

# North American **Clean Energy**

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## 2018 WIND Buyers Guide

### Debunked!

5 myths about solar panels

### Solar Survives the Storm

Focus on Puerto Rico

### Storage Investments

Paying off & paying back

### How to Accelerate Architectural Solar in the US Market

From BIPV to building component

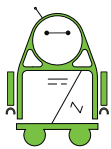
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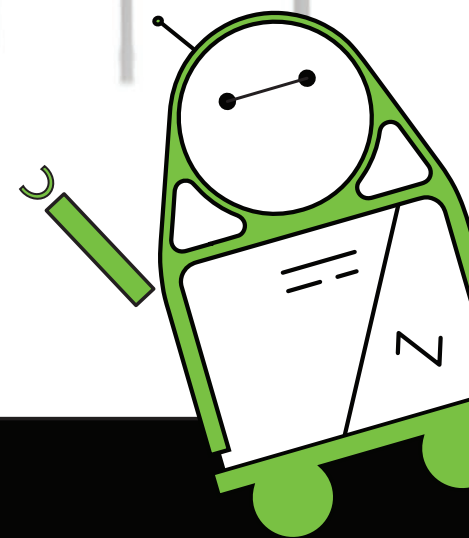
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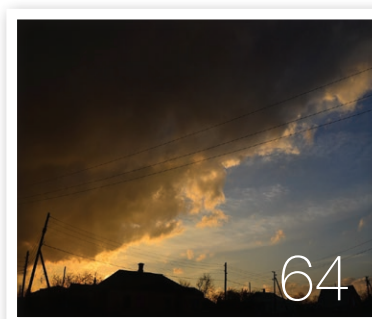
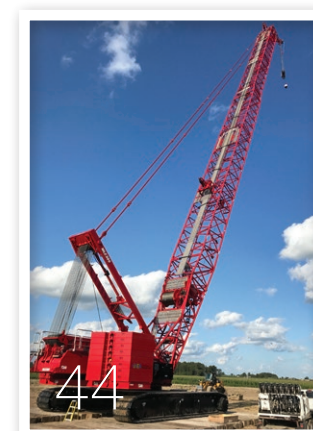


**On our cover...**

The Long Island Association, along with Stony Brook University's Advanced Energy Research Center, the Gershow Recycling Corporation, and Deepwater Wind, recently hosted a tour to America's first offshore windfarm, three miles off the Block Island coastline. Our own Meg Lugaric was onboard to see the windmills, which now provide nearly all of Block Island's power.

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**PUBLISHER**  
Ian Stuart  
[istuart@nacleanenergy.com](mailto:istuart@nacleanenergy.com)

**EDITORS**  
Jill Walters  
[editor@nacleanenergy.com](mailto:editor@nacleanenergy.com)

Meg Lugaric  
[meg@nacleanenergy.com](mailto:meg@nacleanenergy.com)

**ART DIRECTOR**  
Chris Van Boeyen  
[production@nacleanenergy.com](mailto:production@nacleanenergy.com)

**SALES MANAGER**  
Ian Stuart  
[istuart@nacleanenergy.com](mailto:istuart@nacleanenergy.com)

**SALES**  
Don McIntosh  
[dmcintosh@nacleanenergy.com](mailto:dmcintosh@nacleanenergy.com)

Quinn Stuart  
[quinn@nacleanenergy.com](mailto:quinn@nacleanenergy.com)

**CIRCULATION MANAGER**  
James Vail  
[circulation@nacleanenergy.com](mailto:circulation@nacleanenergy.com)

**ACCOUNTING**  
Alison Bell  
[abell@nacleanenergy.com](mailto:abell@nacleanenergy.com)

**255 NEWPORT DRIVE, SUITE 336**  
Port Moody, B.C. V3H 5H1  
Phone: (604) 461-6223

North American Clean Energy (USPS 1370) is publishing bi-monthly and distributed free by Action Media Ltd. Periodicals postage paid at Henry, IL. POSTMASTER: Send address changes to North American Clean Energy at 515 University Ave. Suite 1, Henry, IL 61537. Subscription updates can be made at [circulation@nacleanenergy.com](mailto:circulation@nacleanenergy.com).

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Editorial, Advertising, Production and Circulation are at 255 Newport Drive, Suite 336, Port Moody, B.C. V3H 5H1 (604) 461-6223. Subscriptions: \$48 per year outside North America. Email: [circulation@nacleanenergy.com](mailto:circulation@nacleanenergy.com)



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Why are you here? That was my stock question to fellow boat passengers last month, during the 70 minutes it took for the Long Island ferry to chug its way towards five towering wind turbines in the distance. Judging by the company names on all the lanyards, I figured most of these people had some serious business on board. Aside from exchanging business cards and comparing stories, however, as far as I could tell, we were all there for one reason: seeing giant wind turbines up close and in person is really cool.

**Tip 1:** When they say to dress boating casual, don't try to look good - especially if you're so excited to see the blades in the distance that you run to the tip of the bow. From now on, this area shall be called the "splash zone".

After braving the spectacular weather, mild waves, and brilliant blue sky, the boat captain managed to get us close enough to the massive foundations where we could easily read the safety signs directed at turbine maintenance crews. The steadiest legs (and stomach) on the deck belonged to Deepwater Wind's Montauk Manager and Fisheries Liaison, Julia Prince. A long time Long Island resident and active member of the community, she's made this run more times than she can count. Of course, we were all armed with the trifold brochure listing the facts and figures associated with this wind farm, but Julia had more of a local's take on the whole project; she's gone diving around the bases of several of the turbine foundations (there are 5 total), and told me that each one hosts its own ecosystem. Marine biologists confirm this phenomenon, which has been observed for decades around abandoned ocean oil rigs. According to Milton Love, a professor of marine biology at the University of California Santa Barbara, these rigs "are more productive than coral reefs, more productive than estuaries. It just turns out by chance that platforms have a lot of animals that are growing really quickly."<sup>1</sup> In fact, Montauk fishermen have noticed that the waters around turbine number 5 are an excellent source of Mahi. While I did not get a comprehensive list of all the fish landing on the menus around Long Island courtesy of the other turbines, it was nice to hear about some positive collateral effects from what has been historically (hysterically?) cited by Nantucket NIMBY naysayers as a blight on their horizon.

If you already know all the numbers and facts by heart, you can skip to the end. For those of us still awed by the engineering genius of our fellow man, here goes...

Not only are they quite lovely and graceful close up, these turbines can produce 125,500 megawatts of power each year. A 6.77-inch diameter cable runs 4 to 6 feet under the ocean floor, and over 30 miles, to deliver that power to Block Island. Even though this could meet the needs of almost everyone on the island, they only get to keep about 10 percent - the rest gets dumped into the mainland grid. All told, it's enough energy to power 17,000 homes. These are monster machines. Each blade is 240 feet long. That means it's twice the wingspan of a Boeing 727. It also means that, should you ever be dumb enough to

stand on the very tip when it's vertical, you would have a 600-foot drop to the ocean surface. GE makes some impressive and incredibly sturdy wind turbines, but I doubt they or the execs at Deepwater would appreciate your stunt. The waters around the turbines, however, are open for boating and exploration. Much like an iceberg, the bulk of each turbine is underwater; the ocean is only about 70 to 90 feet at the site, but the supporting concrete piling reaches 200 feet into the ocean floor. The bright yellow paint on the foundations not only protects the underlying metal; it's also eco-friendly and easy to see (though at a height of 70 feet above the water line, the trusses are hard to miss). Added safety gear includes marine and aviation lighting, and a 360-degree pivot that allows each turbine to weather powerful winds - the blades start turning in 6.6 mph breezes, but nacelles and blades must pivot away from the wind when it kicks up past 56 mph.

What about the birds? The U.S. Bureau of Ocean Management is funding a collaborative study by the U.S. Fish and Wildlife Service, University of Rhode Island, and University of Massachusetts at Amherst. Researchers will spend the winter analyzing data obtained from a tracker installed earlier this year on turbine 1. It came down mid-October, but will go back up in the spring of 2018, when it will continue to track the migration patterns of specially tagged bats and birds. Whenever any of these animals fly within 20-miles of the wind farm, their transmitters will send the data to the tracking station. The information gleaned from this study will likely influence the design and construction of future offshore wind farms.

**Tip 2:** If you think you won't need Dramamine, take it anyway. This saved me from the same fate as many of my colleagues during the violently nauseating hour and a half return to port.

I'd like to thank Kathleen Ferrell for working to organize my adventure. Stony Brook University's Advanced Energy Research Technology Center, the Gershow Recycling Corporation, and the Long Island Association sponsored this field trip for all of us industry nerds. If you want to see the turbines in person, you'll have to wait until the regular tours resume next year. In the meantime, check out the latest industry developments in our 2018 Wind Buyers Guide starting on page 35.

Meg

<sup>1</sup><https://www.nytimes.com/2016/03/08/science/marine-life-thrives-in-unlikely-place-offshore-oil-rigs.html>


news bites




**A solar awareness journey**

An energy engineer from Mumbai, India named Sushil Reddy initiated a solar energy outreach cause, The SunPedal Ride, in May 2016 where he rode a solar ebike across north west India for a Guinness World Record of more than 4350 miles. In the summer of 2017, he rode more than 660 miles along the West Coast of the USA from San Francisco to San Diego and interacted with people along the journey to talk about the solar energy scenario in India and global sustainability awareness. The SunPedal Ride is a movement to create awareness about solar energy and to encourage electric cycling as a mode of environment-friendly mode of transportation.


**The SunPedal Ride** | [www.thesunpedalride.in](http://www.thesunpedalride.in)




## Battery-less Off-Grid Solar Air Conditioning System

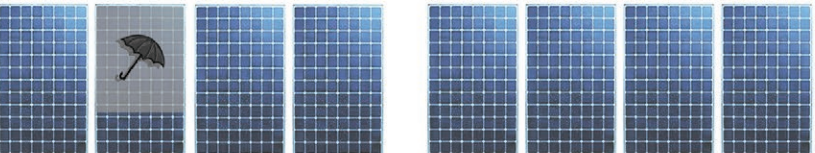


Mini-Split Inverter-Air-Conditioner (IAC)





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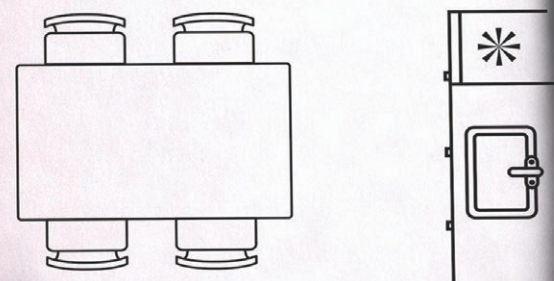
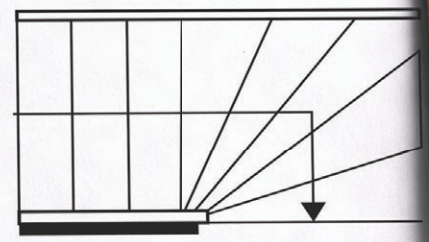
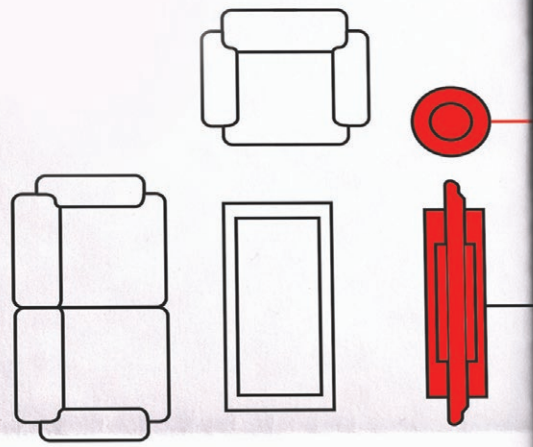
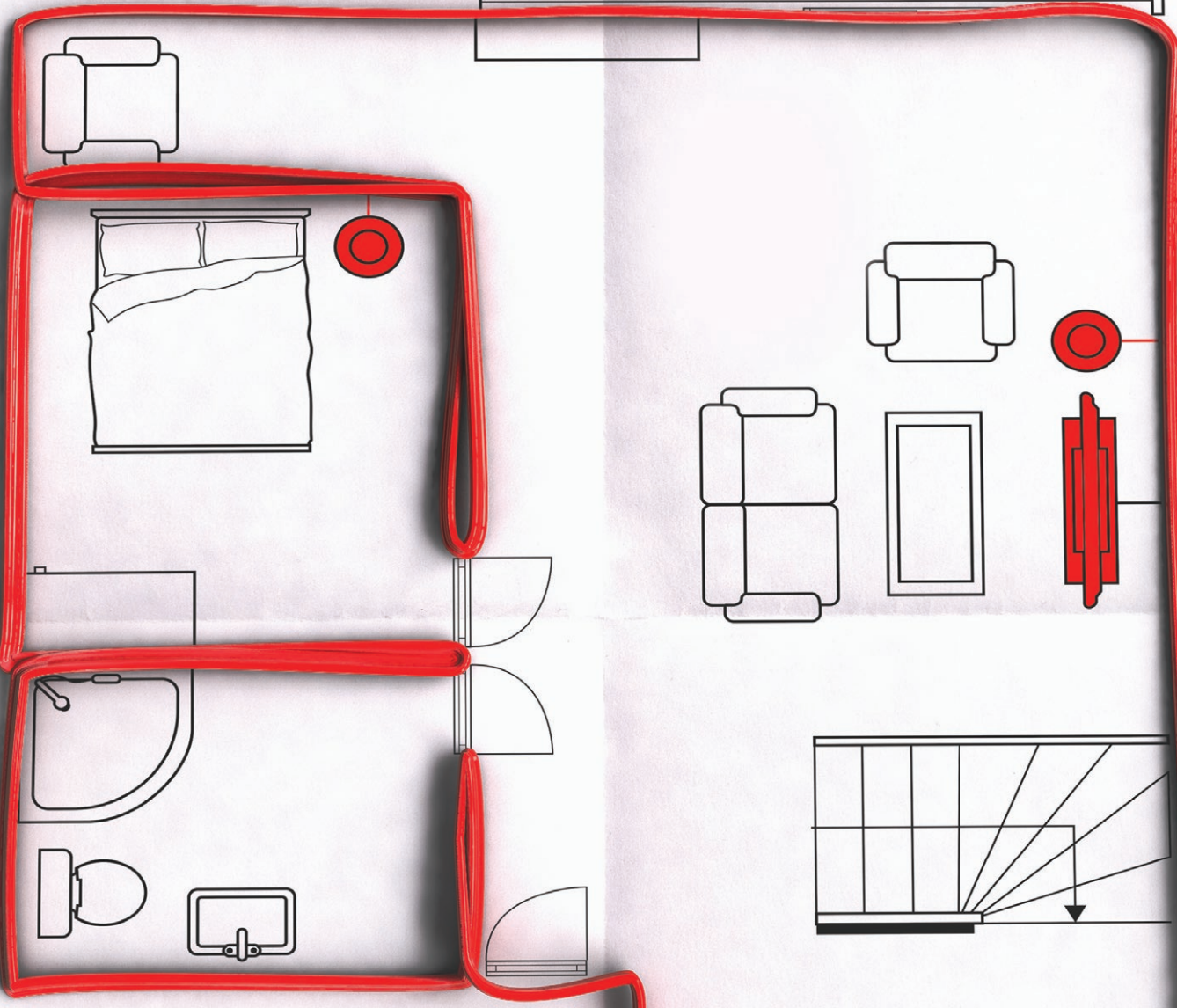
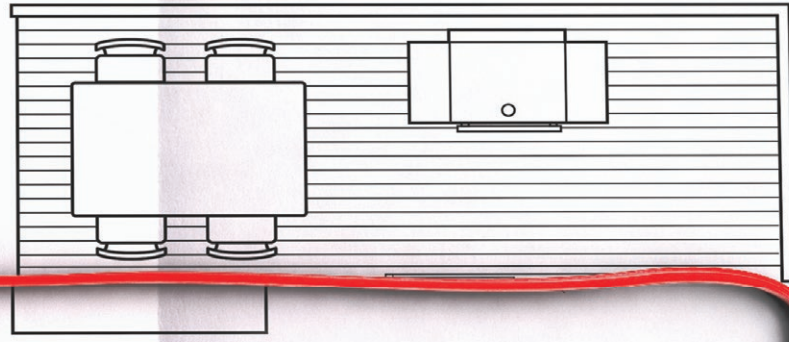
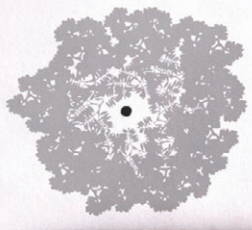
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# Debunked!

