified.

[www.viessmann.com](http://www.viessmann.com)

### Solar Thermal Systems



### Chromagen Solar Water Solutions

Chromagen has manufactured solar water tanks and solar water collectors since 1962. Chromagen offers open loop and closed loop products for warm and cold climates, for residential and commercial applications. Chromagen provides engineering design services for projects such as hotels, industrial plants, elderly homes, and buildings which bring cost savings to home owners and institutions.

[www.chromagen.com](http://www.chromagen.com)



### SEA Groups, Ltd.

SEA Groups, Ltd. is a manufacturer providing renewable and clean solar energy technologies and products, with an emphasis in solar thermal applications, affordable solar water heater, solar space heating, solar pool heating, and solar air conditioning for domestic and commercial purpose. The company also holds a US Patent for retrofitting gas/electric water heaters into solar water heaters, and has been successfully installing those solar water heater systems in the US for over 10 years.

[www.sea-groups.com](http://www.sea-groups.com)



### Solcan

Solcan solar thermal systems contribute to GHG reduction targets for residential and commercial applications. The Solcan 2101 solar thermal collector is manufactured in Canada and is available with a 4' x 7' and 4' x 8' collector frame. The standard header is 3/4" with pre-installed union connections. Other header sizes and connection methods are available upon request. Solcan solar collectors are backed with a 10-year limited warranty and have a life expectancy of over 20 years.

[www.solcan.ca](http://www.solcan.ca)

# G-Max

### Pre-Installed Connection Points

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

**40% Span Increase**  
In purlins

### 30% Pre-assembly

Girder, head, and strut unfold in field allowing for single person installation

### On-site QC

Factory printed ID # and description for improved quality control

### Revolutionizing Utility-Scale Fixed-Tilt Market with G-Max™

- Reduced component count
- Highest level of pre-assembly in the industry
- Single person installation of girder, head adapter, and strut
- Components optimized for strength, safety, and fast installation
- 20 year limited warranty

Contact us at **1-888-608-0234** or visit online to watch a video—just one person to install girder, head and strut in a few simple steps.

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**SCHLETTER**  
The Solar Mounting Group

[www.schletter.us/gmax](http://www.schletter.us/gmax) | [www.schletter.ca/gmax](http://www.schletter.ca/gmax)





**Stiebel Eltron**

Stiebel Eltron manufactures energy saving and renewable energy products, including their Tempra Plus tankless electric water heaters, which can perform as back-ups for solar thermal systems and Accelera 220E (58 gal) and 300E (80 gal) heat pump water heaters which can run on a solar PV system. Stiebel Eltron SOLkits consist of a well-insulated storage tank with heat exchanger(s) and high performance flat plate collector panel(s). They constitute an economical and reliable solar domestic hot water (DHW) system for commercial and residential applications, including space heating and swimming pools. The solar closed loop system includes their SOL 27 PREMIUM flat plate collector panel(s) and mounting hardware, a SB/SBB storage tank with heat exchanger(s), a pump station with expansion tank, and various temperature / pressure gauges, pressure relief and check valves, and a controller unit with corresponding sensors. There is a 10-year warranty on Stiebel Eltron solar panels and tanks.

[www.stiebel-eltron-usa.com](http://www.stiebel-eltron-usa.com)



**Sun Bandit by Next Generation Energy**

Sun Bandit by Next Generation Energy is an ICC-SRCC certified, ENERGY STAR rated, and UL listed on-site solar PV water heating and energy storage solution. It requires no net meter connection and provides simple off-grid operation empowering home builders, solar professionals, and consumers to reap the benefits of solar energy regardless of the incentive landscape, and without utility approval or long-term contracts.

[www.sunbandit.us](http://www.sunbandit.us)



**TIGI Solar**

TIGI developed a new type of solar thermal collector and system targeting higher temperatures, as required for commercial and industrial users even in cold climate conditions. The patented technology is based on transparent insulation and focuses on minimizing energy losses with additional related innovations including collector-level overheating prevention and system innovation that increases performance and decreases cost. Certified in Europe and the USA, with sales and working projects in Israel, Europe, and the USA, including for wineries, laundry, senior citizen homes, hatching farm, large dish washing, and more.

[www.tigisolar.com](http://www.tigisolar.com)

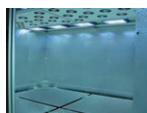
**Testing & Certification | Testing Chambers**



**EYE Lighting /Applied Optix**

EYE Applied Optix provides scientific and industrial application lighting systems for solar simulation, weathering test chambers, and high speed imaging. This professional group focuses on the science of using lighting, optics, filters, and electronics to interact with matter and provide solutions to a wide range of industrial applications.

[www.eyeppliedoptix.com](http://www.eyeppliedoptix.com)



**Honle UV America, Inc.**

The Honle Group is an international supplier of industrial UV/LED, and Sun Simulation technology. Honle UV Technology develops, manufactures, and distributes UV systems, UV lamps, LED systems, and measurement instrumentation worldwide. The equipment is used in the curing of photo reactive substances as well as surface sterilization and sun simulation. At the heart of every UV system is the Honle Lamp. Honle manufactures its own high-performance UV discharge lamps and apart from standard spectra lamps, customer specific and process specific lamps are produced.

[www.honleuv.com](http://www.honleuv.com)



**Q-Lab Corporation**

Q-Lab provides accelerated weathering and corrosion test equipment and test services. Comprehensive accelerated testing of materials and modules helps to develop higher durability solar solutions. In addition, Q-Lab offers contract test services, which include accelerated laboratory testing, at locations worldwide. Outdoor exposure testing for weathering, light-fastness, and corrosion is available in both Florida and Arizona locations.

[www.q-lab.com](http://www.q-lab.com)



**UL, LLC**

UL advises on solar projects, as well as battery and energy storage technologies, helping their clients make them safe, compliant, and perform to high standards. They provide project development support, resource assessment and energy services, asset management services, technical due diligence services, grid solutions, testing, and certification.

[www.ul.com/solar](http://www.ul.com/solar)

**Theft Protection**



**Bryce Fastener, Inc.**

Bryce Fastener provides tamper-resistant and custom keyed ground-mount security screws, nuts, and self-drill fasteners.

[www.brycefastener.com](http://www.brycefastener.com)

**Tools**



**McCann Equipment, Ltd.**

McCann Equipment Ltd. is a multi-branch Canadian industrial tool distributor, specializing in the sale, service, and rental of torque and tensioning products. Their services include the repair, calibration, and certification of torque tools (manual, electric, pneumatic, hydraulic), transducers, and testers. Additionally, they certify air pressure gauges and hydraulic gauges as well as tension calibration testers (Skidmore). Each of the company's branch offices is ISO 17025 accredited. The scope and accreditation for each is available on their website.

[www.torquetools.com](http://www.torquetools.com)



**WEH**

WEH designs and manufactures high-quality nozzles, breakaways, receptacles, filters, and check valves for hydrogen refueling and has become a partner to the automotive industry in this technology. Safety, ease of operation, and the well-executed design make WEH H2 products a solution for manufacturers for H2 filling stations and fuel cell vehicles worldwide.

[www.weh.us](http://www.weh.us)

**STANDING SEAM ROOF ANCHOR**

**STANDING SEAM ROOF ANCHOR**

**THE INDUSTRY'S LIGHTEST AND MOST UNIVERSAL FIT**

**1 DEVICE FITS OVER 500 DIFFERENT SEAMS**

- Industry's lightest device at 4.5 lbs
- OSHA/ANSI 5,000 lbs tested
- Non-corrosive components
- Protects from falls in all directions
- Roof jack adapter plate available

**863-703-4522**

Patent Number: US D629,679

[www.standingseamroofanchor.com](http://www.standingseamroofanchor.com)



## Tracking Systems



### Array Technologies, Inc.

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

<http://arraytechinc.com>



### GameChange Solar

GameChange Solar's Genius Tracker is a single axis tracker with a power density of 99.3%. With Black & Veatch technical assessment, CPP wind tunnel tested and rated 150mph, ETL / UL 2703 tested, this reliable 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 and Tru3D-Gimbal bearings account for pile installation being out of plumb, out of azimuth, and out of vertical and east-west alignment. The self-powered rows eliminate the central drive and allow for uninterrupted grass cutting and panel washing.

[www.gamechangesolar.com](http://www.gamechangesolar.com)



### Ideematec, Inc.

Ideematec SafeTrack Horizon Version 3 is a large unlinked tracking system with 120kW per tracker. SafeTrack Horizon has only 180 posts per MW, a high terrain flexibility with up to 36% terrain inclination, and fits for framed and frameless modules. By implementing O&M free components and free access for cleaning, SafeTrack Horizon provides a low O&M impact with only 9 motors per MW. Ideematec has installed more than 1GW worldwide.

[www.ideematec.com](http://www.ideematec.com)



### Nclave

Nclave (as a result of the merger between Grupo Clavijo and MFV Solar) is a global company, providing development, design, manufacturing, installation, and maintenance of structures and solar photovoltaic trackers, including the design and execution of any type of foundation. With over 2.5GW developed worldwide and their own manufacturing center in Spain, Nclave offers solutions custom-made to its clients with minor installation costs and, during the projects lifespan, also low operational and maintenance expenses.

[www.nclavegroup.com](http://www.nclavegroup.com)



### NEXTracker

NEXTracker's smart self-powered tracker, NX Horizon, is a tracker used by EPCs and project developers worldwide. NX Horizon has self-contained motor power on each independent row, using less steel and rotating a full 120° degrees. Efficiently designed, NX Horizon has been installed on over 10GW of solar projects globally. CAPEX is lower because rows are not linked with a drive shaft so maintenance vehicles can drive through the arrays freely, resulting in faster and easier O&M, less labor, and truck rolls. NX Horizon also comes with Digital O&M services, allowing for owner-operators to have predictive maintenance control and real-time performance analytics.

[www.nextracker.com](http://www.nextracker.com)



### Solar FlexRack

Solar FlexRack's latest tracker technology bundles an advanced tracker design with full project support services reducing solar project costs and risks. Engineered for high performance, BalanceTrac technology supports higher energy yield designs and reduces wear and tear on components for longer lasting tracker equipment. Features include more modules per row (up to 90), rotational range of 110° (± 55°), optimized for 1000 and 1500V modules, lower per-unit fixed costs for BOS savings, new wind damper technology to mitigate wind conditions, and more.

[www.solarflexrack.com](http://www.solarflexrack.com)



### Soltec America, LLC

Soltec is a manufacturer and supplier of horizontal single-axis solar trackers. The company has manufacturing facilities in Brazil, China, and Spain, as well as offices in Australia, Denmark, Chile, India, Israel, Italy, Mexico, Peru, and the United States. Soltec introduced SF7, its next generation PV tracker, which enables high yield and achieves low installation costs. SF7 is a solar tracker with high yield-per-acre performance and versatile land-use options; a solution for large-scale PV tracking projects.

[www.soltec.com](http://www.soltec.com)

## HEYCO® Wire Management and Screening Solutions for Solar Installers & Integrators...

### Heyco® Solar Products Warranty

Visit [www.heyco.com](http://www.heyco.com) for information about Heyco's 20 Year Limited Warranty on our solar products.

**Heyco® HEYClip™ SunRunner® Vidrio™** NEW  
Designed to mount directly onto glass panels with compression force only—will not harm the glass surface. The black TPE coating meets many HOA requirements while providing an electrically insulated cable mounting.



**Heyco® HEYClip™ SunRunner® 90, 90-2 & 90-4** NEW  
Double-compression, right angle design for use with PV modules mounted in "landscape" mode.



**Heyco® HEYClip™ SunRunner®**  
Double-compression design holds from (1) 12 gauge USE-2 to (2) 10 gauge PV-1000 V solar wires.

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

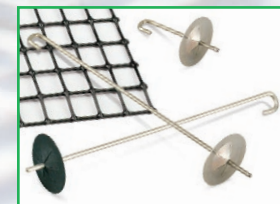


**Heyco® SunBundler® Stainless Steel Wire Cable Ties**  
Aircraft grade 302/304 stainless wire w/UV protected vinyl jacket and stainless steel crimp sleeve, 8" (203 mm) to 20" (508 mm) lengths—Special lengths available upon request.



**Heyco® SunScreener® Wire Mesh Clips and SunScreen™ Wire Mesh**

Firmly holds wire mesh screen to module assembly to protect panels from rodents and nesting birds. SunScreen Wire Mesh available in 4', 6', and 8' x 100' rolls.



For FREE samples or product literature, call toll free 1-800-526-4182, or visit [heyco.com](http://heyco.com)



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**STi norland USA, Inc.**

STI Norland is a horizontal single axis tracker designer, manufacturer, and supplier. They can also provide installation services. They offer centralized (STI-H1250) and single row (STI-H160) tracker solutions, and fixed structures either monopile (STI-F3) or bi-pile (STI-F5). They can also offer complete mechanical EPC services including: engineering (geotechnical report, topographical analysis, earth movement balance, execution project), foundations design, manufacture drawings, supply, and assembly of the equipment. All the technical documentation including quality, assembly, logistics, and maintenance manuals (preventive and corrective) are included as the associated training.

[www.stinorland.com](http://www.stinorland.com)



**Sunfolding**

The Sunfolding T29 is designed for simplicity. It eliminates motors, gearboxes, linkages, batteries, and bearings, reducing costs at each stage of the solar product lifecycle; from project planning and engineering design to construction and maintenance. The Sunfolding T29 incorporates a proprietary design, commonly used in industrial lifting and tilting, to eliminate complexity and increase reliability. By removing complexity, the T29 is more efficient, reducing overall system costs.

[www.sunfolding.com](http://www.sunfolding.com)



**Zomeworks Corp.**

Zomeworks manufactures the passively operated Track Rack for PV tracking systems. No motors or gears, just simple reliability. Several sizes for all needs. Pole mounted Fixed Racks are also available in several sizes. For unique battery enclosures that passively cool in summer, resist freezing in winter, Zomeworks manufactures the Cool Cell. These are also available in several sizes and custom configurations. All products are made in USA.

[www.zomeworks.com](http://www.zomeworks.com)

**Transformers**



**Dongan Transformers**

Dongan Transformers provides power, custom, and distribution transformers up to 2000 kVA for solar, wind, and general purpose applications, including tracker motor supply, industrial control, high voltage, ignition, air and iron core reactors, fault current limiting reactors, and more. Dongan's products are designed and manufactured in the USA.

[www.dongan.com](http://www.dongan.com)



**Virginia - Georgia Transformer**

Pad Mount transformers manufactured by VTC are custom built pad-mount GSUs for renewable energy power characteristics, and not distribution-type transformer designs. VTC designs address the appropriate technology that apply as recommended by specialists for pad-mount GSUs for renewable energy. This technology results in a custom design which addresses the special power characteristics of varying dynamic loads and the associated harmonics in wind and solar farms.

[www.vatransformer.com](http://www.vatransformer.com)

**Utility Scale Solar | PV**



**Ciel & Terre**

Established in 2006 as a specialist in the integration of photovoltaic systems, Ciel & Terre (C&T) has been fully devoted to floating solar PV since 2011, developing the first patented and industrialized water-based PV concept HYDRELIO. In response to land use conflicts, this solution consists of installing PV modules on inland and artificial water bodies to produce energy in a more efficient way. The floating PV group's activity is fully-integrated, including technical innovation, manufacturing, project development, design, and EPC, as well as system O&M, financing solutions, and consulting activities.

[www.cieletterre.net](http://www.cieletterre.net)



**Parker Hannifin**

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

[www.parker.com/energy](http://www.parker.com/energy)



**TerraSmart**

For eight years, TerraSmart has provided solar racking, engineering, design, and manufacturing of turnkey, ground-mount racking solutions for commercial to utility-scale solar projects. Bringing more than thirty years of experience in structural engineering and steel fabrication, TerraSmart has built over 1.8GW's of ground-mount projects across the United States. TerraSmart's ground screw foundation and racking systems help minimize project risks, ensure successful installation in all soil types, and offer cost-effective solutions.

[www.terrasmart.com](http://www.terrasmart.com)

**Energport Battery Energy Storage System**

Driven By **Sinexcel**

**AC RACK L3060**



- 30kW Sinexcel PCS
- 64.5kWh Battery
- LFP Li-ion Battery
- Small footprint
- Easy install
- EMS included
- Remote monitor
- 480V 3p
- ETL Certified
- CA SGIP Approved

- Demand Charge Bill Savings
- PV Self-Consumption
- Backup Power for Emergency
- Turnkey Solutions
- In Stock Now in Bay Area
- Dealer / Installer Wanted
- 10 Year Warranty

**Storage Inverters 30~500kW**

- cETLus listed according to UL9540/UL1741SA/CSA22.2
- HECO CGS/CSS listed
- CPUC listed
- Grid-interactive & Grid-forming

**Outdoor Commercial & Industrial Battery Energy Storage Solutions**



30kW      50-150kW      250-500kW

**Eco-NRG Llc**

Eco-NRG Llc has been in the industry over 35 years, providing system equipment, evaluation, design/siting, interconnection services, and access to capital.

[www.econrgllc.com](http://www.econrgllc.com)



**Inovateus Solar, LLC**

Since 2003, Inovateus Solar has been creating energy solutions for their clients. With the ability to offer customers a wide variety of solar energy products and services, Inovateus Solar has built a strong portfolio of customers ranging from fortune 500 companies to utilities, universities, municipalities, and the federal government. Inovateus has completed over 315MW of solar installations in the USA and the Caribbean, and has delivered services in over 15 countries.

[www.inovateus.com](http://www.inovateus.com)



**Tropenas Company**

Tropenas Company provides independent engineering to developers, owners, utilities, and solar OEMs by offering turnkey electrical, substation, structural, and civil solar permit drawings. With more than 4GW of interconnection applications and designs, their multi-state local engineers will lead any portion of a solar project. Tropenas' designs blend contractor field experience with value engineering, resulting in durable and affordable utility-scale solar.

[www.tropenas.com](http://www.tropenas.com)



## Wire Management



### CAB Products

The CAB Solar Cable Management System, for use in large scale, ground mount power plants is a unique and simple solution to the age-old problem of cable management. CAB's patented designs get cabling up and out of the ground by using messenger wire to support hangers containing cabling of all types. Their new design integrates cable management and grounding into one cost-saving system.

[www.cabproducts.com](http://www.cabproducts.com)



SOLAR COMPONENTS  
a PennEngineering® Company



### Heyco Products

Heyco recently added two new SunRunner clips to its line of wire management products for solar installations. The SunRunner 4-2 and 4-2U both work with the new Enphase Q Cable and work with a variety of racking profiles. The 4-2 works with Everest, SnapNRack, and other similar racking profiles whereas the 4-2U works with Unirac, IronRidge, and other similar racking profiles.

[www.heyco.com](http://www.heyco.com)

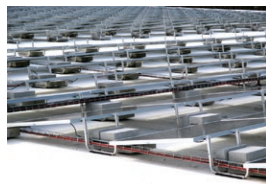
**NINE**  
FASTENERS INC.



### Nine Fasteners, Inc.

Nine Fasteners introduces their newest wire management clip offering; the NFI-1701. This clip was designed for the new Enphase IQ microinverter wire, but is also capable of holding multiple PV wires or SolarEdge Optimizer wires. The NFI-1701 is a rail mounted clip constructed of 301½ hard stainless steel material. It is manufactured entirely in the U.S. and, as with all of Nine's clips, with a rolled outer edge for maximum wire safety. This new clip was recently passed UL testing to scope 1565 for use within a solar installation and carries a UL Listed designation.