## 5 myths about solar panels

by Garry Wicka

**HOME SOLAR PANELS CAN DRASTICALLY CUT OR EVEN eliminate electricity bills, reduce a home's carbon footprint, increase resale value, and may even help a home sell faster.**

The cost of rooftop solar systems has fallen dramatically in recent years; most homeowners have the option of buying the system, leasing it on reasonable payment terms, or having a third party pay for and install the system at no up-front costs to the homeowner. Plus, home solar systems are eligible for federal tax credits.

All of this explains why the number of homeowners installing solar has sky-rocketed across America. So, why are many homeowners still skeptical about taking control of their energy use and installing solar? The various myths that persist around solar power could be to blame.

"Solar technology has been around for a long-time, but even though it's entered the mainstream, many homeowners are still skeptical," says renewable energy expert Roger Ballentine, President of Green Strategies, a leading Washington-based consulting firm. "That's because a number of myths persist, pointing to the need for better consumer education about the benefits of home solar installations."

Ballentine points to private and government studies providing real information that debunks the myths surrounding solar power. For example, research by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) and the Lawrence Berkeley National Laboratory, found that solar panels help homes sell faster and for more money than those without solar.

If you're considering installing a solar panel system on your home, here are five common myths – and why you shouldn't believe them:

### **Myth # 1: Solar panels only work if you live in a warm, sunny climate.**

While solar panels work best when they get a lot of sun, a lack of bright sun doesn't mean they're not working. Panels can still absorb ambient sunlight, even on cloudy days or in regions that get less direct sunlight. What's more, today's solar panels are more energy efficient than ever. Newer systems maximize sunlight absorption and generate the maximum possible output. This higher efficiency means that solar panels can work in virtually any climate and every season.



### **Myth # 2: You need a lot of roof space for solar panels.**

Just like other amazing technologies (think microchips), solar panels are getting smaller, more powerful, and more efficient. High-efficiency panels take up less space because fewer panels are needed to produce the electricity to power your home. Even if you have a smaller home, it could have enough roof space to fit the number of panels you need to generate power, and save money.



### **Myth # 3: Installation is a long, drawn-out hassle.**

While adding solar panels to your home isn't a DIY project, installation usually takes only a day or two. New models streamline the process further, eliminating the need to install a separate inverter. Most solar panels require a separate inverter to bring electricity into your house. Panels with newer technology actually incorporate the inverter, which simplifies and accelerates the installation process.



### **Myth # 4: If something goes wrong, you're on your own.**

As with any major investment in your home, you should make sure you understand the manufacturer and installer warranties for your solar panels, including how long the coverage lasts, and what types of problems are covered. And, unlike a furnace or an air conditioning system, a solar installation has no moving parts to wear out, so it typically requires little maintenance and repair.

### **Myth # 5: Solar panels will look big, bulky, and ugly on your roof.**

Solar panels are becoming smaller, sleeker, and more aesthetically pleasing. Higher-efficiency models are also offering increased flexibility of configuration. Instead of having to cover an entire roof with panels in a specific arrangement to generate power, modern options allow you to arrange panels to meet your own sense of aesthetics.

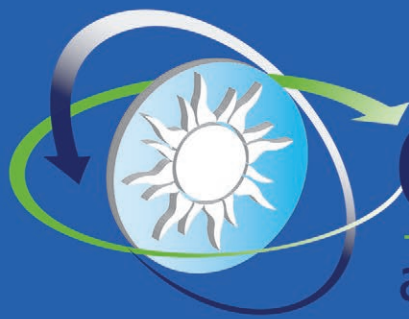
Adding solar power to a home offers homeowners many benefits, from reducing energy costs, to increasing the value of your home, to helping the environment. "Overall," says Ballentine, "it's a decision most homeowners feel positively about once they've made it." The NREL notes in its study: "Buyers of homes with (solar panel) systems are more satisfied than are comparison buyers. A significantly higher percentage...indicate they would buy the same houses again."



Garry Wicka is Head of Marketing at LG Electronics, a technology innovator working to deliver environmentally sound solutions with advances in solar energy.

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# How Massachusetts will Guide the Rest of the US to Adopt Floating Solar

by Bernard Prouvost, Victor Stolt-Nielsen Holten, and Corey Kupersmith

**ACCORDING TO THE SOLAR ENERGY INDUSTRIES ASSOCIATION, THE U.S.** reached 44.7 gigawatts (GW) of total installed capacity in Q1 2017 – which is expected to triple by 2022, to 128 GW. As solar projections continue to skyrocket, and average costs of photovoltaic (PV) panels decrease, the economics of solar will rival that of fossil fuels.

Rooftop and ground-mounted PV systems are most common, but floating photovoltaics (FPVs or floating solar) have become the rising champion for quick, convenient, and cost-effective power production. Simply put, floating solar systems allow standard PV modules to be installed on the surface of inland bodies of water. Unlike rooftop and ground-mounted systems, floating solar technology is creatively designed to take advantage of mostly unused water “realty”, rather than taking over land that could be used for agricultural or municipal purposes. By capitalizing on unused water spaces, or making these spaces more dual-purpose, floating solar can meet economic demands for energy production, while offering secondary environmental benefits, such as reducing evaporation.

Japan, with its limited land, has already turned to FPV to provide clean energy, without wasting its most precious resources. Other island nations like the UK, Taiwan, and Singapore have done the same. While the attractiveness of FPV for island nations is obvious, other developed countries are slowly seeking to implement this technique in an effort to pursue their goals of maximizing the economic value of untapped acreage.



*A 31.5 kWp floating solar system at the Orlando Utilities Commission's storm water storage reservoir.*



*50,000 solar panels create a 1.35 MW floating solar system at the Yamakura Dam in the Chiba Prefecture, just east of Tokyo.*

Like island nations, countries interested in pursuing floating solar must first create pilots within their agricultural industry, using properties like wineries and dairy farms; these are extremely energy and water intensive industries which cannot afford to waste resources. With floating solar, agricultural based industries are able to repurpose their water retention ponds and irrigation reservoirs for energy production.

Pilot programs are currently in place at the University of Central Florida, and at the Kunde Family Winery in California. The biggest operating FPV system is located at the Orlando Utilities Commission. The progress of FPV has been slow but steady; conditions for adoption vary from state-to-state.

Florida and California, with their perpetually sunny climates, may seem like ideal states for solar technologies to flourish, but even they have experienced delays in implementing more floating solar systems, due to slow legislative procedures. As unlikely as it may seem, the birthplace of floating solar just happens to be Massachusetts.

Massachusetts' strong financial incentives and environmentally motivated population have turned it into one of the biggest markets for solar. This rapid expansion occurred in many environmentally valuable locations, especially on agricultural land. However, regulatory, environmental, and agricultural groups quickly faced conflicts between wanting to support solar development, and their core mandates regarding land appropriation.

In response, the Department of Energy Resources (DOER) established the Solar Massachusetts Renewable Target (SMART) program. It created land use and design standards for ground-mounted projects, developed siting criteria with financial incentives and deterrents, and incentives to use certain technologies, or selling to certain population segments.

Land that was scarce, or used for farming, limited agricultural landholders' access to solar. On the other hand, floating solar could provide the DOER a way to further its goals of solar development; the same solar system used on irrigation ponds for rice patties in Japan, would adapt perfectly to the irrigation and tail water recovery ponds of Massachusetts cranberry bogs.

FPV was a clear solution for cranberry farmers, who were already under financial strain from restructuring. As more international projects came online, however, the DOER realized that the potential benefits of floating solar could impact the entire state on a much greater level. Massachusetts is a high power consumption state with constrained land space. By utilizing vacant and otherwise unusable spaces in an environmentally-friendly way, floating solar is able to preserve Massachusetts' usable land, reduce land clearing, and mitigate the water evaporation that has caused the state to suffer several recent droughts.

In August of 2017, the SMART program was finalized to include and emphasize floating solar. Currently ranked 7th in solar capacity, Massachusetts is set to climb the national ranking in 2018, due to its imminent boom in floating solar. Future projections are estimated to hit 2,377 MW over the next five years, but Massachusetts should reach this number even faster, again thanks to floating solar. The rapid increase of installed solar capacity, along with new solar jobs, will likely influence other states to follow suit. Just as Japan pioneered floating solar for many island nations, Massachusetts is on track to break barriers, and set the standard for other US states. Not since the Mayflower dropped her anchor in Plymouth Harbor has a floating object had such a big impact on such a little state.



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*Bernard Prouvost is Chairman and Co-founder of Ciel & Terre, International. Established in 2006 as a renewable Independent Power Producer (IPP), Ciel & Terre has been fully devoted to floating solar PV since 2011. The company pioneered the first specific and industrialized system, Hydrelio®, to make solar panels float on water, with criteria such as cost-effectiveness, safety, longevity, resistance to winds and waves, simplicity, drinking water compliance and optimized electrical yield.*

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*Victor Stolt-Nielsen Holten is Managing Partner of Sun2o Partners, LLC, a Connecticut-based renewable energy company that specializes in unconventional system design, project development, and financing. Relationships with a variety of manufacturers allow Sun2o to take advantage of the most advanced technology available, to create a customized system that suits the needs of their clients.*



*Corey Kupersmith is also Managing Partner of Sun2o Partners, LLC.*

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# Solar PV in Developing Countries

by Gabriel Hurtado González and Sasaenia Paul Oluwabunmi

With the enforcement of the Paris Agreement a year after its adoption, countries are developing plans to implement their Nationally Determined Contributions (NDCs) to achieve their energy targets. Both energy efficiency and renewable energy initiatives are pivotal strategies of these NDCs, and will be fundamental to the ability of these countries to meet their commitments.



While developing countries are key to mitigating global carbon emissions, meeting the long-term goals set in the Paris Agreement represents an ambitious and strategic approach towards energy initiatives. According to the International Energy Agency, renewable energy activities from developing countries will have an overall reduction of 1.4 Gt in CO<sub>2</sub> emissions by 2020<sup>1</sup>. The fact that solar power is a locally available energy resource with minimum O&M cost, makes this technology a fundamental ingredient in the energy mix of developing countries, when compared to other renewable energies.

## Trends

Currently adopted in 46 developing countries, Feed-in tariff (FIT) policies are the most extended form of solar PV support<sup>2</sup>. This has been reflected in countries such as Algeria, which implemented a FIT in 2014 for both solar and wind projects; Costa Rica, which proposed new FIT rates for solar PV systems; and Ghana, which placed temporary caps on its FIT until upcoming solar PV projects can be assessed. Public finance mechanisms are also frequently used as platforms to stimulate the growth and investment of solar PV technologies. India, Mongolia, Jordan, El Salvador, and Pakistan are among the countries that added new policies, and extended existing policies in this regard<sup>3</sup>.

Tendering for solar projects has also gained momentum in recent years, with new record low bids below \$0.03 per kWh in some markets<sup>4</sup>. Very low bids for solar PV projects in 2016, and early 2017, were achieved by developing economies such as India, Jordan, Argentina, Saudi Arabia, the UAE, and South Africa<sup>5</sup>. Additionally, Mongolia and Zambia saw record low national bids for winning tenders in 2016<sup>6</sup>.

Regarding the manufacture of solar PV units, China dominated global shipments for eight consecutive years, throughout 2016<sup>7</sup>. The top 10 manufacturers, of which a vast majority are China-based, accounted for about 50 percent of the shipments during 2016<sup>8</sup>.

installed capacity<sup>11</sup>. However, some countries, such as Peru, are focusing on extending solar installations throughout rural areas by subsidizing household connections for future solar PV systems. Also, two of the largest PV operative plants in South America can be found in Chile, in the Atacama Desert, with installed capacities of 100 MW and 246 MW, respectively.

- **Africa Region:** Solar PV installed capacity accounts for approximately 2.5 percent of the worldwide total<sup>12</sup>. However, the fact that Africa features the highest hours of sunlight per year (around 4,300, which equates to 97 percent of the possible total capacity<sup>13</sup>) gives solar energy the potential to be fitted in virtually any location in the continent, without the need of large-scale grid developments. South Africa is the leading country for solar PV in this region, with 1,243 MW of installed capacity, followed by Nigeria, with 976 MW, and Egypt, with 540 MW<sup>14</sup>.

Although several challenges exist for the expansion of solar PV in developing countries - including the development of a transmission infrastructure network, and the inclusion of subsidies - the globalization of PV systems is now a reality. This is especially true in Asia, which accounts for a significant proportion of the worldwide installed capacity.

While solar energy development in off-grid and mini-grid solutions is often the most competitive solution in developing countries, major challenges exist. These include: complex financial and organizational questions; bottlenecks in the financing, management, business models, sustainable operations and maintenance; difficult local social and economic conditions.

Solutions to these challenges include: providing stand-alone solutions such as solar home systems with micro credits, or a fee for service; installing mini-grids via a different business model; using capital subsidies and cost recovery via tariffs.

Policy changes are yet another challenge developing countries must face, as most energy policies are short sighted. Another hindrance is that so many of

## Expansion

Solar technology has been emerging in developing countries, with Asia leading the way. To summarize:

- **Asia Region (excluding Japan):** Asia solar PV plants account for approximately 42 percent of the overall installed capacity<sup>9</sup> of solar plants in the world. China is the leading generator in Asia, with 52 percent (8,548 MW) of the solar capacity installed in the region. India is second, with 2.3 MW, and Thailand follows, with 518 MW installed capacity. Kazakhstan, Pakistan, and the Philippines together account for 1 GW of solar PV energy<sup>10</sup>.
- **South America Region:** Solar energy is in its early stages in this region, as it accounts for only 2.3 percent of the worldwide

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these countries remain focused on grid extension, urban electrification, or large hydro, gas or coal power plants, with no long-term strategy for sustainability and supply. When demand outstrips supply, this approach is costly, resulting in power shortages and losses in the economic sector. This lack of planning illustrates how much diversified electricity generation capacities are needed, especially in rural areas, where the use of off-grid solar technologies can bring reliable electricity to the masses<sup>15</sup>.



Originally from Spain, Gabriel Hurtado studied his MSc at Cranfield University & Imperial College of London. Since then, he has worked in many projects for several FTSE companies and public organizations and he has published energy articles in four UK Magazines, and in energy magazines in China, India and New Zealand. He has extensive experience in business development, project management and energy systems. He seeks to finely synchronize energy consultancy with energy systems and business development and being part of businesses that use technology to solve society's problems.  
**gabriel.hurtado@vincifacilities.com**



Sasaenia Paul Oluwabunmi is a First Class graduate of Electronic/Electrical Engineering from Obafemi Awolowo University, Nigeria and has a Masters (Distinction Grade) in Energy Systems and Thermal Processes from Cranfield University, United Kingdom where he studied as an Exxon-Mobil international postgraduate scholar. He has experience in project management, energy finance and entrepreneurship. He is an Operations Officer at the OPEC Fund for International Development (OFID) and he manages a portfolio of developmental projects across multiple countries in the Asia continent.  
**s.oluwabunmi@ofid.org**

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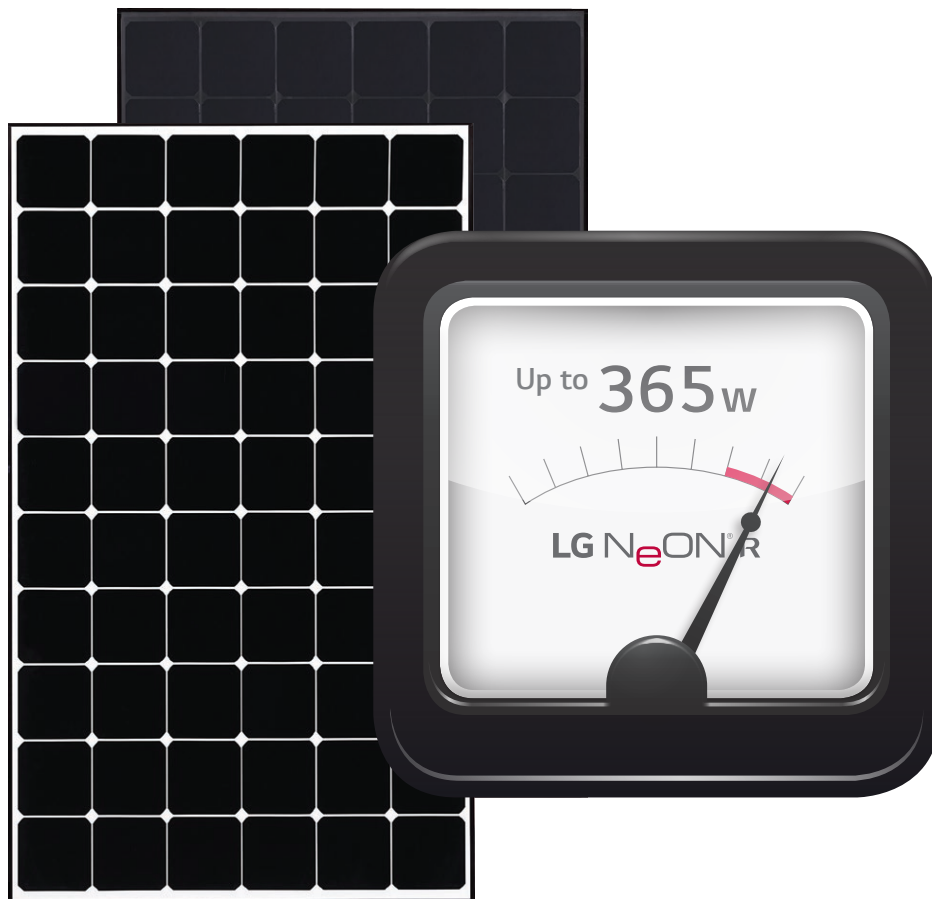
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# How to Accelerate Architectural Solar in the US Market

## From BIPV to building component

by Christopher Klinga



### IF YOU CONSIDER YOURSELF A VETERAN OF THE

solar industry, you most certainly have heard of Building Integrated Photovoltaics (BIPV). BIPV has taken on many different definitions over the years. Year after year, we hear of the projected explosive growth of BIPV, but it always seems to be on the horizon. Why has a concept that has been so widely discussed lack widespread adoption? The answer is multi-fold, and a factor of the barriers that this niche segment is working to address.