[www.ninefasteners.com](http://www.ninefasteners.com)



### OBO Bettermann of North America, Inc.

OBO Bettermann of North America provides specially designed wire management products for solar installations. Their hot dip galvanized wire basket trays are self connecting. The 10ft section connects in a single snap, making installing tray on rooftops fast and easy. Their tray systems are UL classified and feature a lightweight aluminum cover to protect cables from direct sunlight and extend cable life. Most sizes and finishes are in stock and ready to ship. They can also help select the right size tray and mounting options for custom applications.

[www.obous.com](http://www.obous.com)



### RayTray Solar, LLC

RayTray v2 is a solar wire management system. Listed to conform to UL Standard 870 for use with ballasted flat roofs, or standing seam. A simple 3 piece system composed of tray, cap, and base, is highly customizable. Cap and tray, standard 8' lengths. Created by a NY-based EPC for their own installations, available nationally since January 2016. RayTray is utilized by installers and EPC's for commercial solar projects in over 25 states. It can hold thirty 10 AWG wires per tray. It is an efficient and economical alternative to PVC or conduit. Quick installation, and simplifies O&M. No grounding, no roof attachment needed. With a short lead time, this system is made in the USA in a factory powered by solar and costing less than a penny per watt.

[www.raytraysolar.com](http://www.raytraysolar.com)



WILEY

### WILEY

Engineered for high-quality wire management solutions, Wiley Cable Clips simplify wire management and create a clean aesthetic to solar PV arrays. The clips are made of corrosion resistant stainless steel, which makes for a durable, long lasting, and reliable solution in all environments and are designed with coined edges to prevent damage to cable insulation. Custom designs are available upon request. The Wiley Bundle Strap is made of corrosion resistant 304 stainless steel, which makes them a durable, long lasting and reliable solution for all environments.

[www.hubbell.com](http://www.hubbell.com)

## Other Aerial Imagery Solar Report



### EagleView

The EagleView SunSite Report delivers precise roof measurements and 3D models designed to meet the needs of solar installers and designers at multiple stages of a photovoltaic project. With data derived from high-resolution Pictometry aerial imagery, the report offers far greater accuracy than satellite images can provide. Enterprise and smaller residential installers save hours on each project with EagleView's guaranteed-accurate measurements and data, including azimuth calculations, roof area and pitch diagrams, and roof penetration locations. SunSite Reports include DXF or JSON files that easily import into popular solar design products for a fast and efficient workflow.

[www.eagleview.com](http://www.eagleview.com)

## RibBracket™ I-IV

NO MESSY SEALANTS AND NO LEAKING.

ADJUSTABLE | VERSATILE | EPDM WATER TIGHT SEAL



S-5 leads the way in ingenuity and smart design when it comes to attaching anything to a metal roof. That's why we invented the RibBracket I, II, III, and IV products. They are thoroughly tested for strength, have no moving parts, and flexibility to fit various trapezoidal roofs.

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**Associations**



**Ironworker Management Progressive Action Cooperative Trust (IMPACT)**

IMPACT is a labor management partnership designed to provide a forum for union ironworkers and their contractors to address mutual concerns and encourage reasonable, balanced solutions. Their members are committed to increasing the competitiveness and market share of the union ironworking industry. Their primary mission is to expand job opportunities through progressive and innovative labor management cooperative programs, providing expertise in ironworker and contractor training, construction certifications, safety, marketing, and construction project tracking and bidding.

[www.impact-net.org](http://www.impact-net.org)



**Capacitors**



**Cornell Dubilier Electronics**

Next generation inverter designs for renewable energy demand reliable DC link capacitors with higher capacitance values, voltage, and current ratings. Available in new case sizes and ratings, Cornell Dubilier's Type 947D power film capacitors offer high bulk energy storage, ripple filtering, and life expectancy for wind and solar power inverter designs, as well as electric vehicle applications. Clients can select from hundreds of standard catalog listings, or connect with CDE engineers to develop special designs to their requirements.

[www.cde.com](http://www.cde.com)

**Civil Engineering**



**Taney Engineering**

Taney Engineering meets all pre-construction project requirements from Zoning and Entitlements to Final Maps. Services include Feasibility Studies, Grading Plans, Street Plan and Profiles, Hydrology Studies, Aerial Mapping, Ground Support Services, A.L.T.A. Surveys, Boundary and Topographical Surveys, Construction Staking, and Hydrologic Modeling. Taney Engineering also provides Channel and Storm Drain Design, Flood Control Masterplanning, Technical Drainage Studies, Sedimentation and Erosion Modeling, Stormwater Detention/Retention, Basin FEMA Flood Plain Delineation, Hydraulic Design of Bridges and Culverts, Record of Survey, Right-of-Way Acquisitions, GPS Surveys, Aerial Control Surveys, Geodetic Survey, Legal Descriptions, Lot Line Adjustments, and Parcel Mapping.

[www.taneycorp.com](http://www.taneycorp.com)

**Construction**



**Worldwide Rental Services and Pipeline Division**

The SPD-150 padding machine is a solution for smaller jobs where space, mobility, and accessibility is restricted. This machine is useful for small pipelines, utilities, and wind and solar energy projects. It is useful in the latter due to the grid-like pattern some of the cabling needs to be laid in. The SPD-150 padder is operated by an easy-to-use remote controller which offers simple handling and provides the operator with views of both the ditch and its surroundings. An optional ROPS is also available if/when the operator needs to sit in the platform for transportation to and from the job site.

[www.wsrents.com](http://www.wsrents.com)

**Equipment Manufacturer**



**GRT Utilicorp, Inc.**

GRT Utilicorp is a manufacturer of post driving and pressure digging machines. They also provide sales of new and used machines, truck and track mounted machines (for highway median or solar panel post driving), repair and replacement parts, pneumatic rock drills, augers, and driving equipment for smaller jobs.

[www.grtutilicorp.com](http://www.grtutilicorp.com)

**Power Engineering and Consulting**



**Electric Power Engineers, Inc.**

EPE Consulting provides the following services; transmission and distribution planning and design, energy market analysis, project/system design, interconnection testing and commissioning, NERC compliance services, integrated resource planning, smart grid modeling, and power system studies.

[www.epeconsulting.com](http://www.epeconsulting.com)

**Project Management & Asset Development**



**CWL Energy Management Ltd.**

CWL Energy offers land, environmental, and permitting expertise to support clean energy development projects in Canada. They provide project management support through all stages of project development from site selection through to permitting, design, financing, and offtake agreements, to create a platform for clean energy development and investment. They are currently managing the build out of over 300MW of clean energy development projects.

[www.cwlenergy.com](http://www.cwlenergy.com)

**Protective Solar System Barrier**



Beautify your system. Protect your investment.



**SolaTrim**

SolaTrim is a barrier system for rooftop solar that provides an easy-to-install perimeter skirting giving an aesthetic, completed look to solar arrays while eliminating any potential damage from pests, debris, and environmental threats. Squirrels, pigeons, leaves, snow and ice dams are no longer a problem with SolaTrim. SolaTrim uses a peel and stick adhesive designed to withstand extreme climate conditions and is designed to last for the life of the solar system. SolaTrim is a permanent solution that beautifies rooftop solar, raises customer satisfaction levels and referral rates, increases closing percentages, and mitigates long-term O&M costs.

[www.solatrim.com](http://www.solatrim.com)

**PV Design | Build**



**Baker Electric**

Baker Commercial Solar is the solar energy arm of Baker Electric. They design and install commercial and utility solar and storage systems, helping their customers save money and increase profitability. They analyze electric usage to design a new system or add to existing systems. They recommend what works best for specific project needs; roof, ground mount, canopy, and carport. Their on-site staff includes engineers, designers, estimators, project managers, and LEED and NACEP Certified employees. Their expertise includes, but is not limited to small and large commercial buildings, non-profits, education facilities, and government/military installations.

[www.baker-electric.com](http://www.baker-electric.com)

**Solar Wire Management Solutions**



Solar Edge Clips



Wire Clips



Cable Ties



Stainless Steel Ties



[www.lecosolar.com](http://www.lecosolar.com)

201-343-3330

[barry@lecosolar.com](mailto:barry@lecosolar.com)



## Radiant Heating

**STEP**  
warmfloor®



### Electro Plastics, Inc./STEP Warmfloor

Electro Plastics, Inc. is the manufacturer of STEP Warmfloor, an electric heating system based on self-regulating nanotechnology. As the material warms up, it uses less energy and cannot overheat. Installation is simple, and the thin, flat heaters can go under any flooring. The system is energy efficient, can be operated by line or low voltage, AC or DC, and can be connected directly to solar panels. Used for primary heating in new construction and remodeling for all buildings, it is also available for snow melting and roof deicing. All products are manufactured in USA with sustainable, non-hazardous, and recyclable materials.

[www.warmfloor.com](http://www.warmfloor.com)

## Rock Crusher & Milling



### Ironwolf Manufacturing, LLC

The IronWolf Crusher is an attachment designed to mount on wheel and track loaders to enable superior mobility for a variety of construction, reclamation, mining, and forestry applications. The 1000 Series includes a cutter assembly with a 10ft wide cutter drum and an auxiliary engine package. The cutter drum diameter options are 40" and 48" enabling cutting depths up to 12" and 16" respectively.

[www.ironwolf.com](http://www.ironwolf.com)

## Snow Removal System

**M&S**  
TRACK BUGGY



### Bitimec International, Inc.

M&S Track Buggy's RoboKlin is a machine for washing commercial ground-mount PV installations. For winter weather, they've added a special brush to the machine, turning it into a Snow-Brush, and able to get the megawatts flowing quickly after a severe snowfall.

[www.wash-bots.com](http://www.wash-bots.com)

## Solar HVAC Equipment Manufacturer



### Multiaqua Inc.

The MHRC-AE chiller features a built in solar inverter that allows a connection from solar power directly to the chiller. The chiller captures 100% of the refrigeration process waste heat that is normally rejected to the air. The unit will operate in dedicated cooling, dedicated heating, or water to water simultaneous heating and cooling modes. It does not have to be in the cooling mode to make heat. With this system, it is possible to cool rooms as well as heat showers, sinks, or a swimming pool with the same outdoor unit thereby eliminating the need and cost of traditional water heating methods.