At the root of the issue, the definition of BIPV is flawed, and the varying colloquial definitions of BIPV are selling it short. By some definitions, BIPV must be physically integrated into the building envelope to be considered “BIPV”. Others see the integral nature of BIPV as simply part of the building design. Rather than spark the on-going debate about the definition of BIPV, it is more important to pivot our discussion to the heart of the story: Architectural Solar. The Architectural Solar market is where the true opportunity lies.

Architectural Solar has, and will continue to evolve to encompass technologies that span the broad spectrum of the word “integrated”. Starting from solar panels that take on artistic expression (void of any function beyond art and energy production), to solar panels that form an aesthetic functional surface in an outdoor environment, to integrating PV technologies into insulated glass units (PV-IGUs) as a multi-functional building skin.

### Architectural Solar - The Multi-Functional Building Component

The benefits and differentiators of Architectural Solar lie in its multi-functional nature; it's what has generated all the buzz over the past several decades, and will also be how proponents of Architectural Solar will justify it to traditional building industry decision makers. It provides a platform to leverage the intrinsic building materials of solar modules as building components. The structural backbone of a solar panel (glass,

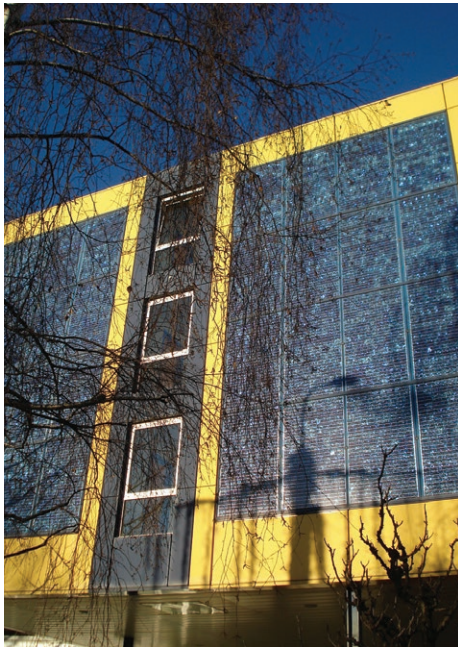
encapsulant, and aluminum) can be found throughout the built environment. For instance, glass-glass laminates are a commonplace architectural component. They're typically used to increase a lite's structural properties, make it safer, or provide sound protection. Glass-glass construction also happens to be a growing trend in the global PV industry, due to its added reliability over glass-foil modules. When considering the benefits of glass-glass laminates, and other components that can serve a functional purpose within the built environment, the incremental cost of solar becomes that much more palatable.

One of the most appealing multi-functional attributes of Architectural Solar is the opportunity to leverage its opaque, or in some cases, semi-transparent nature. The building industry commonly coats glass with ceramic coatings or patterns, to form what is called a frit. Frit is typically used to reduce the solar heat gain coefficient (SHGC) of vision or sloped glazing, or to create an opaque barrier within a façade (e.g., glass in front of floor partitions, known as spandrel glass). It is also used for glare control and bird-safe applications. There are currently solar cell technologies available that can address these exact needs, while also generating energy. Ceramic frit coatings can typically cost developers a \$10-20/sqft premium. To put this in perspective, the average U.S. cost of a 100 kW commercial system in 2015 was \$2.29/watt, or \$36/sqft. This doesn't mean that Architectural Solar always has a lower levelized cost of energy (LCOE), but it does mean that its multi-functional nature provides a means to offset a substantial portion of its intrinsic costs; this works in its favor towards being a more desirable solution. The fact that the full installation of a PV system isn't far from the cost of ceramic frit, and fractions of the cost of a granite façade, means that the cost equation is no longer the barrier.

### Building Industry Integration

Now that the cost of solar is at a record low, you may wonder what is stopping this obvious progression. Regrettably, the major barriers remain the same. First, the building industry and the solar industry





claimed. The cost of PV continues to drop, and innovative technologies are being brought to market that can easily integrate into glass fabrication processes. The opportunity is immense, but can only be realized when the critical barriers are overcome. Once they are, PV will be seen and experienced by all - in more ways than one.

*Christopher Klinga P.E. is the Technical Director of the Architectural Solar Association, a trade organization focused on harmonizing the PV industry and the Building Industry. He also owns and operates Solmotiv Design, a product and project based design-consulting firm based in Boulder, CO. His client list includes architects, developers and product companies. In addition, Chris is an engineering consultant to Solaria, an industry leader integrating solar technologies into the built environment.*

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need to actively embrace one another. Building industry players need to see the value in adding solar technologies to their product offerings. This trend has gained considerable traction in the roofing segment of the building industry, as several of the industry leaders now have solar divisions. The next step is for building envelope suppliers to make this shift, a shift that is upon us today. Solar technology companies are pioneering the creation of a trusted supply chain by developing partnerships with large building envelope leaders. In the last two years alone, some of the world's most respected glass conglomerates have brought to market their own branded PV-glass products, embedding proven PV technologies from leading solar companies, thereby making it a safe bet for building owners and developers. It is trends like these that will accelerate Architectural Solar into the mainstream.

#### PV Codes & Standards

When a PV manufacturer certifies a product in the U.S., they are typically constrained by standardizing their offering (due to the nature of UL 1703). Until now, mass manufacturing has dominated the solar sphere; there has not been a need for the standards to adapt. However, in order for PV to adapt to the architectural industry, codes and standards specific to the PV industry must accommodate some level of customization, as well as a range of product types and applications. Better yet would be the independent development of a framework for an Architectural Solar product standard – one that references relevant PV standards and building components. There are several glass and framing standards that meet the demands of the architectural industry, but the electrical standards within the PV industry have yet to be challenged by the same constraints. Architectural solar will only prove to be successful if standards can effectively evolve and adapt to the critical needs of the architectural community.

Architectural Solar is still poised to see the exponential growth that all have

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# Does More Sun Equal Higher PV Plant Performance?

by Helena Wingert



## SOLAR POWER COMPONENTS HAVE UNDERGONE

an extreme cost reduction of 99.61 percent - from \$76 per Watt to \$0.3 per Watt - since they started to evolve in 1977. Since 2014, they have been able to compete with atomic or coal-fired power. Reasons for this trend are scale effects, sinking feed-in tariffs, increasing competitive pressure (e.g. from China) funding programs, as well as technological process. The latter also increased the service life and efficiency of solar cells. The newest silicon-based solar modules run for 35 years, and have a performance ratio of 80 percent, and rising. Compared to the 1980s, this increased by 20 percent. Moreover, up-to-date solar plants pay back after less than one year. Thus, they give back twenty times the energy that was necessary to produce them, when operating 20 years.

As a result, solar plants are springing up like mushrooms worldwide: Between 2010 and 2016, the amount of utility-scale PV and thermal plants increased by about 72 percent, making it the fastest growing energy industry.

## What kind of environmental factors influence solar power plants?

Solar cell material, module size, and surroundings (trees, mountains, etc.) are all factors that influence solar cell performance. Weather-related parameters include radiation, temperature, wind, humidity and precipitation. Since all of these variables affect the profitability and protection of a PV plant, professional weather stations are necessary to the success of any solar farm.

## How to deal with weather factors?

Global radiation is the key parameter for continuous plant assessment. It influences the possible yield, and thus the profitability. Radiation is dependent on site geography; the closer to the equator, the higher the radiation. Aerosols and cloud optical depth also contribute to the reduction of radiation.

They are often monitored by super sensitive (7 to 14V/W/m<sup>2</sup>) thermopile pyranometers. The most high quality pyranometers are maintenance-free for 10 years, don't need to be powered, and fulfil the Secondary Standard, which is the highest WMO standard for pyranometers.

## Ambient Temperature

High ambient temperatures can cause noticeable reduction in efficiency: The dark glass of solar modules absorbs so much heat, that the "nominal" cell temperature is about 25 degrees higher than the ambient temperature. If the surrounding is 104°F, for example, the solar cell is heated up to about 149°F, and its efficiency drops by 18 to 15 percent. Ambient temperatures of 68°F are optimum.

Digital NTC thermistors measure this parameter with an accuracy of up to 32.36°F. This level of accuracy is supported by active ventilation, and a special housing that protects the probe from direct sunlight.

## Relative humidity and dew point

The dew point is the threshold where air humidity is separated in form of dew or mist, at a constant air pressure. Small dewdrops form when they meet cooler objects - the air becomes saturated with vapor, and humidity measures 100 percent. The more vapor in the air, the higher the dew point. If the ambient temperature drops below 32°F, these dewdrops can freeze and cause frost. This ice or water particles can cover solar modules, and significantly impede their operation.

Capacitive relative humidity sensors precisely monitor humidity. They boast fast response times, low hysteresis, and accuracies of up to 2 percent. Combined with a NTC temperature and a MEMS capacitive pressure sensor, the dew point can be determined with a 33.26°F accuracy.





digital sensors outpace them in terms of service life. On average, mechanical sensors need to be replaced after 2 years, but digital sensors can operate for 10 years with no maintenance. Comprehensive weather measurement is a smart choice for a successful and profitable solar installation.

*Helena Wingert is an editor and content specialist at Lufft – a German developer and supplier of environmental measurement equipment with a 136-year history. She works closely with R&D and sales to create data sheets, blog posts, press releases and more. Helena has a Master's degree in Business Management, which she achieved dually at Lufft and the School of International Business and Entrepreneurship at Stuttgart, South-Germany.*

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#### Wind

Wind measurement is essential to help safeguard a PV system. While breezes have a cooling effect on solar panels, wind gusts can cause damage, especially during storms. Trackers protect solar modules by adjusting them into a position that exposes the least amount of surface to the elements.

Up-to-date ultrasonic wind sensors are capable of measuring wind strengths of up to 200mph with an accuracy of 0.6mph, and directions with 3° accuracy. They are highly stable, with no moving parts, long-term maintenance-free operation, and an extensive MTBF of about 10 years. Moreover, they boast low response thresholds for fast measurements.

#### Precipitation

Precipitation influences solar panels in many ways. Liquid precipitation can have a positive cleaning effect. Panels are prone to collect many types of deposits on the surface such as leaves, bird droppings, pollen, dust, and sand. Rain is a natural way to wash them away. On the other hand, snow can build up, and hail may cause serious damage. Solar trackers mitigate the effect of most types of precipitation.

High-tech precipitation sensors are capable of distinguishing between precipitation types. Doppler radar sensors are maintenance-free, have a high resolution of 0.39mil, and an accuracy of up to 10 percent. They recognize droplets as small as 0.3mm, and precipitation intensities of up to 7.8 in/h.

#### Which weather sensors are suitable for utility scale PV plants?

Combining all these weather sensors in one housing can save owners time and money. Even if the acquisition costs are higher than those of mechanical sensors,



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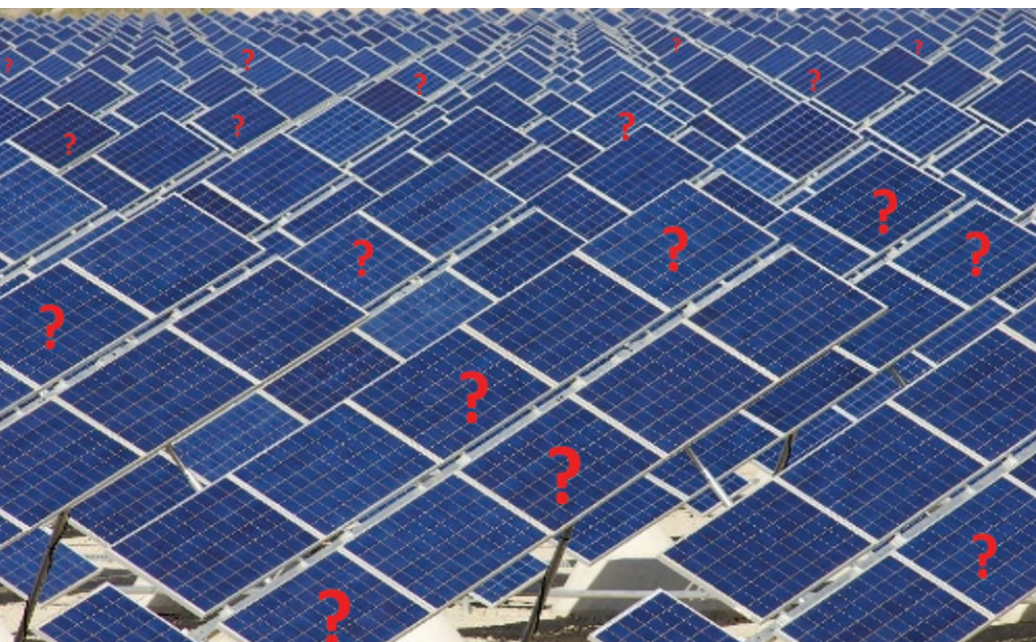
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# Can Module Digitalization Revolutionize PV O&M?

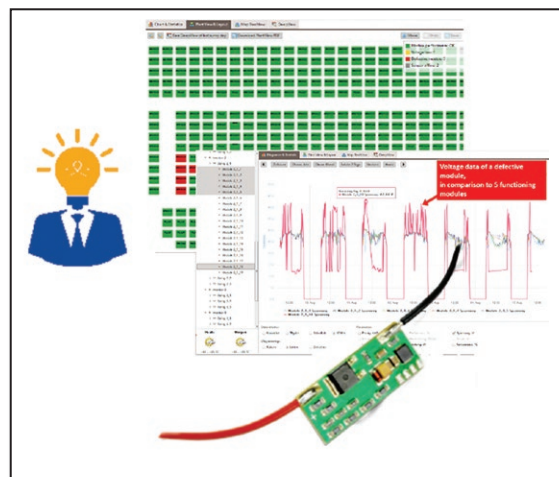
by Ingmar Kruse and Daniela Kramer



Nearly everything is digitalized these days – except solar modules. Considering all of the developments in the PV industry, it would seem that their time has come. A statistical evaluation of the Bavarian Center for Applied Energy Research (ZAE Bayern) found that nearly 8 percent of all modules in the field have issues, and 4 percent of all strings<sup>1</sup>. These errors were exposed through extensive IR inspections, not usual monitoring.

### So how is a PV plant usually monitored?

In general, a PV plant is monitored at inverter level, and sometimes at string level. Monitoring at inverter level gives information about the amount of power production and downtimes, and, if available (through additional irradiation sensors), can give information about the performance of the plant. But is the power produced the maximum the plant can achieve? And if not, why not? Where are the errors? Error-search is time-consuming and expensive, and requires the right equipment and expertise. Depending on the size and location of the plant, searching for the error can be a herculean task. In some cases, therefore, operators may be reluctant to organize a service - accepting the losses may seem a less costly route. Even when the modules are still under warranty, the search process can be deterrent. However, if ignored, they will grow and lead to additional collateral failures. String monitoring also has its faults. While it gives a more compartmentalized insight into the plant, it cannot detect specific problems. Another study of ZAE Bayern showed that the current of a defective module is pulled up to the current values of the functioning modules in that string<sup>2</sup>. So string monitoring will not disclose an error within that string, as the current will not deviate, and gives no indication about an error.