[www.multiaqua.com](http://www.multiaqua.com)

## Solar Radiometer Calibration

**ISO-CAL**  
north america



### ISO-CAL North America, LLC

ISO-CAL North America is an ISO/IEC 17025:2005 accredited calibration laboratory specialized in the calibration of solar radiometers: including UV, visible light, solar, and far infrared sensors. Services include indoor and outdoor WRR, WISG, or NIST traceable primary and secondary reference calibration, depending on calibration method and sensor model type.

[www.isocalnorthamerica.com](http://www.isocalnorthamerica.com)

## Solar Screen Manufacturing



### Babcock & Wilcox MEGTEC

Babcock & Wilcox MEGTEC is a global turnkey supplier of custom single-side or simultaneous two-side coating lines, drying systems, and environmental solutions. B&W MEGTEC has developed solutions for applications in lithium-ion battery electrodes, fuel cells, advanced composites, battery separators, solar films, membranes, clean room processes, and others. Its GigaCoater wide-web coating line for lithium-ion battery electrodes provides high-volume production of battery electrodes, with each GigaCoater capable of producing up to 3GWhr of electrode capacity per year on average. B&W MEGTEC has also developed an easy-to-use laboratory coating line designed for short production runs. In addition, they offer a complete range of pollution control equipment consisting of oxidizers, solvent recovery systems, and distillation and purification systems.

[www.babcock.com/megtec](http://www.babcock.com/megtec)

## Solar Slip Sheets & Block



### East Coast

East Coast is a distributor and manufacturer of slip sheet solar roofing material which can be cut to size and delivered onsite. East Coast distributes manufacturers including Garland, Tremco, and Firestone and can cut the material to specific sizes or rolls, meeting their client's needs. They offer ballast block for ground mount or roof mount applications which meet or exceed ASTM requirements. East Coast also provides MC4 Connectors individually or in pairs.

[www.eastcoastelectronics.com](http://www.eastcoastelectronics.com)

## Valves, Measurement & Control Systems



### GEMÜ Valves, Inc.

GEMÜ supplies valves, measurement, and control products to plant designers and manufacturers of solar cells. GEMÜ is itself also an end customer for solar technology. The photovoltaic roof of the Development and Innovation Centre, the GEMÜ Dome, has a tower roof which can be rotated through 360° following the course of the sun.

[www.gemu-group.com](http://www.gemu-group.com)

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MORE VALUE.**

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Lower your production costs by choosing quality **Steinbach** materials.

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**Steinbach**  
Diaphragms  
& PTFE



## SOLAR POWER NORTHEAST

February 5<sup>th</sup>-6<sup>th</sup>, 2018

Westin Boston Waterfront — Boston, MA

Formerly known as PV America, Solar Power Northeast has featured leaders such as New York's energy Czar, Richard Kauffman, the former COO of the Carbon War Room, Peter Boyd, and other recognizable names in the industry. The event will bring 70 exhibitors looking to connect with those looking to network and grow their business in one of the hottest solar market in the US.

[events.solar/northeast/](http://events.solar/northeast/)

show in print

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



### Custom solar support structures

Baja Construction's Solar Support Systems product line of patented structures branded under Baja Carports, the company creates custom solar design-build carports and turnkey covered RV and boat storage. With over 300MW PV's successfully installed, Baja provides in-house designers, engineers, project managers, and construction crews to their customers. They can create one-on-one customized site plans pre-fabricated from pre-galvanized high-tensile, light-gauge steel and install to fully commissioned canopies. All mainframe structures are offered in solar or non-solar canopies to meet the criteria of developers, architects, contractors, and end user's specifications.

**Baja Construction**

[www.bajacarports.com](http://www.bajacarports.com)



### Earth anchor foundation system

Nuance Energy's patent-pending Osprey PowerPlatform affords advances in ground mount solar EPC practices by minimizing the engineering required, adding modular scalability to the construction and procurement process, and reducing costs and effort. This earth anchor foundation system satisfies permitting requirements for virtually any site and soil type without any need for geotechnical reports or special inspections. It eliminates the need for heavy equipment or cement by enabling small, unskilled crews to install the entire platform quickly and easily using only handheld tools. Simple field testing to 1.5x the specified loads then assures compliance with applicable codes and regulations.

**Nuance Energy**

[www.nuanceenergy.com](http://www.nuanceenergy.com)



### Rail-less mounting system

POWER DISK is a unique roof attachment that can go anywhere on residential rooftops. It does not need to be secured to rafters and allows solar modules to be installed in four simple steps. POWER DISK is flexible and adaptable; it allows installers to set modules in portrait or landscape format and can be attached directly to rafters, if desired. Fitting most framed 60- and 72-cell modules, POWER DISK is pre-assembled and quick-to-install with built-in electrical grounding clips integrated in the mount and optional flashing. POWER DISK is UL2703 code compliant. PLP's website also features a new POWER DISK design tool which provides optimal residential roof layouts with the unique deck mount attachment and offers built-in code compliant engineering, and a simple user interface.

**Preformed Line Products**

[www.preformed.com](http://www.preformed.com)

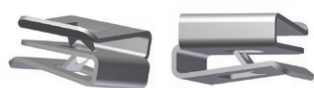


### Dual-axis tracker

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

**AllEarth Renewables**

[allearthrenewables.com](http://allearthrenewables.com)



### Flange securement clip

The ACC-FWT flange securement clips from BURNDY are used to secure a cable tray to PV module frames. The ACC-FWT is made of corrosion resistant 304 stainless steel, which makes it a durable, long lasting, and reliable solution for all environments. The ACC-FWT is easy to install and can be installed onto flanges of various thicknesses. ACC-FWT flange securement clips are a solution for keeping the PV installation neat, clean, and free from ground faults.

**BURNDY** | [www.burndy.com](http://www.burndy.com)



### UL listed stainless steel clip

Nine Fasteners NFI-1307-V90 solar wire management clip is a 90-degree oriented, module mounted, PV wire clip designed to secure up to two PV wires, or equivalent. As with all of Nine Fasteners' clips, the NFI-1307-V90 is manufactured in the U.S. with a rolled outer edge for maximum wire safety. Recently, Nine Fasteners has upgraded this clips' status with UL from Recognized to Listed, ensuring an added level of assurance for installers using Nine's clips.

**Nine Fasteners, Inc.**

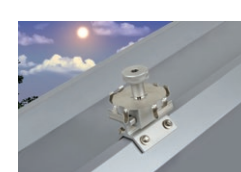
[www.ninefasteners.com](http://www.ninefasteners.com)



### 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](http://www.fronius.com)



### Water-tight, aesthetic, and versatile mounting system

The PowerMount for R-Panel Metal Roof Systems provides ease of installation in an aesthetically pleasing system. The 6061-T6 PowerMount features a fully EPDM Gasketed Mount to help form a water-tight seal with the roof. Cross Stitch Attachment Technology secures the system with 4 custom screws angled to provide maximum strength and uplift. The stainless fastener w/ EPDM washer offers an additional layer of water protection. The PowerGlide Adjustment Technology provides 2" of adjustment. Their 6061-T6 Universal PV Cube features a robust design and is compatible with all PowerMounts. Go rail-less and utilize the UL 1703 and UL 2703 listed and approved Solar Connection Kit with GroundBonding Technology.

**Solar Connections**

[www.solarconnections.com](http://www.solarconnections.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](http://www.axitecsolar.us)



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# What You May Not Know About Thermal Management

by Sean Whiting



## AS LITHIUM ION-BASED BATTERY ENERGY STORAGE SYSTEMS

(BESS) continue to be developed and deployed, the demand for high performance, high precision thermal management systems is increasing - especially for designs that are economical, practical, effective, and intelligent.

The end result would provide critical support to the energy needs of a growing economy and the power market segment, while protecting the personnel and stored energy equipment assets of the growing membership of power producers.

Battery rack power densities using lithium ion chemistries are typically quite high during the dis/charge cycle(s). The best and most effective thermal management solution for a new or existing installation will depend on the constraints of each BESS subsystem, with air containment and control being the foundation for a successful, fielded design.

There are a large number of variables in a BESS including, but not limited to, the housing (custom ISO shipping container, conventional brick & mortar, etc.), HVAC/R, air volume ducting, battery racks, power consumption, environmental and geographic concerns, and high density, high flux heat loads (which can be a moving target in the new RegD power delivery market).



## Approaches to Thermal Management

- Containment;
  - Allows for the controlled and effective handling of air product within the cooling system while maintaining total system spec for air flows and static pressures.
  - Eliminates air recirculation by sealing gaps, holes, or any other opening, which can cause overheating, and/or hot spots locally or within adjacent equipment.
- Controls;
  - Air Control;
    - Optimizes and directs the volumes of cooling air that flows over the battery modules within the rack(s) resulting in uniform temperatures during dis/charge cycles.
    - Provides the heat laden return air with a clear return path back to the cooling unit(s) and/or alternate path(s) back to ambient.
  - Electrical Control;
    - Is the basis for an intelligent system that can respond quickly and appropriately to changes such as increasing/decreasing internal heat loads in different environmental conditions (extreme hot or cold, etc.).
    - Allows for data acquisition (DAQ) used for system oversight, recurring periodic maintenance, analysis, and system improvements.

## Benefits of Thermal Management

- BESS reliability will be increased by keeping the process system within prescribed operational guidelines for temperature, ensuring that OEM warranties can be supported, and the full lifecycle of the BESS will be fully realized for the most economic gain.
- Battery rack power density can be maximized when the airflow paths (supply & return) are stratified and segregated (not mixed).
- Cooling systems that are properly selected & sized will not experience problems associated with temperature, humidity, airflow, etc.
- Thermal management continuously allows for the proper system “Delta T” (i.e. the difference in temperature between the cold supply air and the hot return air) across cooling unit coils, thereby not reducing the capacity of the units and providing operational cost savings. When conditions occur where the DeltaT rises past spec for an extended period of time, cooling



units may experience shutdowns on pressure due to frozen coolant lines, which shortens the useable lifespan of the equipment.