### How about a list of exact power losses of individual modules?

Only constant module measurements, and analysis of these data, can address the problem of faulty modules on an operational day-to-day basis, without the need of frequent IR inspections. Measuring the data of each module, and analyzing them by artificial intelligence, enables a complete different O&M. With real-time monitoring remotely from one's desk, the main O&M tasks shift from finding an error, to precisely defining when to service or exchange defective modules. When you know the exact power loss of each individual module, exchange services, warranty cases, and even linear warranty, can easily be settled.

Real-time module precise monitoring through digitalized modules, shifts maintenance from preventive to predictive. A comparative study demonstrated that IR imaging is not able to assert defects resulting in power losses of below 4 percent<sup>3</sup>. Yet highly precise measurements of even 1 percent are very valuable, as these allow predictive maintenance; evaluations of degradation processes over a long time span, such as PID, are clearly identifiable.

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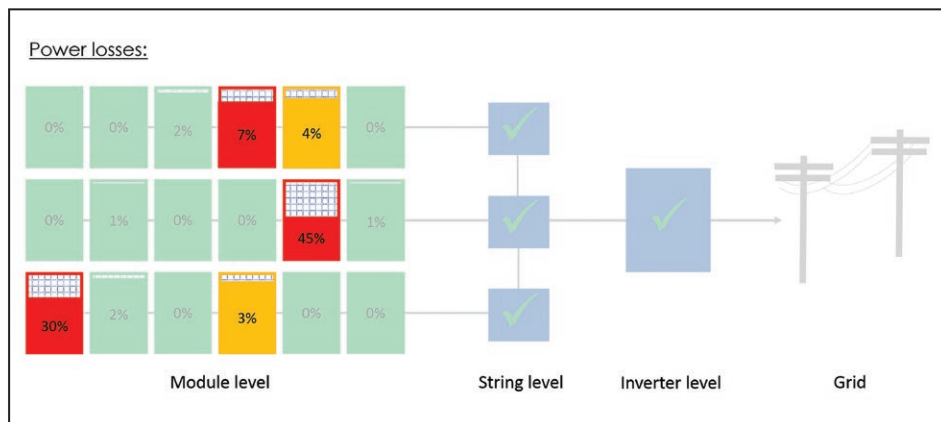
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### How can precise module monitoring be a solution?

Every module has a specific voltage line, which is quite consistent. Deviations of this line instantly point to errors. Measuring this line over the course of each day, and analyzing the data (including all historical information), leads to clear error detection and identification. Temperature significantly affects module performance as well. By measuring each module's temperature, it's possible to calculate each module's real power performance. Also knowing the exact real-time power loss of each module compared to a reference module, enables the setting of parameters regarding exchange of a module. For example, should the power drop by more than 3 percent within the warranty period, that module can instantly be exchanged. This is even more important in terms of a linear warranty.

With digitalized modules, the information of every module – its power, voltage, and temperature – is available in real time. Sophisticated analysis enables management of the entire plant, even for non-technicians. Financial, commercial, and technical evaluations can be produced at the push of a button – literally. With a list of exact power losses of each module, O&M can be structured and standardized.

Digitalization is the future, and the PV industry is finally catching up.

*Ingmar Kruse founded his first company in 1983. He studied Business Administration in Nuremberg, and Computer Science in Atlanta, and has devoted himself entirely to the development of new technologies and their market introduction. In 1996, he received a rare license from Apple for the production of Apple computers. In 1989, he introduced the first color scanner in the market, launched the first color management system "Color Storm" in 1993, and in 1997 developed the ColorProof Software, the first digital color simulation software. With SunSniffer he developed the first Operating System for solar modules.*

*Daniela Kramer is head of marketing and public relations for Sunsniffer.*

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<sup>1</sup>[www.sunsniffer.de/images/downloads/ZAE\\_Statistical-overview-of-findings-by-IR-inspections-of-PV-plants.pdf](http://www.sunsniffer.de/images/downloads/ZAE_Statistical-overview-of-findings-by-IR-inspections-of-PV-plants.pdf)

<sup>2</sup>[www.sunsniffer.de/images/downloads/ZAE-Defect-Analysis-of-installed-PV-Modules\\_with-comment-v3.pdf](http://www.sunsniffer.de/images/downloads/ZAE-Defect-Analysis-of-installed-PV-Modules_with-comment-v3.pdf)

<sup>3</sup>[www.sciencedirect.com/science/article/pii/S1876610217339383](http://www.sciencedirect.com/science/article/pii/S1876610217339383)



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## THE EVOLUTION OF RESIDENTIAL ROOF FLASHING

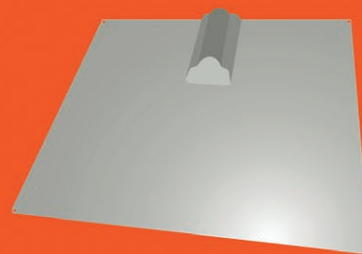
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#### PROS

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#### CONS

- Inserted underneath the Shingles, which requires the shingles to be separated and voids the roofing warranty
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- Large, bulky size adds unnecessary costs



1900's

2008

1980's

2012

TODAY

### MICROFLASHING

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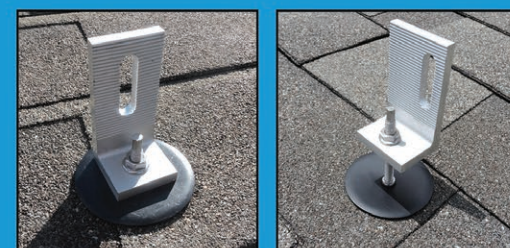
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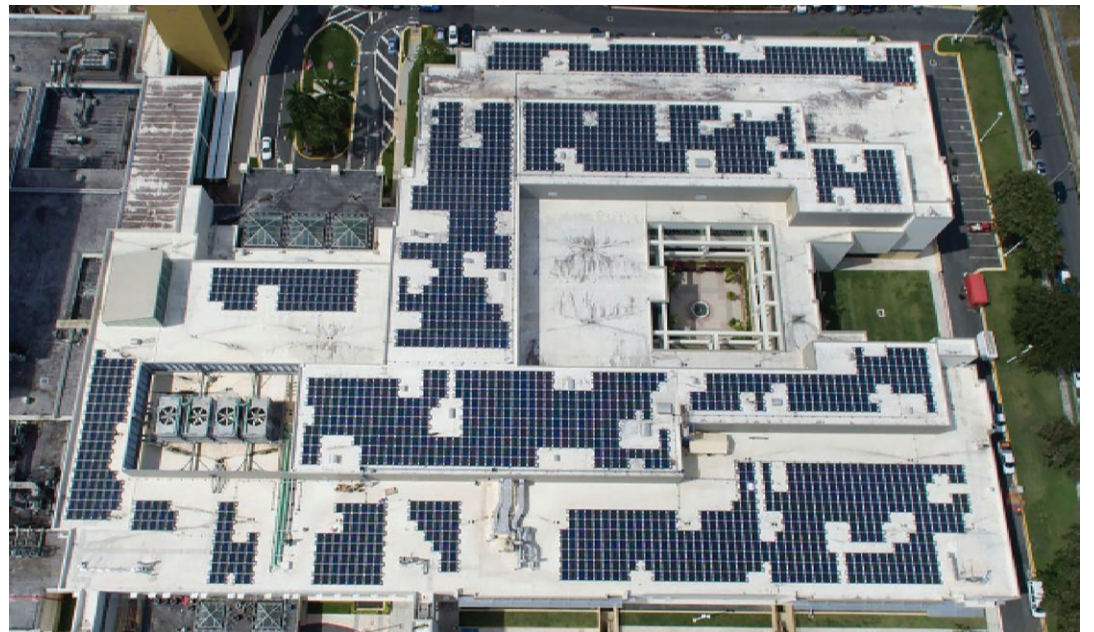




# Solar Survives the Storms

## Focus on Puerto Rico

by Elie Rothschild



### CLIMATE CHANGE REARED ITS UGLY HEAD THIS HURRICANE

season, with the Island of Puerto Rico getting hit especially hard. Hurricanes Irma and Maria (both category 5) made land less than a week apart. The destruction was wide spread, and affected all of the 3.5 million island residents. The resulting loss of power and communications illustrated the vulnerability of a conventional energy infrastructure. An estimated 80 percent of transmission lines were felled, and cell phone towers damaged; people were left in the dark, with no way of knowing what to do, or how to let family and first responders know they were ok.

Because it has no domestic resources of fossil fuel, Puerto Rico depends on imported oil for the majority of its energy production. Antiquated generators running on imported oil are expensive and inefficient. To date, solar PV has addressed the island's high energy costs, but, no matter how modern the technology, it is still dependent on an overtaxed and antiquated grid. Some experts estimate that it could take more than a year to bring power back to the entire island. This may be the timeline for conventional power sources, but solar PV can be implemented much more quickly and cost effectively. The question remains, can it be installed to sustain the extreme weather Puerto Rico will inevitably endure in the future? To answer this, we need to examine solar installations post-Maria and post-Irma, to see what worked and what didn't.



### What didn't work

Historically, solar PV installed on flat roofs has used conventional raised racking, with stanchions and rail. Roof anchors, every few feet, tie into structural supports under the roof, which results in numerous roof penetrations. This translates into an increased chance of roof failure due to leaks. Also, this method of installation is laborious, and requires on-site customization of rail lengths to handle roof undulations. Since the solar panels sit higher above the roof, they're subjected to higher wind loads. Post hurricane images of the damage – aerial shots of missing panels and torn roofs – have shown that this is not the best fit for

areas with extreme weather. A system is only as strong as its weakest link; rigid structures, with no allowable give, were unable to withstand the 180 MPH rotating winds of a hurricane. Given the recent drive to rebuild Puerto Rico's power grid with PV and batteries, it's critical that these components are engineered to last.

### What worked

A 645 kW rooftop array on the VA Hospital in San Juan (installed in 2015) is operating at 100 percent - even after facing sustained 180 MPH winds from hurricanes Irma and Maria. Why is it still operating? This particular system, which sits atop the 100-foot-tall deck of a 9-story building, was engineered to withstand a 170 MPH burst of 3 seconds (ASCE 7-10). The array was installed with a combination of ballast and mechanical anchors. It's a pliant racking system that is polymer based and injection molded from glass-reinforced nylon. This gives the array the ability to flex in multiple directions without breaking – which is the main reason it's still on the roof. Modules were clamped on the long rail, mounted in landscape at 5 or 10 degrees, and clamped 12" in from the edge. The design of the racking, combined with clamping the modules in the zone recommended by the module manufacturer, gave the array the necessary flexibility. Unlike more rigid aluminum systems that fight the winds, polymer-based systems have shown to operate much like a chain link fence, bending to extreme forces, rather than breaking.

With all of the available solar power technology, plus today's low costs, the damage wrought by these storms has given us a perfect opportunity to rebuild Puerto Rico's energy infrastructure. With solar plus storage, island residents will not only benefit from a reliable and efficient grid, but also one that can be up and running much faster than conventional power plants. More importantly, now that we have proven and reliable rooftop PV systems that can withstand some of the most extreme weather nature can dish out, it's time to start planning.

*Elie Rothschild is Sales Manager at Sollega, a solar racking manufacturer focused on commercial flat rooftop PV and ballasted ground mounts.*

**Sollega** | [www.sollega.com](http://www.sollega.com)



## Design your own solar system

The new PRE Design Tool from SunWize has many capabilities which allow users to design and quote appropriate off-grid solar systems easily, reliably, and quickly. Featuring a complete NREL site database with State/City lookup, an advanced load calculator for up to three discreet devices, coupled with direct input options, this design tool brings solar design capabilities to the fingertips of their customers. The Power Ready Express (PRE) Systems are always designed to IEEE 1562, and the system enclosures are NEMA3R rated for indoor or outdoor use. SunWize PRE Systems are complete off-grid solar battery kits containing everything needed to run a stand-alone DC load using solar energy. SunWize Power Ready Express kits feature a pre-wired and fully pre-assembled control panel, requiring only simple array and battery connection terminations during installation.

**SunWize** | [www.sunwizepower.com](http://www.sunwizepower.com)



## All-in-one residential energy storage solution

Developed to help homeowners achieve grid independence, Delta's all-in-one energy storage solution consists of a 7kW hybrid inverter E7U; external battery cabinet containing a high capacity BX6.0 6kWh lithium-ion battery; R4 smart monitor and control system; and power meter. PV energy can power household loads, charge the battery, or feed into the grid automatically based on pre-setting. As a result, homeowners can capitalize on optimal power output from their PV systems. The E7U hybrid inverter integrates seamlessly with the BX6.0 battery, creating a compact, flexible solution that can be detached as needed. It features three Maximum Power Point Tracking (MPPT), standalone functions, and a high charging efficiency of up to 97%, sending DC power from the PV system directly to the batteries without additional power conversion, also supporting the power flow from grid to battery. Delta E7U is also equipped with a revenue grade meter (RGM) which complies with ANSI standards. Both E7U and BX6.0 are outdoor rated. Delta R4 monitor system provides users with an easy-to-use monitor interface for power generation, consumption, and battery management. The power meter measures energy flow and displays data on the 7" touch smart monitor, used to control the system operation modes and optimize the power usage throughout the day and night. Pairing with Delta Solar Cloud Service, homeowners can access data through their computers or mobile devices remotely, and receive warning and alarm information via email notification.

**Delta Group** | [www.deltaww.com](http://www.deltaww.com)



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# Unique Requirements for Solar Projects for Agriculture

by Sean Hood

Energy is the lifeblood of many businesses, including agriculture. Solar energy can offer agribusinesses the opportunity to convert vacant or hard-to-farm land into power generation facilities that can significantly reduce electricity costs, achieve energy independence, and improve cash flow. It's no wonder more and more agricultural businesses are investing in solar energy.

The basics of whether solar is right for an ag business are the same as for any home or business owner; the availability of sunlight, the cost of utility electricity, and the cost of the energy system, all factor into whether the investment makes business sense. For homeowners and urban businesses, the decision to go solar is often based on these factors alone.

## Utility-Scale Projects

For agricultural businesses, once those basic issues are determined to “pencil-out,” the issues unique to ag need to be considered. The decision to go solar for farms, dairies, and orchards can be complicated because the requirements and conditions vary so widely. Environmental conditions, site conditions, mounting options, and the location of public utility connections, are very different than the requirements for a home or business in a built-out neighborhood or business park.

Ag solar projects also differ from a typical residential or commercial solar project. Consider their sheer magnitude; a 1 Megawatt (MW) system, for example, is not uncommon, and will require approximately 4 to 6 acres of land, over 3,000 solar panels, tons of mounting hardware, miles of wiring, and thousands of electrical connections. This kind of system is considered, by many agencies, to be utility-scale.

## Site Considerations

It's also important to identify the best location for a solar energy system. In most ag businesses, that means finding the most suitable land. In addition to optimizing the sun exposure for the solar panels, the soil should be tested and analyzed to determine if any issues would impact the performance of a solar energy system.

For example, very coarse sand or soils that drain poorly can result in topsoil shifting, sinking, or eroding near the base of equipment. The location of the system in relation to the water table is also important for the stability of the mounting structures. Slight shifts in the soil can occur - the system needs to be designed to handle that possibility.

Ag businesses should test soil for corrosive elements. Factors that influence the severity and rate of corrosion include the inherent moisture content, conductivity of the soil media, pH, and the oxygen concentration. Chemicals used in farming, such as fertilizers, grain and silage preservatives, chemicals for pest/disease/weed control, and proprietary acid solutions for cleaning dairy equipment, can also be significantly corrosive. Not to mention animal waste.

## Structural Durability

Because ag solar installations are often in rural areas with little in the way of protection from the elements, and in areas where weather conditions can be particularly harsh, the structural durability of the panels, mounting systems, and electrical connections are all critical to long-term performance. High winds, heavy rain and snow, and temperature swings can strain electrical wiring, panel positioning, panel performance and more.





Loose wiring can cause fires or degrade electricity production. Standard wire management practices, like using zip ties to bundle cables, may work fine in an ordinary home or business solar system, but can quickly wear out in a rural environment where weather conditions and animal activity can put exposed wiring at risk. Protecting wiring with hard conduits is a better option.

### Net Metering and Net Energy Metering Aggregation

One of the policies that can make grid-tied solar energy cost-effective for any home or business is net metering; the owner of the system receives credit of excess energy generated, and pays only the difference (net) between what is consumed and what is sent back to the grid. By allowing the meter to spin backwards, the utility gives the owner the ability to receive credit for daily excess energy generated by the solar system. The “Net” is then simply calculated at the end of the year when the final utility bill is trued-up. In states like California, which has among the highest electricity rates in the U.S., net metering has played a significant role in the adoption of solar energy by homeowners and business owners, including agricultural businesses.