- Cold supply air that is contained will be forced to flow through the battery racks, where it will absorb heat energy and then be transported directly back to the cooling units. For a traditional, uncontained, raised-floor BESS with perforated floor tiles, more than 50 percent of the cold air supplied from the cooling unit(s) will bypass directly back to the cooling unit(s) as a result of any open paths and/or leakage points that exist.
- Contained hot air returns guarantee an unobstructed path back to the cooling unit(s), which improves system efficiencies.
- Cooling system energy savings will increase and maintenance/replacement costs will decrease by being able to use a lead-lag operation logic with cooling units that become redundant.
- Provide a stable environment for the use of economizer cooling or “free cooling” technologies that work by delivering and trading outdoor air into the system that is cooler than the temperature of the indoor air. When the economizer mode is operational, the cooling system compressors do not work to reject heat to the outdoors, resulting in lower overall operating costs and longer equipment life.
- Can work with almost all stored energy installation configurations and is compatible with fire detection/suppression systems, lighting, and other ancillary subsystems.



Sean Whiting is Vice President of Global Equipment & Manufacturing (“GEM”). GEM is a supplier of commercial and industrial equipment. Product lines include standard and custom ISO containers, trailers, dry vans, reefers, and fabricated housings to enclose work & personnel processes, containerized battery energy storage systems (CBESS), electrical power generation, water treatment processes, power distribution, and UPS & Switch Gear Lineups. Typical product applications include storage, maintenance support, security, military, disaster & emergency preparedness, first response, health & medical and communications.

**GEM** | [www.gemanufacturing.com](http://www.gemanufacturing.com)



### Quick EV charger with modular technology

Circontrol’s new DC quick charging station, Raption 50, includes modular technology, which allows bigger uptime and increases flexibility, without sacrificing a stylish and modern design. This third-generation quick charger increases its uptime and the availability for users thanks to its functioning modular power technology with four individual power packs delivering 12.5kW each. The Raption series also offers flexibility through scalable power, so if a local power network doesn’t support rapid charging or if a user only needs to draw 25kW of power, it may adjust the supply. Designed specially to be placed where vehicles need to be ready to continue their journey in less than half an hour, such as fuel stations, road-side rest areas, or airports, the new unit completes an 80% charge in 30 minutes with simultaneous charging for two EVs at 50kW DC and 43kW AC. The Raption 50 Series has a sophisticated and slim enclosure but is robust and ensures high durability. Another key attribute of the new Raption 50 is its usability. It includes a user friendly and fast 8” touchscreen daily readable with multiple language options, an inbuilt light for better visibility at night, and/or secure charging connector holsters that can only be unlocked from the charging station with a verified RFID card or with the backend authenticate protocol, reducing damage to the equipment through improper use or vandalism. In addition, the Raption 50 emits no audible high frequency noise and the height of connectors/display has been adapted for disabled.

**Circontrol** | [www.circontrol.com](http://www.circontrol.com)

### Testing-based verification tool for battery lifetime

DNV GL has created Battery XT, a testing-based verification of battery lifetime for Li-on batteries. The independent verification tool compiles battery life cycle data and predicts battery degradation under different conditions and duty cycles, providing renewables stakeholders with an objective way to compare the value and reliability of types and brands of energy storage technology. Battery XT offers an independent third-party testing and verification of product warranties and performance guarantees before making a purchasing decision. Battery XT, which can also provide consulting on battery size and chemistry selection, aims to reduce risk and inform purchases and planning for energy storage asset management. The independent verification enables the industry to test at a low cost, helping stakeholders save time and money by eliminating the need to address individual, customized testing protocols for each vendor. DNV GL offers an interactive online demo to illustrate the way Battery XT works. Viewers can try three scenarios—fast charge electric ferry, hybrid genset, and solar+frequency by entering sample information such as system size, temperature, and initial state of charge, and then running a simulator to show how the factors apply. The full service offered on a per project basis is able to tailor even the most complex duty cycle to the customer and their battery.

**DNV GL** | [www.dnvgl.com](http://www.dnvgl.com)



### EMF meter for extremely low frequencies

Extech Instruments’ EMF510 is a single-axis electromagnetic field (EMF) meter optimized for measuring extremely low frequencies (ELF). The compact new meter makes it easy to measure EMFs in the 30 to 300Hz frequency range, making it useful for applications from utilities to product development and engineering. The EMF510 features an informative, oversized dual display indicating both EMF reading levels and the selected EMF range. Users can measure EMF/ELF levels in either milliGauss (mG) or microTesla (μT) units in two ranges up to 2000mG (200μT) with +/-5% accuracy. Useful data functions include data hold, as well as minimum and maximum readings. A bright backlight adds versatility for testing in dark job sites. The auto-power-off function preserves battery life and can be disabled for extended monitoring. The pocket-sized EMF510 is always ready for testing by utilities of EMFs found in the generation, transmission and distribution of electricity, with power lines and substations, as notable examples. Product development and electrical engineers can use the EMF510 to quickly assess EMF levels generated by electrical components such as motors and blowers. Homeowners can use the meter to measure EMFs in household wiring and appliances from vacuums and hair dryers, to electric and hybrid vehicles. A wrist strap is useful for toting while a tripod mount lets users set up the meter with consistent placement to avoid variability in routine measurements (using an optional tripod, TR100). The EMF510 is backed by Extech’s one-year warranty and comes with three AAA batteries.

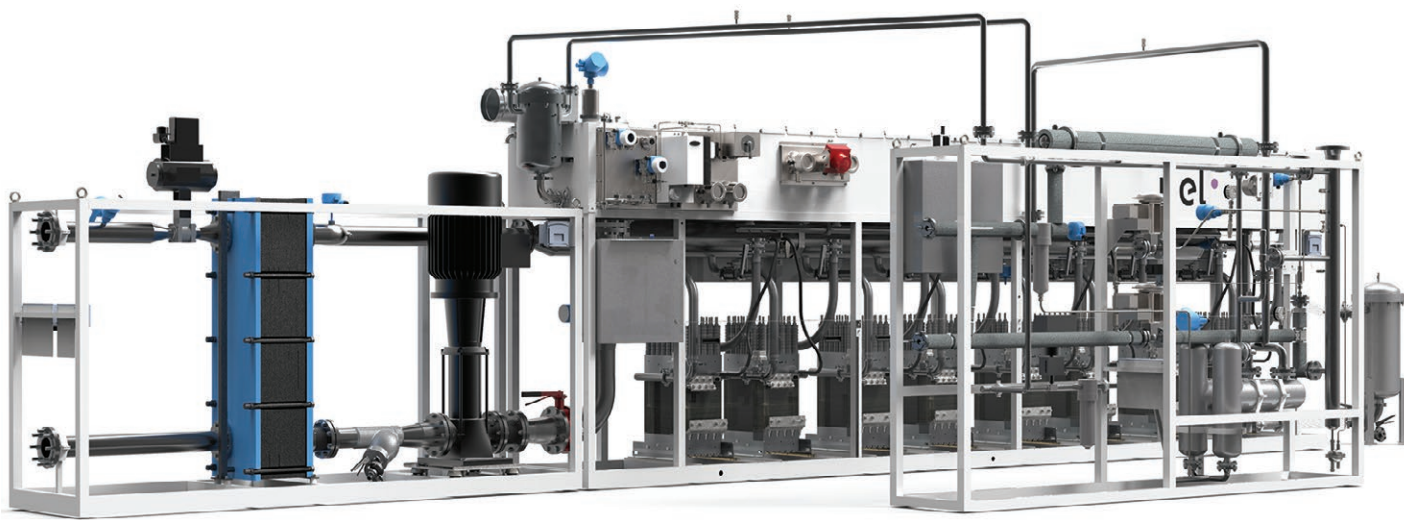
**Extech Instruments** | [www.extech.com](http://www.extech.com)

### Simple energy storage quoting tool for solar dealers

JLM Energy’s Simple Quoting and Design tool, or SQUAD is a straightforward way for solar dealers to provide residential quotes on solar plus JLM’s MicroStorage product Phazr. Phazr pairs each solar panel with a battery pack for a streamlined approach to solar plus storage. SQUAD 1.0 brings time-of-use shifting solutions to California residents, where time-of-use pricing has recently changed in San Diego Gas & Electric Territory in a way that reduces the value of standalone solar. This means homeowners can save their solar power in batteries for hours later in the day when the utility is charging higher rates and people are generally using more electricity. SQUAD is designed to be used at the kitchen table with the homeowner. The sales person plugs in answers to customer lifestyle questions, enabling SQUAD to calculate the ideal combination of solar plus storage along with system pricing. SQUAD generates a sleek, one-page summary of system cost and savings as a leave behind at the conclusion of the in-home consultation. SQUAD uses JLM’s proprietary software Measurz to perform powerful calculations behind the simple user interface. Future versions will include demand shaving and self-supply algorithms.

**JLM Energy** | [www.jlmei.com](http://www.jlmei.com)





# Hydrogen Electrolysis

A viable solution for large-scale renewable energy storage

by Everett B. Anderson

The global demand for power is increasing. This has caused power grids, energy resources, and the environment to face a variety of challenges that often result in high levels of pollution, greenhouse gas emissions, and elevated indirect costs on society. Renewable energy is a viable option to meet the world's ever-increasing demands for energy while combatting greenhouse gas emissions. However, employing solar and wind to generate clean energy on a utility scale doesn't come without caveats.

Potential investors in renewable energy assets look for two things: capital cost, and return on investment (ROI). From a financing perspective, dealing with renewables can prove difficult due to their natural variability; a fluctuating income stream can make it difficult to predict the ROI. For example, if energy demand is high but there is a lack of wind at a wind farm, or cloudy weather that hinders photovoltaic panels from generating energy, local supply suffers. These inconsistencies can be intimidating to stakeholders. Conversely, renewable energy may be wasted if the highest output is produced during lowest periods of demand. Whichever the case, it is critical that stakeholders identify the proper tools to leverage the full potential of renewable assets. Having a scalable, cost-effective solution to storing power will help yield higher returns for renewable energy producers. Many stakeholders are turning to one reliable method for both generating and storing energy - hydrogen.