Net Energy Metering Aggregation (NEMA) is a different animal (pardon the expression) for agriculture businesses. Many farms, dairies, and orchards have widely distributed facilities - pump stations, homes, production facilities, barns, storage buildings and more. Agribusinesses can have dozens of meters spread throughout thousands of acres of land. With NEMA, utilities allow a single solar power plant to offset all electricity used by the business, even those not directly powered by the solar energy system (with some restrictions).

### Environmental Benefits

Of course, solar energy reduces the carbon footprint of any user, and agriculture businesses have an implicit stake in protecting the environment. In businesses where consumers prefer sustainably raised products, the environmental benefits of solar energy can translate directly into additional economic benefits.

### Harvesting the Sun

Solar energy isn't right for every agribusiness, but when it is, the economic and environmental benefits can be powerful. In fact, in many cases agricultural businesses can generate more income per acre from solar energy than they do for the crops or products they produce, even taking into account high-yield crops like wine grapes and almonds.

The price of solar panels have dipped to all-time lows, and the federal Investment Credit Tax, which provides a 30 percent price reduction in most cases, has been extended through 2020. Some states have additional tax deductions to make solar energy even more attractive. Where utilities allow it, NEMA allows solar power system owners to offset electricity use in all metered facilities. When conditions are right, ag business owners are finding that a solar energy system can pay for itself in just a few years.

Sean Hood is president of project development and GTM and Coldwell Solar in Rocklin, California.

Coldwell Solar | [www.coldwellsolar.com](http://www.coldwellsolar.com)



### Alarm annunciator with leap-ahead functionality

EES introduces the WAP, the omniflexible window annunciator. The device offers 24 inputs in different voltage levels ranging from 24V – 230V AC/DC, displayed via colored “windows” which are set at 28 x 28mm by default but can be enlarged individually by multiples in width and length. The clou of the WAP is, no mechanical works are necessary to execute the changes. All settings can be done on an online or offline web interface via mouse by drag and drop. Additionally, the WAP provides the possibility to display different indication statuses in different colors. Good states appear in green, fault conditions in flashing red, and acknowledged states in steady light in a different color. A color scheme of 6 colors is available per input. To ensure high reliability, each window comprises 2 LED for higher brightness and redundancy. In case of a failover of one LED, the windows shines with 50% of the brightness and provides the leeway to look after spare devices. The designation legend and the frame assignment of the windows are generated dynamically by a click within the parameterization interface and can be printed out on a standard foil.

EES Elektronik GmbH & Co. Störcontroller KG | [www.ees-online.de](http://www.ees-online.de)



### Central inverter with modular architecture


Power Electronics introduces its new medium voltage string inverter, “the HEM”, designed with all the advantages of its modular (string) architecture with the benefits of the central inverter. The new HEM, up to 3MW, will reduce project costs and increase ROI for developers, plant owners, and investors. With the patented “cyclone drive” cooling system, the HEM guarantees maximum production in extreme climates, corrosive environments, and sandstorm conditions. The HEM Power Station was also designed with CAPEX in mind, ensuring quick deployment, easy installation, and quality cable management. The design team also paid careful attention to the OPEX side of the inverter with compact, easy to service power components. With its 1500V input and medium voltage output the HEM is a platform for utility scale projects.


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

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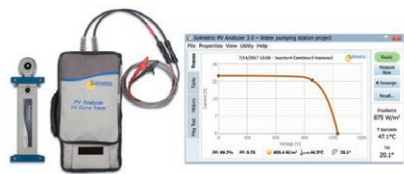
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### I-V curve tracer

Solmetric's 1500V PV Analyzer I-V curve tracer has the ability to measure strings up to 1500V and 30Amps. It also includes features such as a WiFi interface for connecting to a tablet or laptop, eliminating the need for a USB dongle, long range wireless connection to the SolSensor, and battery charging and level indicators. Additional features include: high measurement throughput even in hot environments; high I-V, irradiance, and temperature accuracy; 300+ foot wireless range; and large user interface and clear visualization of performance issues.

**Solmetric Corporation** | [www.solmetric.com](http://www.solmetric.com)



### Energy storage product modeling

Energy Toolbase launched a major software update, enabling users to transparently quantify the dollar savings for any type of behind-the-meter (BTM) energy storage project. This empowers developers in both the residential and commercial market to identify the best storage use-cases, more efficiently focus their development resources, and close deals. Energy Toolbase's new release was designed to take an objective, third-party approach to quantifying the savings for different types of energy storage system providers.

**Energy Toolbase** | [www.energytoolbase.com](http://www.energytoolbase.com)



### Hybrid flux

German flux manufacturer Emil Otto GmbH continues to expand its product portfolio and brings an additional flux to market with the new alcohol-water-based flux EO-Y-004, which is also obtainable as a granulate-based concentrate. The hybrid EO-Y-004 flux exhibits a solids content of 3.5% to 3.7% and has been developed for use in wave and selective soldering for a broad range of applications. The soldering properties have good rise-through and circuit-board wetting. The broad process window has great thermal stability. Practice has shown that with proper application, the washing of circuit boards soldered with this flux can be largely dispensed with. The circuit boards are visually clean. Its low alcohol content renders it frost resistant enabling it to be transported and stored quite well in winter. The flux is moreover obtainable as a concentrate and can be packaged more simply and compactly. Transport optimization enables the flux concentrates to be economically transported over great distances, since shippers impose lower costs for non-hazardous goods.

**EMIL OTTO Flux- und Oberflächentechnik GmbH** | [www.emilotto.de](http://www.emilotto.de)

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ROOF ANCHOR**

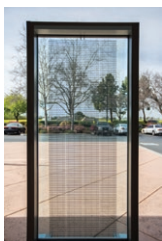
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Patent Number: US D629.679  
[www.standingseamroofanchor.com](http://www.standingseamroofanchor.com)



### Architecturally aesthetic energy-producing glass

Solaria Corporation's PowerVision-150 product empowers the transformation of building facades, skylights, canopies, and other structural components into power-generating assets. Deployment of Solaria's patented technology, which leverages the reliability and efficiency of crystalline silicon technology, enables structures to generate electricity cleanly and reliably. Solaria's unique solar cell process technology has allowed the company to develop an architecturally beautiful vision glass which can be used in locations not typically associated with solar panels; these include skylights, patios, and window openings, providing an electricity generating see-through surface. Building owners and occupants accrue many benefits, as solar-outfitted windows mitigate the sunlight's effect on a building. When combined with high-efficiency solar PV modules, together they offer a seamless strategy to unlock the full power potential of buildings with technologies that boost energy generation, providing high yield at a low cost. Extensively tested and demonstrated at Lawrence Berkeley National Laboratory's FLEXLAB, Solaria PowerVision has proven to deliver a unique combination of high performance and high power density with optimized thermal performance, effective daylighting, and glare control.

**Solaria Corporation** | [www.solaria.com](http://www.solaria.com)

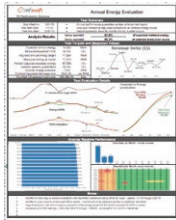


### Easy and efficient photovoltaic plant design

For the input of object data, 3D models in different file formats can now be imported into PV\*SOL premium 2018 via its new interface. This makes it possible to import realistic and detailed 3D objects created with photos taken from different perspectives like using a drone. This will add another 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 integrating them to scale into a project. Flexibility has been increased with regard to the subsequent configuration of the modules, which are automatically placed on an object. The new possibility of polystring configuration allows completely different strings to be connected parallel or in series to an MPP tracker. This is required, for example, to connect an east-west roof parallel to one MPP tracker. Even different modules in a string can now be interconnected; for example, defective modules which are no longer available and have been replaced by similar, new ones. Modules with different orientations can now also be connected in one string via the integration of power optimizers. These new functionalities increase the flexibility of the design process and allow more detailed configuration and simulation of the PV system. Other useful additions for the optimization of a system are the output of the I-V characteristics for each time step of the simulation, as well as an energy flow diagram representing the overall system including the battery system, consumers, and an electric vehicle.

**Valentin Software GmbH** | [www.valentin-software.com](http://www.valentin-software.com)





## Modernizing solar PV performance management

infiswift's swiftPV leverages IoT technology to change how the solar industry uses data to optimize the performance of photovoltaic (PV) systems. The suite of products and services allows PV power plant owners and operators to connect diverse PV assets and distill insights from the data, ultimately increasing solar plant performance. The swiftPV suite of products and services includes 'blocks' which can be used to build a customized solution. The current swiftPV blocks include: Data ingest: This core block is built on the infiswift IoT platform, which connects and manages all field devices and cloud feeds regardless of vendor. This highly scalable platform ensures data is properly routed from origination to destination in near real-time. Apps: SwiftPV apps use custom mobile and web visual interfaces for each stakeholder on the team. Cloud Historian: This is a private database with open data access and flexible setup to cover all data needs. Reports: SwiftPV produces reports with tailored recommendations and data that can be updated and customized for delivery when needed. PV Performance Services (PVPS): Professional engineering support is available to monitor, analyze, and interpret complex data.

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



## Single axis tracker package

SunLink's TechTrack Distributed single axis tracker is a technologically advanced tracker with intelligent operating modes which optimize performance for ever-changing environmental conditions including wind, snow and flood. Its proprietary Dynamic Stabilization feature efficiently redistributes loads, allowing the tracker system to handle extreme wind with less steel, fewer foundations, and lower cost. The Virtual Pivot creates 120° accurate tracking to maximize generation potential while eliminating dead space and enabling superior terrain following. ETL certification to UL 2703 and UL 3703 standards. TechTrack Distributed will now be sold in two product packages: Standard Package which includes engineering and project management support to ensure success on every size project, as well as commissioning support with tracker status reports from VERTEX. The Pro Package provides additional topographic grade following foundation analysis to minimize steel overages and ensure install tolerances and a certified commissioning team for faster interconnection and ongoing access to actionable system performance data via VERTEX.

**SunLink Corporation** | [www.sunlink.com](http://www.sunlink.com)



## Smart module functionality

Tigo has launched three new "Duo" covers to its TS4 add-on / retrofit solution: TS4-R-O-Duo (Optimization), TS4-R-S-Duo (Safety), and TS4-R-M-Duo (Monitoring). The TS4-R-X-Duo brings smart module functionality to standard PV modules, adds smart features to new PV installations, and upgrades underperforming PV assets. With UHD-Core technology and expanded specifications, the Duo supports two PV modules connected in series with a combined power of up to 700W and a combined voltage of up to 90V. With a universal base and a range of covers containing flexible module-level power electronics (Flex MLPE), Tigo's Duo increases freedom of choice when selecting features for a particular project and budget. All three Duo covers work with any inverter and any module within its electrical specifications. This new addition is fully compatible with Tigo's current shipping products. Customers can design Smart PV Systems by mixing any of the TS4 products for cost-efficiency. The Duo also supports Tigo's Selective Deployment capabilities. Both the TS4-R-O-Duo (Optimization) and TS4-R-S-Duo (Safety) are NEC 690.12 rapid shutdown compliant and pending approval by Underwriters Laboratories (UL). Tigo's Duo provides PV systems with faster installation, integrated monitoring, 99.6% efficiency, compatibility with 60-cell modules, and module-level voltage shutdown.

**Tigo** | [www.tigoenergy.com](http://www.tigoenergy.com)



## Made-in-America string inverters

Yaskawa Solectria Solar's new Solectria XGI line of American made inverters are engineered and manufactured in United States, and are designed to achieve unmatched quality and reliability. Each individual component of the inverter is carefully selected and tested to perform reliably beyond the expected 20-year life of the inverters. The XGI 1000 inverters are offered in 60kW and 65kW power levels and the XGI 1500 inverters are offered in 125kW and 166kW power levels. They offer wireless HMI and connectivity, reducing the cost of installation and commissioning. Various options for the integrated combiner include fused or unfused inputs as well as PV connectors.

**Yaskawa - Solectria Solar** | [www.solectria.com](http://www.solectria.com)



## Utility scale solar inverter

Huawei Smart PV Solution's utility scale solar inverter, SUN2000-95KTL-USH0 offers integrated stretching molding for a reliable outdoor application. The 95 KTL utilizes an 800VAC output stage to minimize AC losses. To improve string flexibility and maximize yield compared to central inverters, the 95 KTL includes six MPPTs and twelve directly connected string inputs. The 95 KTL provides value with reduced O&M cost and inverter replacement reserves. The 95 KTL also offers a high AC power output for a naturally cooled string inverter with fuseless design and maximum efficiency of 99%.

**Huawei** | [solar.huawei.com](http://solar.huawei.com)

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### Miniaturization through controlled laser soldering

EUTECH GmbH has been using diode lasers for its customized soldering systems for years to provide pinpoint-accurate, fast, and definable soldering. Laser sources are subdivided into various categories; gas, solid, and semiconductor lasers are differentiated. The laser-active medium is important in this connection, since it determines the wavelength as well as the radiation quality. Radiation quality is decisive for the laser's energy density and ability to focus. Medium or low energy densities are needed during laser soldering. In this connection, the solder joints must be efficiently and homogeneously heated without scorching the material. Miniaturization is allowing solder joints are becoming ever smaller. They inhabit ranges from <math><200\ \mu\text{m}</math> to a few millimetres. The diode laser's output power is thus easy to regulate. The power can be smoothly adjusted into the kilohertz range, whereby the laser can react quickly to energy fluctuations. An additional advantage is radiation focusing, which puts the laser in a position to solder  $180\ \mu\text{m}$  solder joints. Focusing with fixed focal width limits energy input locally and with pinpoint accuracy, thereby enabling reduced thermal load on the components in the immediate vicinity. The temperature-time curve is decisively important during the entire soldering process. The diode laser can be controlled according to a prescribed curve. Among other things, a non-contact temperature-measurement system, which regulates heat input relative to process- and product-specific specifications, can be used for this. The system records all process changes, which are retrievable for quality-assurance measures. Combined with the likewise adjustable wire feed, the customer obtains a system that guarantees reproducible solder quantities and connections.

**EUTECH GmbH** | [www.eutech.de](http://www.eutech.de)



### Measurement and control datalogger

Campbell Scientific's powerful new data-acquisition product: the CR1000X measurement and control datalogger provides measurement and control for a wide variety of applications. Its reliability and ruggedness make it an excellent choice for remote environmental applications, including weather stations, Mesonet systems, wind profiling, air-quality monitoring, hydrological systems, water-quality monitoring, and hydrometeorological stations. The CR1000X has a fast processor, with more channels to improve accuracy and resolution. It has more ways to move data, via added port options plus more built-in communication and storage features. This new datalogger operates in extreme environments, with a standard operating range of  $-40^{\circ}$  to  $+70^{\circ}\text{C}$  and an available extended operating range of  $-55^{\circ}$  to  $+85^{\circ}\text{C}$ . It captures quickly changing data values with faster analog measurement capabilities. It differentiates even slight changes in data values by way of its higher-resolution measurements. The CR1000X provides an embedded, browser-based user interface for quick and easy data and system interrogation from any IP device. This includes connections directly with USB or Ethernet, and wireless devices such as WiFi, cell, or satellite devices. Memory includes internal 4MB SRAM for data storage and a microSD drive for extended data storage up to 8GB. For communication, the CR1000X supports full PakBus, Modbus, DNP3, and other protocols, making it an important part of a network. The CR1000X is programmed with Campbell Scientific's LoggerNet software, which includes a point-and-click program generator, and a network planner for graphical layout of devices.

**Campbell Scientific** | [www.campbellsci.com](http://www.campbellsci.com)



### Pressure transmitter with low-power voltage output

Endress+Hauser added a 1-5VDC low power output option to the PMP71 pressure transmitter that draws only 17 milliwatts of power at 9V, making the PMP71 consume less power during operation. This low-power draw makes the PMP71 suited for battery- and solar-powered applications, such as remote oil & gas wellheads, offshore platforms, or pumping stations where low power consumption is critical. The PMP71 measures absolute and gauge pressure of gas, steam, or liquid and has built-in algorithms to calculate level, volume, and mass of liquids. Measuring spans are available in ranges from  $-6$  to  $+6$  psi up to  $-15$  to  $10,500$  psi. For safe operation at process temperatures up to  $752^{\circ}\text{F}$ , it has a piezo resistive measuring cell and metallic welded process isolating diaphragm. The PMP71 has ATEX, FM, CSA, NEPSI, IECEx approvals and is suitable for use in up to SIL3 hazardous applications. The voltage output version is available with the CSA C/US XP approval in North America.

**Endress+Hauser** | [www.us.endress.com](http://www.us.endress.com)



### Utility-interactive microinverter

A smart microinverter for the smart grid, the YC600 with Reactive Power Control is Rule 21 compliant for California, H14 compliant for Hawaii, and meets NEC 2017 690.12 Rapid Shutdown requirements. Offering 548VA continuous output power with 600VA peak performance as well as integrated ZigBee wireless communication, the YC600 is a solution for high output PV panels from 200W to over 365W.