## Why Hydrogen?

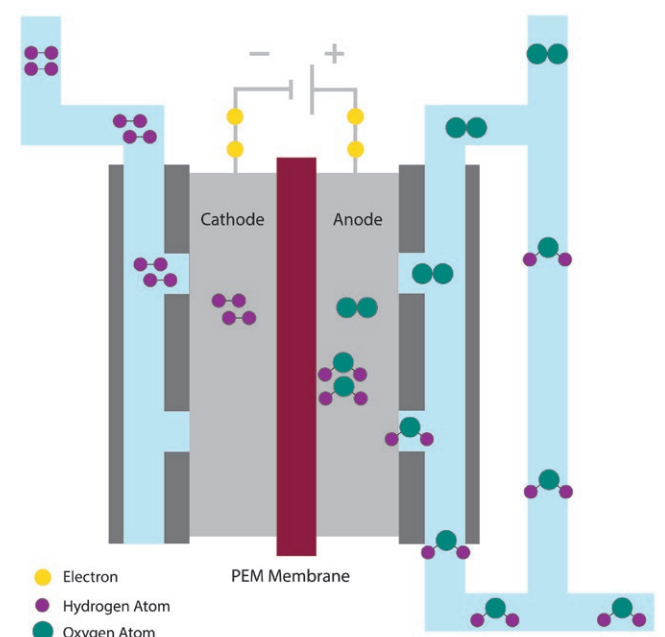
Hydrogen generated from renewable assets is referred to as "green hydrogen." Green hydrogen can be generated and stored in times of low demand, and utilized in periods of peak demand. This flexibility yields predictable and consistent energy figures for stakeholders, essentially acting to fill gaps, meet supply and demand mismatch, and balance the grid. Hydrogen can be stored in high or low-pressure tanks, in large volumes, indefinitely and without any energy "leakage," as compared to a battery. Hydrogen energy storage infrastructure is extremely scalable; it can utilize the existing natural gas grid, or even natural underground caverns. Hydrogen's ability to store large amounts of energy for long periods of time enables seasonal energy storage, which gives it a significant advantage over battery storage. Furthermore, green hydrogen is becoming increasingly valued in the marketplace, as corporations' search for broader solutions to meet their sustainability goals and automotive OEM's embrace the transition to low/no carbon fuels.

It's also important to note that hydrogen energy storage costs more than 50 percent less, compared to battery storage systems - primarily due to the limited life expectancy of batteries. Additionally, batteries that cannot be recycled create other cost and pollution issues.

## Three Ingredients for Hydrogen Energy Storage

Advances in hydrogen generation technology have made it possible to store renewable energy produced by wind, solar, or hydroelectric power, in the form of pressurized gas.

1. Proton Exchange Membrane (PEM) electrolysis is the enabler that makes this possible. PEM electrolyzers utilize an advanced membrane technology and electricity to split water into hydrogen and oxygen. PEM electrolysis has the capability to closely match the variability of wind and solar assets. PEM electrolysis offers a wide dynamic operating range, efficiently generating hydrogen gas over a broad capacity range, ensuring that available energy is not wasted. PEM electrolyzers can also rapidly start up and shutdown operation, which allows renewable energy assets to generate hydrogen efficiently in periods of either peak electric generation or low demand. In addition, the battery-like rapid response of the PEM electrolyzer makes it capable of providing grid ancillary services, such as voltage or frequency regulation. These services can provide additional value streams for the investor, further improving the project ROI.





2. A hydrogen energy storage solution requires a method of storing the hydrogen. In addition to using traditional methods, such as low or high-pressure tanks, the hydrogen generated by the renewable energy assets can also be used in non-traditional ways, such as distribution via a gas pipeline or truck, sold for hydrogen fueling, or used directly for industrial applications.

3. Electricity generation is the final ingredient in most hydrogen energy storage solutions. The stored hydrogen can be transformed back into electricity via a gas turbine, internal combustion engine, or fuel cell.

Energy storage is a hot topic in the renewable energy field, but batteries alone will not be a viable long-term solution for large scale energy storage. Battery energy storage can relieve smaller short-term problems in managing power supply, but there will be extended periods of high demand or low supply, where batteries cannot meet the energy requirements. Hydrogen energy storage is an excellent solution for large scale long term energy storage. This technology will not only enable more investment in renewable energy assets, but increase stakeholders' return on investment. Hydrogen could be the key to a 100 percent green energy future.



*Everett Anderson has more than 30 years of R&D experience in hydrogen and fuel cells. Currently serving as VP of Business Development, he is in charge of identifying and quantifying new opportunities in the emerging markets for hydrogen. His primary focus is on hydrogen energy applications and Proton's M Series megawatt-scale hydrogen generator. Mr. Anderson joined Proton in 2000 and has served previous positions as Research Manager, Research Director, Director of Process and Materials Development and Vice President of Electrochemical Technology. Mr. Anderson holds a Bachelors' Degree in Chemistry from the University of Vermont, an MBA in Management from Bentley University, and has been granted 6 U.S. patents.*

**Proton On Site**  
www.protononsite.com

**Nel Hydrogen**  
www.nelhydrogen.com



### Energy storage solution compatible with various batteries

Sinexcel's commercial and industrial all-in-one battery energy storage solution is based on their ETL/HECO/CPUC listed PCS from 30kW to 500kw, and is compatible with most batteries, such as lead-acid, lithium-ion, flow, and ultra-cap batteries. Various sizes of outdoor cabinets or containers with verified layout of PCS and controls provides high flexibility of working with different battery vendors. The MESA compatible protocol has a full list of registers which offers high flexibility of control via its remote energy management platform.

**Sinexcel, Inc.** | [www.sinexcel.us](http://www.sinexcel.us)

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# The Captive Insurance Opportunity

## Renewable energy

by Monica Everett

### **MOST CORPORATE BUYERS OF INSURANCE HAVE**

heard the terms “Captive Insurance”, or “Captive Insurance Program”. However, many business owners may have differing levels of understanding of this concept.

The goal of this article is to offer clarity on the subject of captive insurance programs, and to provide basic knowledge on just how a captive program could benefit business performance and profitability.

### **What is a “Captive”?**

A “captive” is an insurance company created and wholly owned by one or more non-insurance companies, to insure the risks of its owners. For example, a group of businesses, individuals, a franchisor, or their association, could form a captive. Captives are a form of self-insurance, with full reinsurance protection, where the insurer is owned wholly by the insureds. They are typically established to meet the risk management and insurance needs of its owners or members.

One of the main reasons businesses form a captive program is to earn underwriting profits and investment income based on the performance of their individual company. Because members have the potential to earn underwriting profits and investment income, participation in a captive insurance program is viewed as a way to transform the insurance expense line of a P&L into a profit source.

### **How does a captive work to save a business money?**

For every dollar of insurance premium paid to an insurance carrier, roughly 60 cents is set aside to pay for claims and the carrier’s underwriting profit. For a business, that dollar is paid out and gone. Even if a company practices good risk management, and works hard to keep claims low, the carrier will keep the profit that results from their diligence.

In a captive program, that same premium dollar can deliver very different results. Because a company owns their insurance program, when claims are lower (due, in great part, to the effort put forth creating a culture of safety in the organization), a portion of that dollar comes back to the bottom line in the form of profit. The business, not the carrier, benefits.

### **Captives are the fastest growing segment of the commercial insurance marketplace**

Today there are over 7,000 captives operating in the world, with more than \$10 billion in annual premiums, and over 2,000 captives domiciled in more than 30 U.S. states. The tremendous growth in captives domiciled both in the U.S. and worldwide, can be seen in both large organizations (over 90 percent of Fortune 500 companies own captives), and mid-sized companies; Group Captives, which insure mid-sized companies, are the fastest growing segment of the captive marketplace.

### **Why a captive program is right for the Renewable Energy industry**

Renewable energy has had tremendous growth in the US in the past several years. The leaders in this space are seeing their Workers’ Compensation and GL premiums rise, while their historical loss ratios have been extremely low. These accounts are often “assigned by analogy”, because it is a relatively new industry, and there is not enough rate-making data to support their own classification and rate structure.

Because of the low loss ratios and misclassification issues, most carriers cannot price these accounts appropriately with their current filed rate plans. A group captive option is one of the few ways in which these accounts can take advantage of their strong risk management practices, and ultimately pay fair and equitable premium for their exposure.







## Benefits to Renewable Energy business owners

For qualified businesses, a captive program would provide the following benefits:

- Underwriting profits (up to 60% of paid premium) that directly enhance a company's P&L
- More control over underwriting decisions
- A market-competitive insurance rate
- Safety and Claims Management services that reduce claims frequency, and drive costs to the lowest possible level
- Comprehensive coverage designed to meet the insurance requirements of contracts (for Workers' Compensation, General Liability, and Auto Coverage)
- Full insurance and reinsurance protection from an "A+ XV" Rated insurance carrier
- Greater control over, and involvement in, how claims are managed
- The lowest net cost for insurance, which provides a competitive advantage in the business marketplace

For many companies, a captive insurance program can offer a much greater degree of control over insurance costs, and provide a real profit opportunity. Once you have a basic understanding of how a captive works, it's easy to see how it could be a good fit for your insurance and business needs.