**APsystems** | [www.apsystems.com](http://www.apsystems.com)



### Single axis tracker

Axsus, a division of Magna International, has been in the solar industry for close to a decade and has over 2.5GW of fixed tilt mounting systems installed across North America. Axsus has designed and introduced an innovative and simple single axis tracker to the solar space. The Axsus tracker was designed using roll formed components that are well equipped to handle bending loads. The system contains a rigid drive unit at each post that alleviates the need for dampeners and eliminates the risk of torsional dynamic forces; this allows for an optimal stowing position of  $0^{\circ}$ . Each table in the row is connected by a flexible drive shaft that is capable of following changing terrain of up to  $\pm 5\%$  between tables and  $\pm 10\%$  within a table. Each row contains one 24V, proven automotive motor that is able to drive up to 180 modules.

**Axsus Solar** | [www.axsussolar.com](http://www.axsussolar.com)



**See the NEW  
FLAT ROOFING PRODUCT**  
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Optimum performance and durability  
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### Ground mount racking for utility scale projects

Schletter's new G-Max solar mounting system ships with 30% pre-assembled components resulting in efficient installation, fewer touch points in the field, less hardware to lose, reduced installation time, and a reduction to the bottom line. Backed by a 20-year standard warranty and UL 2703 certified, 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. G-Max offers these features and benefits: Safety and ergonomic Improvements, modules can be installed either from top-down or bottom-up creating a safe installation with reduced ladder or scaffolding requirements; Reduction of piles, means reduction of costs, as much as 20% reduction of piles creating an overall reduction in manufacturing times, improved shipping costs, simplified site deployment, and faster installation time; Combined purlin design, innovative purlin design eliminates fourth purlin in portrait resulting in a 25% reduction in material; Intuitive design features, G-Max includes visual quality assurance measures designed into the system including part identification numbers, and embedment depth call-out.

**Schletter** | [www.schletter.us](http://www.schletter.us)



### Simple and cost effective soiling measurement

Soiling of the panel glass is one of the major problems in the rapidly expanding solar energy market, with the attendant loss of efficiency and reduction in performance ratios. Based on Kipp & Zonen's unique Optical Soiling Measurement (OSM) technology, DustIQ can be easily added to new or existing solar arrays and integrated into plant management systems. The unit is mounted like a PV panel, in between or on the side. It does not need sunlight to operate and continuously measures the transmission loss through glass caused by soiling, so the reduction in light reaching the solar cells can be calculated.

**Kipp & Zonen** | [www.kippzonen.com](http://www.kippzonen.com)



### Solar inverter with UL 62109 listing

The Sunny Central 2750-EV-US inverter from SMA provides 10% more power than previous models and is SMA's solution for maximum power density and integration. The Sunny Central 2750-EV-US has also achieved UL 62109 listing, assuring customers that it meets high quality and safety standards. Utilizing SMA's central inverter technology with minor component changes, this solution will result in high power yields and low specific costs. With its stack design, the Sunny Central 2750-EV-US offers true 1,500V technology for maximum reliability. With fewer system components, installation and commissioning of the Sunny Central 2750-EV-US are fast and simple. It can be used as a standalone solution, but is also ready for integration into the SMA Medium Voltage Power Station with the DC Combiner, Medium Voltage switchgear, and Power Plant Controller for a complete utility solution. The Sunny Central 2750-EV-US also includes SMA's unique OptiCool precision cooling technology for intelligent and efficient cooling, creating additional OPEX savings and contributing to a low cost of ownership in utility-scale PV.

**The SMA Group** | [www.sma-america.com](http://www.sma-america.com)



### Asphalt shingle roof mounting system

Solar Connections International has incorporated many features into their Solar Connection Kit for Asphalt Shingle Roof Systems. Starting from the base, the PowerPlate is made from durable 0.040" thick aluminum and includes reference marks for easy alignment. It also features their PowerSeal, which uses an easy peel-and-stick installation to form a water-tight seal with the roof. The PowerAttachment secures the system to a roof with 4 angled screws to provide maximum strength and uplift protection. It also features 3 layers of water protection by utilizing stainless steel single piece cap and seal screws with EPDM washers. The PowerMount is made from solid 6061-T6 aluminum and provides 2" of adjustment. The 6061-T6 PV Cube features a robust design and is compatible with all of Solar Connections' PowerMounts. Use the Universal L-Foot for a railed system, or go rail-less and utilize the Solar Connection Kit with GroundBonding Technology, which is UL 2703 listed and approved.

**Solar Connections International**

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



### PV system wire management clips

BURNDY's ACC-FPV180 is a high quality, long lasting, labor saving wire management solution in the WILEY line. The ACC-FPV180 wire management clips are made of corrosion resistant 304 stainless steel, which makes them a durable and reliable solution for all environments. The ACC-FPV180 is easy to install and the snake tongue tabs securely anchor clips straight on or at 180° on to module frames or purlins with a thickness range of 1.3 to 3mm. The ACC-FPV180 accommodates 1 to 2 PV cables up to 8mm in diameter. The rolled edges are designed to help protect cable insulation from damage and the generous lead in provides an installation without tools. ACC-FPV180 clips can keep the PV installation neat, clean, and free from ground faults and will last for the lifetime of the PV system. RoHS compliant, UL1565. Custom designs are available upon request.

**BURNDY, LLC** | [www.we-llc.com](http://www.we-llc.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.

**Visit [www.s-5.com](http://www.s-5.com) to learn more!**



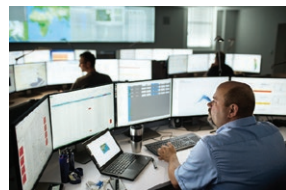
[www.s-5.com](http://www.s-5.com) | 888-825-3432 | A2LA Cert No. 0018.04



### L-foot mounting platform

S-5! has introduced their new SolarFoot for exposed fastener metal roofing. The SolarFoot provides a mounting platform to attach the L-Foot of a rail-mounted PV system to the roof. This solution secures rail-mounted solar systems to exposed fastener metal such as AG-Panel or R-Panel with four points of attachment into the structure or deck with tested holding strength for engineered applications. The SolarFoot is manufactured in the U.S.A. from certified raw material and fabricated in S-5!s ISO certified factory using all aluminum and stainless components. The SolarFoot is a simple, cost-effective pedestal for L-Foot attachment of rail-mounted solar PV. The unique design is compatible with all rail producer L-Foot components. The SolarFoot is integrated with M8-1.25x17mm stud and M8-1.25 stainless steel hex flange nut included and also includes a sealant reservoir to prevent over-compression of sealant. The factory applied 40-year isobutylene/isoprene crosslink polymer sealant provides reliable weather-tightness and the SolarFoot comes with a 25-year limited warranty.

**S-5!** | [www.s-5.com](http://www.s-5.com)



### Direct access to technical support

skytron energy offers a new service portal with quick, direct access to skytron energy's technical support team. Customers can use the portal to request spare parts, create service tickets, and check the status of existing service requests. The portal also allows them to contact support directly with open questions or use skytron energy's newly established wiki. In addition, feedback on products and services can be easily submitted via the site. The new website offers developers, EPC firms, utilities/IPPs, investors, and O&M providers a clear and concise overview of all solutions – from management software, PV monitoring, and power plant control to services such as O&M, project engineering, reporting, system migration, retrofitting, commissioning, and technical support. By navigating to the next level of detail, customers can learn more about product features and the advantages of various solutions. The new service portal includes a wiki containing additional information and practical tips centered around skytron energy solutions.

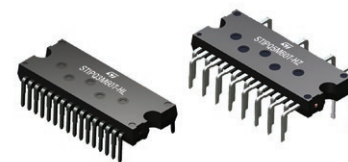
**skytron energy** | [www.skytron-energy.com](http://www.skytron-energy.com)



### Fixed tilt package

SunLink Corporation has announced the availability of their new GeoPro fixed tilt product package. The new product packages are designed to provide EPCs and developers with increased product pricing transparency and greater customization to meet the unique needs of the full spectrum of solar projects. SunLink's GeoPro is a flexible and reliable fixed tilt solution for ground mount solar projects of all sizes and complexity. It is a solution for challenging sites and offers module independence with its support of all major framed and frameless modules. Key benefits of the GeoPro product include: Foundation flexibility for soils of all types with W-Posts, Groundscrews, Helical Piles, cast in place ballast, or a hybrid of solutions; Terrain following to minimize site grading at 20% East-West; Ability to co-locate with TechTrack Distributed to optimize a site's energy density on projects with varying levels of complexity. One engineering team for seamless layout and uniform application of consistent standards and geotech testing, saving time and money. GeoPro is now available in a Standard Package, which includes world-class engineering, stamped structural packages, and project management support to ensure success on every size project and a Speed Package, which bolsters the standard package with the inclusion of components specially designed for maximum adjustability, and delivery of ready-to-install, pre-assembled parts. This is a solution for projects where installation efficiency is the top priority.


**SunLink Corporation** | [www.sunlink.com](http://www.sunlink.com)



### Intelligent power modules


New SLLIMM-nano intelligent power modules (IPM) from STMicroelectronics introduce extra package options and integrate additional components to accelerate development and simplify assembly of motor drives from very low power up to 300W. The 3A and 5A modules contain 600V super-junction MOSFETs to maximize energy efficiency. A choice of packages with inline or zig-zag leads helps optimize space savings and ensure required pin separation. Separate open-emitter outputs ease PCB routing for single- or three-shunt current monitoring. Each IPM contains a three-phase half bridge comprising six MOSFETs, with gate drivers implemented as high-voltage ICs. A bootstrap diode is also integrated to reduce the bill of materials (BOM) and simplify board layout. Smart-shutdown circuitry protects the power switches, and under-voltage lockout (UVLO) prevents malfunction with low Vcc or Vboot. The super-junction MOSFETs have low on-resistance, down to 1.0Ω or 1.6Ω (max.) at 25°C, as well as low capacitances and gate charge to minimize both conduction and switching losses. This enhances efficiency in hard-switching circuits operating up to 20kHz, which includes a wide variety of industrial drives, and allows heatsink-free operation in low-power applications. In addition, optimized switching di/dt and dV/dt ensure low EMI to help further simplify circuit design and layout. The new modules are specified up to maximum operating junction temperature of 150°C and are UL 1557 recognized, providing up to 1500Vrms/min of isolation.

**STMicroelectronics, Inc.** | [www.st.com](http://www.st.com)



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

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





### Fast, smart, and wireless data loggers

The new dataTaker Series 4 Intelligent Universal Input data loggers from CAS DataLoggers feature an increased sampling speed, expanded voltage and resistance measurement ranges, and a programmable analog voltage/current output. All housed within an industrial-strength, ruggedized package. Also new in the line-up are 4 new models with integrated WiFi versions that make it easy to configure the logger and access the data from anywhere.

**CAS DataLoggers** | [www.dataloggerinc.com](http://www.dataloggerinc.com)



### Small terminal kits

BURNDY has announced the release of 2 new kits with small terminals and installation tool in durable dual-latch metal case. Vinyl-insulated terminals include rings, forks, splices, disconnects, and pin terminals packaged with installation tooling. The catalog number STKIT1601Y1022 includes the Y1022 Plier-type crimping tool; catalog number STKIT1602MRE1022NV includes the MRE1022NV full cycle ratchet tool.

**BURNDY** | [www.burndy.com](http://www.burndy.com)



## Quick mobile layout, configure, and commissioning of PV systems

Tigo SMART is a next generation mobile application. The seamless integration between Tigo's online monitoring portal and this SMART app improves the experience for Tigo's installer partners who use this platform to design, lay out, register, configure, commission, and monitor customers' PV systems from the field. The app provides the PV system owners with unmatched insight into energy generation as well as the PV system installers with a set of asset management features at their fingertips from a mobile phone. Key benefits and features of the Tigo SMART app include: Intuitive commissioning, barcode scanning, Bluetooth (BLE) 4.0 connection, prompted configuration steps, production tracking, intelligent alerts, localized weather conditions, and personalized imagery. The new Tigo SMART 3.0 app is downloadable for iOS and Android through Apple's App Store or Google Play. Notifications will be pushed to existing Tigo app users once the next generation updates are automatically completed.

**Tigo** | [www.tigoenergy.com](http://www.tigoenergy.com)



## PV-powered water heating and storage

Next Generation Energy's Sun Bandit is an ICC-SRCC-certified, PV-powered solar water heating and storage solution. Sun Bandit's patented micro-grid technology requires no meter connection and no utility approval, delivering swift, simple, off-grid results that empower contractors, developers, and consumers to receive the economic and societal benefits of solar regardless of the incentive landscape and without long-term contracts. ITC incentive-approved Sun Bandit eliminates the fluids, leaks, pump stations, overheating, stagnation, freezing, and complicated installation and maintenance issues that erode the value proposition of old school solar water heating.

**Sun Bandit by Next Generation Energy**

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



## Solar fastening for metal roofs

The new EJOT solar fastener JT3-SB-3-8.0xL combines the high bearing capacity of EJOT solar fasteners with the fast installation speed of a self-drilling screw. A special hardened drilling tip at the lower end of the fastener allows the installation of the fastener into high strength steel substructures with a maximum thickness of 3mm (1/8") without pre-drilling. EJOT solar fastener JT3-SB-3-8.0xL is designed for fixing solar systems on sandwich elements and trapezoidal sheets. The transmission of all loads into the substructures prevents damage of the roof after the installation. For high corrosion resistance, all bearing parts of the new fastener are made of stainless steel AISI 304 (A2). For special applications, a version out of stainless steel AISI 316 (A4) will also be available.

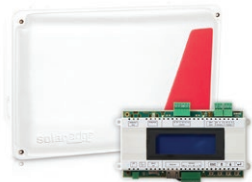
**EJOT Fastening Systems** | [www.ejot-usa.com](http://www.ejot-usa.com)



## New loans for rooftop solar PV installations

EnerBank USA introduced its 12- and 20-Year PowerLoan with an optional re-amortization feature for Solar PV projects. Annual percentage rates (APRs) for 12-Year PowerLoan is 1.99%, 2.99%, and 3.99%; 20-Year PowerLoan APRs are 4.99% and 5.99%. Minimum and maximum loan amounts are \$15,000 and \$65,000, respectively, on approved credit. These new loans are specifically for homeowners who want to use their solar tax credit to pay off a portion of the principal amount, in a lump sum within the first 18 months of their loan, to lower their monthly payments while retaining the loan's original interest rate and terms. In addition to the new PowerLoan, EnerBank offers a variety of other solar loans such as Same-As-Cash and low interest loans with fixed monthly payments. The bank's innovative Combo Loan is another available option.

**EnerBank USA** | [www.enerbank.com](http://www.enerbank.com)



## Commercial data logger

The new Data Logger from SolarEdge features an integrated Control and Communications Gateway (CCG), power supply, and NEMA 3R rated enclosure. The CCG integrates inverter data, RGM data, and weather station readings (RGM and weather station readings require the connection of an RGM / environmental sensors, respectively). The Data Logger supports connection between up to 32 devices (eg: 1 Data Logger + 31 inverters) with an RS485 bus, and a cellular GSM or Ethernet uplink. The Data Logger can also communicate weather station readings via the SolarEdge monitoring platform. The Data Logger supports all North America SolarEdge three phase inverters and provides an interface for inverter and module level data at 5 minute resolution, integrated Control and Communication Gateway (CCG), plug and play connectivity with SolarEdge devices, and fast installation in less than 30 minutes.

**SolarEdge** | [www.solaredge.com](http://www.solaredge.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.

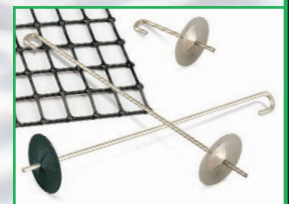
**Heyco® HEYClip™ SunRunner® 4-2 & 4-2U** NEW  
SunRunner 4-2 & 4-2U clips are compatible with the Enphase Q cable. SunRunner 4-2 works with Everest, SnapNRack, Solar Mount & similar rack profiles. SunRunner 4-2U works with Unirac, Ironridge & similar rack profiles.



**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.



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# Performance Monitoring

Solar performance monitoring systems are necessary to verify the components within a solar system are performing and producing the energy they should. Here, we highlight some of the performance monitoring systems available on the market today.