*Monica Everett is Vice President of Sales for York Alternative Risk Solutions, responsible for the design and implementation of captive insurance structures and solutions. With over thirty years' experience in Property & Casualty and Alternative Risk Insurance, Monica is well versed in both Group Captive and Single Parent Captive Insurance Programs, with a focus on the long-term reduction of risk and expense for clients. She was the lead broker and top producer for a very successful Group Captive Insurance Program for ten years and has established many Captives and Alternative Risk Programs throughout her career.*

**York Alternative Risk Solutions**  
www.renewableenergycaptive.com



## Unique multi-use lighting and energy solution

Elevate Technologies Corp., developer and manufacturer of smart, versatile, and highly-reliable energy solutions using sustainable and socially aware practices, is proud to introduce the IntelliEnergy Lamp lighting and energy solution for small space living. A solution for most any small-space living situation where a multi-use light and power source is needed, the efficient, re-chargeable, IntelliEnergy Lamp works as a table lamp, as a re-locatable wall-mounted fixture, and even as a flashlight delivering illumination and serving as a smart power source for USB device charging. The IntelliEnergy Lamp is versatile and reliable, offering numerous smart features for compact, efficient living. The IntelliEnergy is even solar-panel ready, for additional sustainable and efficient living. With patented power processing, rechargeable LFP batteries, long lasting LEDs, and durable materials throughout, the IntelliEnergy Lamp will reliably light any space and help keep cell phones, tablets, cameras, and other USB devices powered for daily use. The lamp's microprocessors auto-sense battery type (as well as solar panel size and power, if applicable), and applies the correct charge sequence for fast, efficient, and safe, optimized charging. The IntelliEnergy Lamp never over-charges or over-depletes batteries. Built-in timer and charge status LEDs provide an extra level of convenience.

**InteliEnergy** | www.smallspacelighting.com



## Surface-mount intelligent low-power modules

STMicroelectronics has added five space-saving surface-mount intelligent power modules (IPM) to its SLLIMM-nano family, giving the choice of IGBT or MOSFET outputs for in-motor or other space-constrained drives all the way from very low power ratings up to 100W. The new modules deliver high conduction and switching efficiency, especially in hard-switching circuits at frequencies up to 20kHz. The integrated gate-driver circuitry is engineered to minimize electromagnetic emissions (EMI) by managing switching voltage and current slopes (dV/dt, di/dt). The thermally efficient package enhances reliability and allows heatsink-free design, while 2.7mm creepage and 2.0mm clearance ensure safety isolation within the compact dual-inline SMD footprint. The module pin configuration is optimized to simplify circuit-board layout. Extra features integrated alongside the gate driver and 500V MOSFET or 600V IGBT/freewheel-diode array include an uncommitted operational amplifier and a comparator that let designers implement advanced current sensing and over-current protection with minimal external components. Smart shutdown with high-speed fault detection, interlocking, and under-voltage lockout are all built-in, and integrated bootstrap diodes simplify powering the module's gate-control circuitry.

**STMicroelectronics** | www.st.com/ipm



## Energy efficient process control

The EFC 3600 variable frequency drive (VFD) by Bosch Rexroth improves the process control through integrated PID controllers, as well as through a sequence control system with eight steps. Due to its high intermittent overload capacity of up to 200%, as well as the high initial torque of up to 150%, the EFC 3600 can be used for a wide range of applications. The freely scalable V/Hz characteristic allows load-dependent adjustment of the voltage/frequency curve, which ensures a long motor service life. The EFC 3600 can be connected to other automation topologies via optional Modbus or PROFIBUS fieldbus interfaces, or via digital and analog inputs and outputs. The EFC 3600 is offered from 400W to 4KW (0.5hp to 5hp). Due to the integrated brake chopper and mains filter, additional peripheral devices are not required. The simple program structure and easy parameter input provide quick commissioning and start-up without the need for a PC. Its compact design enables gapless side-by-side and space-saving installation. Cooling fans are only required for devices with performance level 1.5kW (2hp) and higher, and can be easily accessed without requiring tools for maintenance. The EFC 3600 complements Rexroth's frequency converter series Fe and Fv, which cover the performance spectrum up to 90kW (125hp). The EFC 3600 complies with the EMC directives for industrial applications.

**Bosch Rexroth** | www.boschrexroth.ca



## New energy reliability service

Pyxis Energy has partnered with Generac Power Systems Inc. to bring environmentally friendly, automated generator solutions to homes and businesses. The company has launched their new product Alternative Market Power or AMP, an innovative reliability service that aims to keep their customers' energy grid independent. No longer will homeowners and businesses have to worry about failing utility infrastructure, the increasing number of natural disasters or the threat of cyber terrorism shutting down the power grid. All that's required for AMP customers is a low monthly reliability fee and an electric and gas broker relationship with Pyxis Energy. AMP generators are environmentally friendly and EPA-certified for non-emergency use due to advancements in engine technology. The generators, fueled by natural gas or liquid propane, can run without restriction, and will start automatically to provide back-up power during power outages. Occasionally, Pyxis Energy will remotely dispatch the generator to protect against electrical grid instability or to offset extreme market conditions. Pyxis Energy retains ownership of generator and associated micro-grid hardware for the term of the customer agreement. AMP generators are engineered and built in the USA and installed by locally owned and licensed Generac dealers. Generators are monitored in real-time, and should any issue occur, a local Generac dealer is dispatched. All generators are maintained and serviced according to Generac guidelines or better, which maximizes the useful life of the hardware and its availability.

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# Clean Energy Future and Valuation of Energy Efficiency

California and New York lead the way

by Carmen Henrikson and Bob Callender

For all the excitement these days over the boom in renewables like wind and solar, and the growth of distributed “clean energy” systems, one truth that never changes is that the cleanest energy is the energy you never have to use.

As major shifts cascade across the energy industry, a key question stakeholders are asking is, “How does the energy industry generally, and utilities and rate regulators specifically, best value and procure energy efficiency when and where it is needed on the grid?”

As with so many aspects of state energy policy today, California and New York led the nation in tackling this question head-on in 2017. Both states are directing billions of dollars in new investments into clean energy, while also placing a high priority on development of new approaches to buying energy efficiency.

## Rethinking energy efficiency procurement

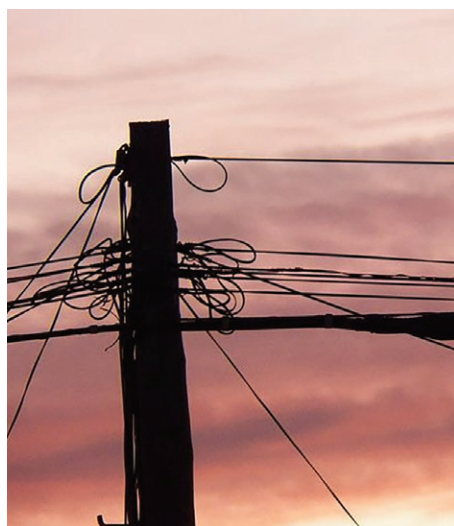
For years, and in some areas decades, energy efficiency has typically been paid for through rebates and subsidies. For example, \$10 coupons for buying energy-efficient light bulbs, or \$200 rebates for upgrading to a high-efficiency water heater.

In California and New York, however, that era appears to be coming to a close. Both states are aggressively shifting towards procurement models that encourage the private sector to take on the delivery of efficiency through innovative technologies, performance-based programs, and financing initiatives.

In many states that have administered long-standing energy efficiency rebate programs, much of the low-hanging fruit has been picked; rebate programs are seeing diminishing returns. The traditional rebate model is proving decreasingly cost-effective in achieving deeper savings across diverse customer classes.

At the same time, technology development in the form of devices such as programmable communicating thermostats and advanced control systems, is advancing faster than government-designed rebate programs ever can. Customers are demonstrating a powerful appetite for engagement, choice, and satisfaction, as new technologies like smart thermostats and electric vehicles impact the cost and convenience of energy. For the utility grid, efficiency and other behind-the-meter resources have the potential to offer greater value through active demand management, to relieve localized and system constraints.

*“The utility of the future is going to be more of a service provider, providing reliability, providing technical help, providing efficiency, and coordinating distributed generation with wholesale power,” says Steve Isser, President of Energy Law and Economics President, a boutique consulting firm.<sup>1</sup>*



## New York's Energy Vision

Increased energy efficiency and related programs, like demand response to curb electric demand during periods when wholesale electric prices are spiking, are pillars of both New York's and California's push to meet aggressive green energy mandates. Both states have adopted a standard of getting 50 percent of their energy from renewable/clean sources by 2030. In the longer term, New York aims to reduce the 1990 levels of statewide greenhouse gas (GHG) emissions by 40 percent by 2030, and 80 percent by 2050.

The state also announced an initiative to invest up to \$1.5 billion in major renewable

energy projects. It would be the largest clean energy procurement by any state to date. The New York State Energy Research and Development Authority (NYSERDA) and New York Power Authority (NYPA) plan to invest up to \$1.5 billion in wind, solar, large- and small-scale hydro, fuel cells, and other technologies - including 2.5 million megawatt-hours of renewably generated electricity.

New York State Public Service Commission Chairman John B. Rhodes said: “The Clean Energy Fund allows the State to make faster and greater progress towards Governor Cuomo's State Energy Plan and Clean Energy Standard goals, while reducing ratepayer collections. It also creates the demand for clean energy and the certainty we need to accelerate the growth of a dynamic clean tech economy that stimulates private investment and job creation.”<sup>2</sup>

New York's 2050 goal for 50-percent year-round renewable energy represents nearly a doubling from current levels. But, as National Grid New York President Kenneth Daly has observed, “The only way to achieve stretch goals is to set them.”

At the same time, New York is pursuing bold changes in energy efficiency. Consolidated Edison, for example, is moving the cost of energy efficiency (now paid for by a system benefit charge) into its rate base. This approach reflects the philosophy that efficiency shouldn't be an add-on or afterthought to buying energy, but rather get fully evaluated as utilities are determining how much energy they need to buy for their customers, and from what sources.

ConEd has also established a new position, Vice President of Distributed Resource Integration—Matt Ketschke, who fills that position, said: “They established my job specifically to think about, as we evolve the business model, and as we get more and more grid edge resources out there, what's going to have to change.”<sup>3</sup>

Walter Rojowsky, an energy and utilities consulting expert with PA Consulting, said: “The transition to the next generation utility system will be made through the actions of the utility, vendors, investors, and customers, and the New York Public Service Commission has created a collaborative process that includes all of these parties.”