SEE AD ON PAGE 33



## Kipp & Zonen

**Product:** RaZON+

**Voltage:** 24V

**Current:** 500mA

**Power:** 13W

**Warranty:** 2-year warranty (5-year warranty on PH1 and PR1)

**Logging Values:** Global, Diffuse, Direct, Sunshine Duration, Solar Angles, GPS time, Longitude Latitude, Status

**Certifications:** CE, FCC

### Key Features:

All-in-one system includes pyrheliometer, pyranometer, and data logger;

- Accurate DNI measurement;
- Designed for remote locations and resistant to soiling;
- Communication via ethernet, RS485 modbus, or Wi-Fi;
- User-friendly installation, operations, and maintenance.

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

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## Shoals Technologies Group

**Product:** BLM

**Voltage:** Systems up to 1500V

**Current:** 12A Isc

**Power:** Parasitic

**Warranty:** 5-year warranty

**Logging Values:** Voltage, Current Power, Temperature, and IV Curve

**Certifications:** UL

### Key Features:

- String Current, Panel Voltage, and I-V Performance monitoring;
- Continuously monitor for underperforming panels; with wireless communication and parasitic power;
- No need to run cables; easy installation via integrated connectors.

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

# WATTNODE®

Power (kW) and Energy (kWh) Submeters

**Revenue-Grade and Standard AC Metering**  
 PV Production Metering • POU Consumption Submetering  
 Energy Management • Building Automation and Demand Response • Battery Storage

**Continental Control Systems, LLC**  
 1-888-WattNode (928-8663) • [ccontrols.com](http://ccontrols.com)



## LI-COR Biosciences

**Product:** LI-200R Pyranometer

**Warranty:** 1-year parts and labor warranty

**Logging Values:** W/m<sup>2</sup>

**Certifications:** Calibrated against an Eppley Precision Spectral Pyranometer (PSP) under natural daylight conditions.

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



## HT Instruments

**Product:** I-V500w

**Voltage:** 1500V

**Current:** 10A and 15A based on voltage

**Warranty:** 3-year warranty

**Logging Values:** Up to 249 I-V Curves

**Certifications:** TUV, CE

[www.ht-instruments.com](http://www.ht-instruments.com)



## Lufft

**Product:** WS510 multiparameter weather sensor

**Voltage:** 24Vdc, 12Vdc

**Current:** 145mA @ 24Vdc, 85mA @ 12Vdc

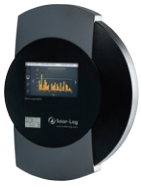
**Power:** Without heating 3.5W; with heating 24W

**Warranty:** 2-year warranty

**Logging Values:** Up to 119 channels can be logged

**Certifications:** IP66 Certificate, EC Certificate of Conformity

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



**Solar Data Systems, Inc.**

**Product:** Solar-Log 2000  
**Voltage:** 120V, 240V, 480V, 600V  
**Current:** any voltage/current combination  
**Power:** up to 2MW  
**Frequency:** 50/60 Hz  
**Warranty:** 5-year warranty  
**Logging Values:** V, A, W, Wh, Hz, VAR  
[www.solar-log-america.com](http://www.solar-log-america.com)



**meteocontrol North America, Inc.**

**Product:** blue'Log datalogger  
**Voltage:** 24V  
**Current:** 208mA  
**Power:** 5W  
**Warranty:** 2-year warranty  
**Logging Values:** Polling Inverter Parameters, Meter Data, Weather Sensor Data, Combiner Box Data  
**Certifications:** CE  
[www.meteocontrol.com](http://www.meteocontrol.com)



**Phoenix Contact**

**Product:** EMpro MA600 series  
**Voltage:** 18-700Vac (direct); up to 500 kVAC (via external PTs)  
**Current:** 0-10,000 amps  
**Power:** 0-8000MW  
**Frequency:** 50/60 Hz  
**Warranty:** 1-year warranty  
**Logging Values:** V, A, W, Wh, Hz, VA, VAR, THD  
**Certifications:** UL/cUL/IEC STD 61010-1 Listed Device, IEC 62053-22 Real Energy Class 0.5 S  
[www.phoenixcontact.com](http://www.phoenixcontact.com)



**Fronius**

**Product:** Fronius Smart Meter  
**Voltage:** 166V – 276V / 384V – 552V  
**Current:** Based on CT's, primary 1-3000A  
**Power:** 4VA  
**Frequency:** 50 - 60 Hz  
**Warranty:** 5-year warranty  
**Logging Values:** AC Currents, AC Voltages, AC power and reactive Power, Power factor, Energy, Frequency  
**Certifications:** UL 61010-1, CAN/CSA-C22.2 No. 61010-1-04, IEC 61010-1, EN 61326: 2002, EN61000-4-2, EN61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-11, FCC Part 15 Class B, EN 55022: 1994 Class B  
[www.fronius.com](http://www.fronius.com)



**Campbell Scientific**

**Product:** MeteoPV Solar Resource Platform  
**Voltage:** 9 to 30Vdc  
**Current:** ~30mA  
**Power:** 12Vdc, 800mA

**Logging Values:** Modbus TCP/IP  
**Certifications:** 802.3af compliant  
[www.campbellsci.com](http://www.campbellsci.com)



**Apogee Instruments**

**Product:** PV-100  
**Voltage:** 24V  
**Current:** 100mA  
**Power:** 3W  
**Frequency:** Application specific  
**Warranty:** 4-year warranty  
**Logging Values:** Plane-of-array or Global Horizontal Irradiance, Ambient air temperature, Back-of-panel temperature.  
**Certifications:** CE  
[www.apogeeinstruments.com](http://www.apogeeinstruments.com)



**Yaskawa - Solectria Solar**

**Product:** SolrenView Web-Based Monitoring  
**Voltage:** 12-24Vdc  
**Current:** 1 channel  
**Power:** 120v  
**Frequency:** 60 Hz  
**Warranty:** 10-year warranty  
**Logging Values:** kWh, W, A, V  
[www.solectria.com](http://www.solectria.com)



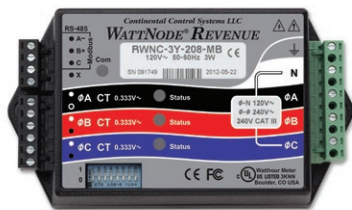
COMPREHENSIVE  
 PORTFOLIO OF  
 1500VDC PV  
 COMPONENTS



**1500VDC HELIOPROTECTION® FUSES FROM MERSEN**

Mersen's Helioprotection photovoltaic fuses are engineered specifically for the protection of PV systems. Their enhanced fuse construction makes them ideal for continuous temperature and current cycling withstand adding to system longevity.

SEE AD ON PAGE 30



### Continental Control Systems, LLC

**Product:** WattNode Energy and Power Meters

**Voltage:** 120/208-240V – 347/600V

**Current:** 5 amps – 6000 amps

**Frequency:** 50/60 Hz

**Warranty:** 5-year warranty

**Logging Values:** Global, Diffuse, Direct, Sunshine Duration, Solar Angles, GPS time, Longitude Latitude, Status

**Certifications:** UL, cUL, CE, ANSI C12, PBI, CE

**Key Features:**

- Revenue-grade production and consumption energy metering;
- Single-phase, split-phase, three-phase kW / kWh sub metering;
- Modbus, BACnet, LonWorks, and pulse output;
- Low-cost, small footprint.

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

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### EKO Instruments USA

**Product:** MS-80, Secondary Standard Pyranometer

**Voltage:** mV Output (12-24Vdc Supply for 4-20mA and Modbus Versions)

**Current:** 4-20mA and Modbus Output

**Power:** 4-20mA (0.5W max) Modbus (0.3W max) Heater (7W) Ventilator (2W)

**Frequency:** <0.5 s Detector Response

**Warranty:** 5-year warranty

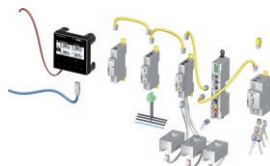
**Logging Values:** Solar Irradiance Measurements

**Certifications:** ISO 17025 Accredited Calibration, IEC61724-1 Class A Requirements

**Key Features:**

- Immune to thermal offsets;
- Fast analog response;
- Low measurement uncertainty;
- High stability;
- No need to replace desiccant resulting in low cost of ownership.

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



### Socomec, Inc.

**Product:** DIRIS Digiware

**Voltage:** 87 - 520Vac (Ph/Ph)

**Current:** 6000A (nominal current)

**Frequency:** 50-60 Hz

**Warranty:** 18-month warranty

**Logging Values:** Voltages, current, power, predictive power, THDs, Individual harmonics, over currents

**Certifications:** UL E257746, IEC 61557-12, ISO 14025

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



### Hukseflux

**Product:** SR05-A1 pyranometer

**Voltage:** 0V – 50mV max

**Current:** 0mA

**Power:** passive (no external power required)

**Frequency:** 285 – 3000 nm

**Warranty:** 5-year warranty

**Logging Values:** - 2000 W/m<sup>2</sup>

**Certificates:** ISO 9060 secondary class

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



### eGauge Systems

**Product:** eGauge Pro

**Voltage:** 1-, split-, or 3-phase 0-277Vac and +/-60Vdc

**Current:** 0-6900A (30 channels)

**Power:** Any current x voltage combination

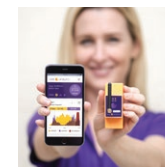
**Frequency:** 50/60 Hz

**Warranty:** 2-year, or 5-year warranty

**Logging Values:** VAC, VDC, A, W, Wh, Hz, VA, VAR, THD, deg

**Certifications:** ANSI C12.2 - 0.5% Accuracy, UL (IEC/UL 61010-1 Ed. 3.0 B:2010)

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



### Solar Analytics

**Product:** Solar Analytics Monitoring

**Voltage:** Measured 50 to 280Vac

**Current:** 60 to 600A CTs

**Power:** Real power: 1% of reading from pf 0.8 leading to 0.5 lagging; Reactive power: 2% below 0.5 lagging

**Frequency:** 45 to 65 Hz, 0.01 Hz

**Warranty:** 5-year warranty

**Logging Values:** Power, voltage, current, power factor, reactive power, reactive energy, frequency

**Certifications:** PTCRB Approved, Safety IEC60950

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





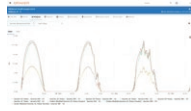
## JLM Energy

**Product:** Measurz energy optimization software

**Application:** Commercial, industrial, residential

**Description:** Measurz JLM Energy's cloud-based software platform empowers users to set and control their monthly utility budget. It optimizes power use based on habits and pre-set budget goals. By visualizing how energy is used, it is possible to make small adjustments which lead to more informed energy use decisions and immediate cost savings. With a complete desktop and mobile phone application, users can control appliances and smart thermostats, monitor energy use and track savings from anywhere at any time. In commercial settings, Measurz can manage and optimize fleets of buildings and provide realtime visibility to locations around the globe.

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



## Draker

**Product:** Draker V7 Software

**Application:** C&I, Utility

**Description:** Draker V7 Software now provides a customizable, mobile-optimized energy asset management software platform through monitoring and data analytics, supported by customer service experts. Customers can remotely access, assess, and manage asset performance in real time with reports tailored to specific data points and time periods, providing actionable insight. A site-specific hierarchical alarm system identifies any issues which matter most to optimizing the performance of each site and across portfolios. Remote on/off control capabilities help with problem solving once the platform detects priority concerns. Other features include financial analyses, inverter heat mapping, and diagnostics.

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



## SolarEdge

**Product:** SolarEdge Cloud-based Monitoring Portal

**Voltage:** Fixed voltage inverter

**Warranty:** Inverters have 12-year warranty, extendable to 20-years and Power Optimizers have 25-year warranty, monitoring portal is free for 25 years

**Certifications:** Inverters: UL1741, UL1699B, UL1998, CSA 22.2, IEEE1547, FCC part15 class B. Power Optimizers: FCC Part15 Class B, UL1741, RoHS

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



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 monitoring**  
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**DustIQ**

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



## Morningstar Corporation

**Product:** EnVision Cloud-Based Site Manager

**Application:** Residential, industrial

**Description:** For residential and industrial markets, Morningstar's EnVision, a cloud-based site manager, will collect and organize data from all the sites the user needs to manage. Easy to set up with Morningstar's Ethernet Meterbus Converter (EMC-1), it is completely scalable for large mesh networks or site clusters. It is a secure and encrypted data transport. It provides site metrics in real-time and server-based notifications of faults and alarms.

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



## infiswift

**Product:** swiftPV

**Application:** Enterprise

**Description:** infiswift's swiftPV leverages IoT technology to change how the solar industry uses data to optimize the performance of photovoltaic (PV) systems. The suite of products and services allows PV power plant owners and operators to connect diverse PV assets and distill insights from the data, ultimately increasing solar plant performance.

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



# SOLAR CANADA ANNUAL CONFERENCE & EXPOSITION

December 4<sup>th</sup>-5<sup>th</sup>, 2017

Metro Toronto Convention Centre — Toronto, Ontario, Canada

The Canadian solar energy market is growing rapidly. Provincial governments and consumers are focusing more on renewable energy in an effort to lower greenhouse gases and utilize more affordable sources of energy. This has created a tremendous opportunity for companies to expand their market presence in Canada. Solar Canada Conference & Exposition provides an excellent platform to connect with industry professionals and enter this growing market.

Take advantage of this unique opportunity to network with thousands of attendees and hundreds of exhibitors representing the entire industry: solar integration, development, engineering and EPC, equipment manufacturers, utilities, consultants, federal, provincial and municipal governments, communities, and students.

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

show in print

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



## O&M services

With 30 years of experience and 10GW of energy under contract in North and South America, EDF Renewable Services helps optimize plant performance, maximize availability, and minimize downtime. With services including full O&M, Asset Management, and 24/7/365 Monitoring, they bring an owner-operator sensibility to all projects. Their development group, EDF Renewable Energy, has over 9GW of renewable energy projects developed in North America.

**EDF Renewable Services**

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



## Solar PV mounting system provider

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

**TerraGen Solar** | [www.terragensolar.ca](http://www.terragensolar.ca)



## Lightweight aluminum carport system

Schletter's Park@Sol offers a lightweight, aluminum system that is maintenance free, cost competitive, and provides excellent aesthetics. Currently, Park@Sol is being installed at Michigan State University (MSU) as part of Inovateus' 14MW solar carport project spanning 5 parking lots and 700 square feet on the East Lansing campus. Canopies stand 14ft tall at the lowest point to provide enough room for recreational vehicles to park during football season. Upon completion in December 2017, the carport project is expected to generate 15,000MWh of electricity annually for MSU and projections show that MSU could save \$10 million in electricity costs over the next 25 years.

**Schletter Inc.** | [www.schletter.us](http://www.schletter.us)



## Touchless snow removal

Buffalo Turbine has been manufacturing turbine style blowers since 1945, which are made using high-precision machined components resulting in long-lasting, dependable products. These turbine units are being used worldwide in a variety of applications. The diverse product line provides its customers with the ability to choose a product that best suits their application and various budgets. Touchless snow and dust removal has drastically increased over the past three years in the solar industry and Buffalo Turbine's stacked hydraulic solar blower is an effective solution. The two machines work together for faster removal of snow or dust resulting in less energy lost and more energy gained. Standard and high speed options are available.

**Buffalo Turbine** | [www.buffaloturbine.com](http://www.buffaloturbine.com)



## PV system protective fuses with crimp cap termination

Protect off-grid or grid tied PV system from unexpected ground faults and line faults using Mersen's Helio Protection fuse line. Mersen's HP10M, HP15M, and HP15G photovoltaic (PV) fuse series were engineered and designed specifically for the protection of photovoltaic systems. Their enhanced fuse construction makes them a solution for continuous temperature and current cycling withstand adding to system longevity. The 1000VDC-rated HP10M, and the 1500VDC rated HP15G and HP15M were designed for low minimum breaking capacity capabilities of 1.35 times the fuse rated current value, allowing for safe circuit interruption under typical low fault current conditions produced by PV arrays. 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, CSA component acceptance pending.