## California's Carbon Revolution

California addresses the efficiency evolution in a more distributed manner; more than 10 active proceedings in multiple state agencies influence how efficiency will be planned for, procured, measured, and evaluated over the next 10 years. In 2016, California passed SB32, calling for a 40 percent reduction in greenhouse gas emissions (from 1990 levels) by 2030. One year earlier, California's SB 350 established a goal of doubling energy efficiency and increasing the renewable energy portfolio to 50 percent by 2030.

Achieving even one of these goals will require a major shift from the status quo, as Governor Jerry Brown has previously acknowledged. “This is going to be a long march to transition the entire modern world to a decarbonized future,” he said.<sup>4</sup> “Taking carbon out of the modern economy requires heroic efforts and tireless struggle. SB 350, in both efficiency and renewable energy, ratchet up the California commitment. We have the technological means and now we have the legal mandate to reduce carbon pollution.”<sup>5</sup>

Andrew McAllister, a commissioner with the California Energy Commission,







said “the state’s highest priority is energy efficiency. To promote a clean energy economy, we must make it easier for markets to function and for people to make choices that achieve energy savings and drive consumer demand for energy services. In order to get scale, we have to utilize markets well and create the conditions within which they function properly.” Commissioner McAllister also noted that, “the savings go well beyond our state, because of California’s sheer size, we can move markets.”<sup>6</sup>

California has had the benefit of learning from some hard-earned, real-world experience. That’s especially true in measuring efficiency savings via customer data. California has spent billions of dollars on smart meters that are widely considered to have provided less value than anticipated. In 2015, California lawmakers directed the utilities to begin measuring energy efficiency savings using the vast, detailed data generated by the smart meter technology.

This approach to measuring energy savings is called “normalized metered energy consumption” (NMEC). It is designed to determine the impact, and therefore value, of efficiency programs by using data from the customer’s meter, instead of traditional engineering calculations. At the highest level, NMEC attempts to quantify how much electricity a customer used before efficiency measures were installed, as compared to how much after (adjusted, or “normalized,” for weather extremes and other anomalous events that may drive big swings in energy use).

NMEC appears straightforward, but its implementation is fraught with questions and concerns. What is the right process for normalization? What happens when the efficiency savings are lost in the noise of the customer’s typical energy consumption patterns? Who has access to, and who is responsible for, the security of a customer’s energy use data? State regulators, utilities, and the efficiency industry are still working to develop the rules for using NMEC to calculate energy savings from California’s next generation of programs.

California’s investor-owned utilities are also making changes in how they procure efficiency. Earlier in 2017, they submitted five-year business plans detailing the strategy they will pursue for procuring energy efficiency, and increasing the portion of their efficiency that is outsourced from 20 percent to 60 percent, over the next three years.

As more delivery of efficiency resources gets outsourced, and NMEC is increasingly applied to measure savings in new programs, efficiency programs may begin to resemble wholesale resource purchases, like solar PPAs. Measuring savings at the meter, and relying on the market for delivery of this resource, will ultimately support broader opportunities for utilities to purchase efficiency in the future from third-party vendors.

### Looking to our energy future

California and New York are still working out how to improve energy efficiency. Other states will benefit from customizing a California or New York model to their local energy situation and policy preferences. There are already important lessons to be learned from New York and California; questions for utility managers and other stakeholders to consider, as they seek to make their own business model transitions a success, and protect their reasonable interests. Utilities, technology vendors, service providers, and their financial investors all face both threats and opportunities.

“You have to make sure the utilities don’t lose money by supporting energy efficiency,” said Energy Law and Economics’ Isser. “Make sure they don’t have to wait years for a next rate case to recover their investment. A utility should be rewarded for performance somewhat like a private sector market rewards a business. If they do a better job, they are rewarded and if they do a worse job, they lose money.”<sup>7</sup>

This will be an ongoing revolution for the utility business model across all 50 states. What California and New York are proving is that when it comes to a clean energy future, and promoting the cleanest energy of all – efficiency – they are leading the way with bold policies, and the regulations, strategies, and funding to make them come to life.

*Carmen Henrikson is TRC Associate Vice President of Energy Services. She has more than 17 years of experience in the advancement of clean and distributed energy resources with a focus on delivery and integration of energy efficiency, demand response and renewable technologies. At TRC, she provides strategic and policy direction for the design and management of utility-scale energy efficiency incentive programs. Ms. Henrikson serves as an Executive Committee member and Treasurer on the California Energy Efficiency Industry Council’s Board of Directors. Ms. Henrikson holds an M.B.A. from the University of Michigan’s Erb Institute of Global Sustainable Enterprise.*

*Bob Callender is a Vice President at TRC. Nationally recognized as a progressive leader in energy, Bob has over 20 years of experience as an innovator in energy policy and its implementation in the market. Prior to joining TRC, he was the Vice President of Programs for the New York State Energy Research and Development Authority (NYSERDA), where he oversaw NYSEDA’s suite of energy efficiency programs. He was instrumental in introducing the whole building approach to New York’s efficiency programs as well as developing innovative program financing mechanisms. Bob held several positions during his 24 year career at NYSEDA, including acting president and CEO. Mr. Callender is also a participating member of the New York REV Clean Energy Working groups and is a participating member of the NYS Public Service Commission’s Clean Energy Advisory Council’s Energy Efficiency Procurement and Markets Working Group. He has a bachelor’s degree in government and management from American University in Washington, D.C., and a master’s degree in public administration from the State University of New York at Albany.*

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<sup>1</sup> <http://www.utilitydive.com/news/how-rate-reform-can-help-turn-energy-efficiency-into-a-profit-center-for/417549/>

<sup>2</sup> <https://www.nyserda.ny.gov/About/Newsroom/2016-Announcements/2016-01-21-Governor-Cumo-Luanches-5Billion-Clean-Energy-Fund>

<sup>3</sup> <http://www.utilitydive.com/news/pushed-by-rev-coned-tests-new-utility-business-models-in-new-york/435489/>

<sup>4</sup> <http://www.latimes.com/politics/la-pol-sac-jerry-brown-climate-change-renewable-energy-20151007-story.html>

<sup>5</sup> <http://www.buildings.com/news/industry-news/articleid/19432/title/california-law-to-double-the-efficiency-of-existing-buildings>

<sup>6</sup> <http://www.utilitydive.com/news/building-codes-utility-mandates-propel-california-massachusetts-to-top-ef/428051/>

<sup>7</sup> <http://www.utilitydive.com/news/how-rate-reform-can-help-turn-energy-efficiency-into-a-profit-center-for/417549/>



**JANUARY**

25 **Southeast Wind Conference**  
Loews Atlanta Hotel – Atlanta, GA; www.awea.org

**FEBRUARY**

05-06 **Solar Power Northeast**  
Westin Boston Waterfront Hotel – Boston, MA; www.events.solar/northeast/

06-08 **Wind Power Finance & Investment Summit**  
Omni La Costa Resort & Spa – San Diego, CA;  
www.infocastinc.com/event/wind-power-finance-investment/

27-28 **AWEA Wind Project O&M and Safety Conference 2018**  
San Diego, CA; www.awea.org

**MARCH**

07-11 **Natural Products Expo West & Engredea**  
Anaheim Convention Center – Anaheim, CA; www.expowest.com

07-08 **SEIA's Inaugural Codes & Standards Symposium**  
Santa Barbara, CA; www.seia.org/codes

14 **ACORE National Renewable Energy Policy Forum**  
Washington Marriott at Metro Center – Washington, DC; www.acorepolicyforum.org

14-16 **GLOBE Forum 2018**  
Vancouver Convention Centre – Vancouver, BC; www.globeseries.com

19-22 **NABCEP 2018 CE Conference**  
Conference & Event Center Niagara Falls – Niagara Falls, NY; www.nabcep.org

20-21 **AWEA Wind Project Siting & Environmental Compliance Conference 2018**  
Memphis, TN; www.awea.org

**APRIL**

18-20 **28th Annual Energy Storage Association Conference & Expo**  
Boston, MA; www.energystorage.org

23-25 **SEPA Utility Conference**  
Rancho Mirage, CA; www.sepapower.org

23-26 **CxEnergy 2018 Conference & Expo**  
Rio All Suites Hotel and Casino – Las Vegas, NV; www.cxenergy.com

30-02 **Midwest Solar Expo & Smart Energy Symposium**  
DoubleTree by Hilton Minneapolis, Park Place – Minneapolis, MN;  
www.midwestsolarexpo.com

**MAY**

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

11-12 **Solar Power Southeast**  
Loews Atlanta Hotel – Atlanta, GA; www.events.solar/southeast/

19 **26th Annual Solar Boat Regatta**  
Eden Prairie, MN; www.mnrenewables.org/solar-boat-regatta/

20-23 **Federation of New York Solid Waste Associations Strive For Sustainability Solid Waste & Recycling Conference with Trade Show**  
The Sagamore, Bolton Landing – Bolton Landing, NY; www.nyfederation.org

**JUNE**

13-14 **Solar Power Texas**  
Sheraton Austin Hotel at the Capitol – Austin, TX; www.events.solar/texas/

20-21 **36th West Coast Energy Management Congress (EMC)**  
Washington State Convention Center – Seattle, WA; www.energyevent.com

**JULY**

10-12 **Intersolar North America**  
Moscone Center – San Francisco, CA; www.intersolar.us

**SEPTEMBER**

24-27 **Solar Power International 2018**  
Anaheim Convention Center – Anaheim, CA;  
www.solarpowerinternational.com

**NOVEMBER**

06-08 **ESNA 2018**  
Pasadena, CA; www.esnaexpo.com

Send us your clean energy show and event listings.

Email information to the editor at editor@nacleenergy.com

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17	WATT	7	YAW
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58	Mersen	ep.mersen.com
17	New World Technologies Inc. - Rad Torque Systems	www.radtorque.com
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