**Mersen** | [ep.mersen.com](http://ep.mersen.com)



## Sealant free asphalt shingle flashing solution

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

**EJOT Fastening Systems L.P.**

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

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# 2018 WIND BUYERS GUIDE

## DIRECTORY

ADHESIVES, SEALANTS, & SURFACE TREATMENTS  
ALUMINUM EXTRUSION & METAL FABRICATION  
BLADE | TOWER MANUFACTURER & REPAIR  
CABLE, WIRE & CONDUIT  
COMPONENT SUPPLIER  
CONSTRUCTION PRODUCTS & SERVICES | EPC CONTRACTOR  
CONSULTING SERVICES  
CONTRACTORS  
CRANES | HYDRAULIC EQUIPMENT | AERIAL DEVICES  
EDUCATION | RESEARCH DEVELOPMENT  
ELECTRICAL EQUIPMENT & SERVICES | POWER GENERATION  
ENCLOSURES  
ENERGY STORAGE | GRID CONNECTION  
ENGINEERING  
ENVIRONMENTAL CONSULTANTS & BUSINESS SERVICES

FILTRATION SYSTEMS  
FINANCIAL SERVICES  
GEARBOX MANUFACTURING, SERVICES & REPAIRS  
GENERATORS | MAINTENANCE & REPAIR SERVICES  
LARGE WIND TURBINE MFG (OVER 100KW)  
LIGHTING  
LIGHTNING & SURGE PROTECTION  
LUBRICANTS  
METAL | METAL CUTTING MACHINES  
OPERATIONS AND MAINTENANCE (O&M)  
PROJECT DEVELOPER | OPERATOR  
RECRUITING | STAFFING SERVICES  
REMOTE MONITORING  
SAFETY EQUIPMENT | FALL PROTECTION  
SOFTWARE SUPPLIER

STEEL SUPPLIER  
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TOOLS  
TOWER FOUNDATIONS  
TRANSPORTATION | LOGISTICS  
UTILITY POLES  
WIND ASSESSMENT | FORECASTING  
YAW, PITCH & BLADE SENSORS  
OTHER  
Economic Development  
Labor Trade Association  
Met Towers  
Rescue & Safety Training  
Track Conversion  
Wind and Solar Measurement and Consulting Services

Adhesives, Sealants & Surface Treatment



**3M**

**3M Wind Energy**

3M designs solutions for wind turbines that enhance reliability, improve performance, and provide protection against weathering and harsh environments. 3M Wind Blade Protection Tape 2.0 helps shield the leading edge of wind turbine blades from damage caused by minor impacts and erosion due to rain, sand, dirt, and other debris. The product is created from a tough, transparent polyurethane elastomer that resists puncture, erosion, and UV rays. The tape also provides a fast and easy application process, extending maintenance and service levels.

[www.3M.com/windenergy](http://www.3M.com/windenergy)



**GS Manufacturing**

GS Manufacturing specializes in custom built dispensing systems for composite fabrication. Their 2 component high output bonding systems are used throughout the world for wind blade manufacturing.

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



**MANKIEWICZ**  
Coating Concepts of the Future

**Mankiewicz Coatings**

Mankiewicz's two new advanced coatings products maintain turbine blade surfaces for optimal performance and efficiency. BladeRep5 is a fast setting putty that dries in one hour with the same profile-building and sandability traits of other Mankiewicz surfacing putties. And Mankiewicz's new ALEXIT Leading Edge Protection single-coat only requires one-coat application and provides substantial cost savings thanks to less application time. Field testing has proved significantly longer product performance. Mankiewicz's coatings also meet the requirements of the cosmetic blade maintenance market.

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



**BUILDING TRUST**



**Sika Corporation**

Sika offers a full system of wind product solutions from the base foundation to the tip of the blades, each capable of withstanding the toughest climatic conditions. SikaForce-7800 Blue and Red are 2-C, high-performance, non-sagging polyurethane structural adhesives for windmill blade repair. This product has been developed to offer the same product finish speed at two different temperature ranges: Blue 0°C to 25°C (32°F to 77°F) and Red 25°C to 40°C (77°F to 104°F). SikaForce-7800 is used for finishing and deeper surface repairs on wind blades, with quick-standing time characteristics, at a maximum of 30 minutes time. SikaForce-7800 Red and Blue are packaged specifically for on-location wind blade repair applications.

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

Aluminum Extrusion & Metal Fabrication



**Falcon Steel Company**

Falcon Steel Company provides custom metal fabrication products, produced from recycled material for the renewable energy industries. They provide solutions for residential, commercial, or utility-scale projects. Falcon Steel has been designing and fabricating steel structures and custom products for over 52 years, while working for a sustainable world.

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



**Matenaer Corporation**

Matenaer Corporation 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)

Anchor Bolts | Fastening Systems



**Cooper & Turner**

Cooper & Turner is a manufacturer of high quality, high strength, safety critical, large diameter (M16 to M100) hex bolts, double ended studs, and thread rod. Employing automation (including in process NDT inspection) and robotics results in high quality and consistent products, having full lot traceability, for supplying the global wind turbine market, OEM's, and major tiers as well. Recently opening an anchor bolt manufacturing plant in Pueblo, CO., they use 100% USA material and manufacturing, producing anchor bolts to ASTM A615 Grade 75 and Grade 90, plus ASTM A722 Grade 150, with all accessories (nuts, washers, and PVC sleeves), with bolt caps and grease optional. All assemblies are tested in a USA independent lab.

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

**FASTENAL**



**Fastenal**

Fastenal Manufacturing services customers in the wind energy industry by providing MRO fasteners as well as OEM parts to the original equipment/parts manufacturers, construction sites, and operating wind farms. Fastenal Manufacturing meets wind-specific material specifications of A615 Grade 75 and A722 Grade 150, available in 1-1/4 – 4.0 and 13/8 – 3.0 thread sizes in both stud and nut.

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



**NTC Wind Energy**

Grout sleeves are relative newcomers to the wind industry. These sleeves replace foam rings, which are installed on foundation anchor bolts prior to grouting to protect rods from exposure to grout. Grout sleeves take that protection several steps further: They will not float in grout, they prevent grout from entering the flange bolt pattern, they displace no grout, and they prevent grout from entering the bolt sleeve. To install, simply push them down on the rods. Priced competitively with foam, grout sleeves save time and require no cutting or taping.

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

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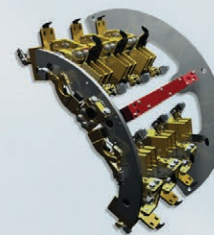
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**MFG Energy Services**

MFG Energy Services provides field of repair and maintenance services of composite turbines to wind farms. Expert technician teams are equipped to assess the condition of components, make on-site uptower and on-ground repairs, and coordinate for factory repairs at their sister company, MFG Texas. The technicians are backed up by an experienced engineering team and have a high safety record. Spare and replacement parts can be provided through MFG's new part manufacturing facilities.

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



**MFG Texas**

MFG Texas in Gainesville manufactures made to order composite components and provides year round in-factory repair and refurbishment services for blades. Their services include; factory repair of damaged turbine blades; blade reconditioning and repowering, including new lightning protection and tip extensions; recoating blades and leading edge coat protection; made-to-order replacement balance boxes, close-out platforms and flanges, root-band covers, flex brackets, hatch covers, and other components; and made-to-order edge protectors for lifting and transportation operations.

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



**WindCom**

WindCom provides blade services in North America. With the engineering team providing the technicians work instructions on the eReporting system, they are able to monitor the work and provide reports seamlessly resulting in quality workmanship. No blade damage is too large or complicated, and WindCom's team is able to "save" a blade, most of the time without bringing it to the ground.

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



**American Wire Group (AWG)**

American Wire Group (AWG) is a single solution for all types of electrical conductors and hardware required to construct and maintain wind and renewable generation projects—for low, medium, and high-voltage applications. Save schedule time and costs with AWG's ability to supply an entire project's cable requirements from stock. AWG inventories 35-kV UL MV-90 and UL MV-105 Collection System Cables in aluminum conductor in all standard sizes, including 1/0, 4/0, 500, 750, 1000, and 1250 (available in both CN or CTS). All of AWG's Collection System Cables carry a 20-year factory warranty, ensuring protection for the longevity of projects. AWG also inventories the following: fiber optic; copperclad steel grounding; bare copper; transmission cables; OPGW; static wire; low-voltage cables; control cables; and associated hardware.

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



**Cameron Wire & Cable, Inc.**

Cameron Wire & Cable supplies LV, MV, and HV (Alum & Copper) wind tower, nacelle, and site cables. Cameron offers a variety of high performance cables 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, same-day shipping to satisfy tight job deadlines, and will warehouse planned goods at no charge.

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



**CTC GLOBAL**

**CTC Global**

CTC Global, in association with 20 international manufacturing partners, 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 improve the overall economics of the generation project—reduced line losses translate into more power delivered for any wind energy investment.

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



**General Cable**

**General Cable**

General Cable offers an array of cables needed for wind turbines to generate, distribute and transmit energy from fiber optic and bare overhead conductors to EmPowr Link CL Advantage underground URD and wind-specific low-voltage power cable. General Cable is positioned to rapidly respond to the needs of the evolving wind farm market with next-generation cabling systems. EmPowr Link CL Advantage is a cable for today's solar and wind farm collection systems. Featuring enhanced, ruggedized installation protection, this cable has a reduced weight and diameter and XLPE jacket technology. Its efficient fault current protection provides reliability and performance.

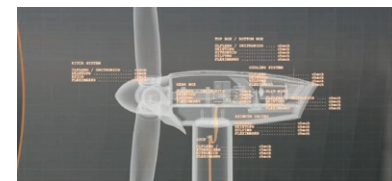
[www.generalcable.com](http://www.generalcable.com)



**HELUKABEL USA**

HELUKABEL's HELUWIND WK line of copper and aluminum cables are made to be used throughout the turbine: rotor tip to the power grid. HELUKABEL offers an array of copper power cables, fiber optic and copper data cables, and communication cables to monitor the multitude of sensors in the nacelle. HELUWIND WK cables have been rigorously tested to withstand more than 15,000 torsion cycles. Their UL/CSA, CE, and VDE-listed aluminum and copper cables down tower cables are rated up to 35kV. An extensive connector range, which allows copper to copper, aluminum to aluminum, and aluminum to copper connections, ensures that HELUKABEL can provide the proper fit, no matter the conductor material used.

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

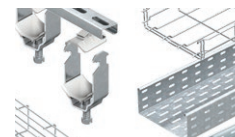


**LAPP GROUP**

**Lapp Group**

As fleets age, the demand for replacement parts increases. Lapp Group is a trusted partner in refurbishing and retrofitting for the life of the turbine. They provide their partners with dedicated wind industry experts, as well as engineering and logistics teams. Lapp Group also has relationships with a large network of distribution partners located all around the country, so components are available as needed.

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



**OBO Bettermann of North America, Inc.**

OBO Bettermann offers a wide variety of cable management products specifically designed for the wind industry, including cable trays, profile raise, cable ladders, and more. They also offer special solutions to meet specifications for most major tower designs. All of their cable trays are UL listed and designed to meet the requirements of wind tower applications.

They offer wire mesh tray, aluminum and steel ladder, ventilated trough trays, and much more.

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

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**Petroflex**

Petroflex is an extruder of HDPE (high-density polyethylene) duct and accessories. PNA's CableGuard is a solution for both domestic and international clean energy initiatives and provides cable in conduit for control and power cabling at both wind and solar farms. Long continuous run lengths of fiber optic cable in duct, up to 14000' on 1"IPS, minimize splicing. Cable or fiber installed in conduit at the factory ensures additional protection before, during, and after installation. They stock many 600v combinations and medium voltage cables already installed in conduit for quick delivery to the site.  
[www.petroflexna.com](http://www.petroflexna.com)



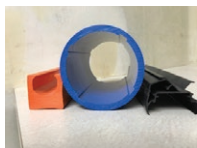
**Superior Essex**

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

**Component Supplier**

**American Roller Bearing Company**

American Roller Bearing Company manufactures large bore (4" / 230mm to 84" / 2400mm) ball, cylindrical, tapered, and spherical bearings.  
[www.amroll.com](http://www.amroll.com)



**Applied Plastics, Inc.**

Applied Plastics is a custom plastic extruder of thermoplastics and some engineering grade tubing and profiles.  
[www.appliedplasticsinc.com](http://www.appliedplasticsinc.com)



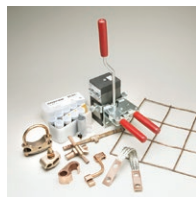
**Bal Seal Engineering, Inc.**

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 wind, solar power, and other alternative energy production. Their solutions enable engineers to protect critical parts and systems, design more compact, efficient electrical connectors, and ensure consistent current and signal transmission.  
[www.balseal.com](http://www.balseal.com)



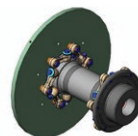
**BGB Technology, Inc.**

BGB Technology designs and produces slip rings and fiber optic rotary joints (FORJ) for use within wind turbines. Applications include generator slip rings, pitch control and yaw slip rings, shaft grounding, and lightning suppression components.  
[www.bgbtechnology.com](http://www.bgbtechnology.com)



**BURNDY**

BURNDY offers a comprehensive selection of grounding products. BURNDY's grounding connectors are systems-engineered to provide system integrity as well as to withstand harsh environments. The BURNDY HYGROUNd irreversible compression system meets stringent safety and performance requirements. The BURNDY Weld connection process is a simple, efficient method of welding copper to copper or copper to steel. All BURNDY mechanical grounding connectors have been designed for easy installation and for lasting durability.  
[www.burndy.com](http://www.burndy.com)



**CENTA Corporation**

CENTA Corporation is a manufacturer of high speed flexible couplings and drive shafts for wind turbines.  
[www.centa.info](http://www.centa.info)



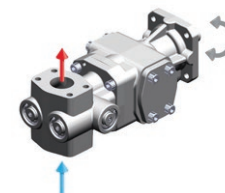
**Helwig Carbon Products, Inc.**

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



**IMO USA Corp.**

IMO provides pitch, yaw bearings, and gear rims for on- and offshore wind turbines from 250kW to +8MW. Their 3-row pitch bearing, T-Solid 4IPC, for low and ultra-low wind site turbines reduce structural loads and extend service life. The T-Solid ball is a retrofit solution for failing bearings. IMO offers 3-row roller bearings as main bearings for gear, shaftless wind turbines 250kW to 8+MW. Their closed slew drives serve as yaw systems for small wind turbines 10kW to 250kW, and 3-row pitch bearings for tidal energy.  
[www.imo-wind.com](http://www.imo-wind.com)



**KRACHT CORP.**

KRACHT CORP. is a subsidiary of KRACHT GmbH in Germany. KRACHT, is a medium-sized, family-run business with 400 employees. KRACHT is a manufacturer of transfer pumps (e.g. noise optimized for air containing oils), hydraulic motors, high pressure gear pumps, valves, pump units, gear type flow meters, and electronics. KRACHT CORP. is located in Maumee, OH.  
[www.krachtcorp.com](http://www.krachtcorp.com)



**Lightning Bolt and Supply**

Lightning Bolt offers a wide selection of ISO-DIN-EU fasteners that are commonly used in the wind turbine industry.  
[www.lightningboltandsupply.com](http://www.lightningboltandsupply.com)



**Morgan Advanced Materials**

Bearing fluting from electrical current is a major cause of costly pitch motor failures. To protect these motors, Morgan offers grounding solutions which are fast and easy to install, even up-tower, and without the removing or disassembly of brakes. By shunting electrical current around the bearings, they maximize protection of this valuable equipment. Morgan designs are lightweight, compact, and can retrofit existing motors. Morgan pitch motor grounding solutions come equipped with a constant force spring resulting in consistent brush pressure and a silver/graphite brush for low contact drop insuring this is the path of least resistance for current flow.  
[www.morganelectricalmaterials.com](http://www.morganelectricalmaterials.com)





### Motion Industries, Inc.

Motion Industries distributes industrial replacement parts and supplies such as bearings, mechanical and electrical power transmission, industrial automation, hose, hydraulic and pneumatic components, safety/industrial supplies, and material handling products to MRO and OEM customers throughout North America. Services provided to renewable energy facilities include repairs of hydraulic and electrical components, OEM parts conversion, committed inventory to reduce lead times, and field expertise in the areas of fluid power, electrical, hose and rubber, and pumps.

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



### NORDIC FIBERGLASS, INC.

#### Nordic Fiberglass Inc.

Nordic Fiberglass designs and manufactures chuted box pads for pad-mounted transformers installed in a slurry mix solution next to the tower pedestal. These chuted box pads provide a reliable and simple solution to protect underground cables from the tower to the transformer. Nordic also offers stilt support systems. These leveling legs for the box pad can be adjusted to obtain desired level height next to the tower pedestal. Nordic's three phase 35kV 600Amp sectionalizing cabinets house up to three, 3 or 4 pt. 35kV 600Amp junctions with U-straps if requested by the customer. 18" or 36" high extensions are available for large cables radius.

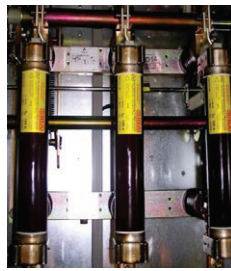
[www.nordicfiberglass.com/wind](http://www.nordicfiberglass.com/wind)



### NRG Systems

For 35 years, NRG Systems has been providing technologies for wind resource assessment. They design and manufacture smart technologies for renewable energy. Their customer-centric products are simple and easy to use. NRG Systems' measurement systems, turbine control sensors, and Lidar remote sensors can be found more than 150 countries.

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

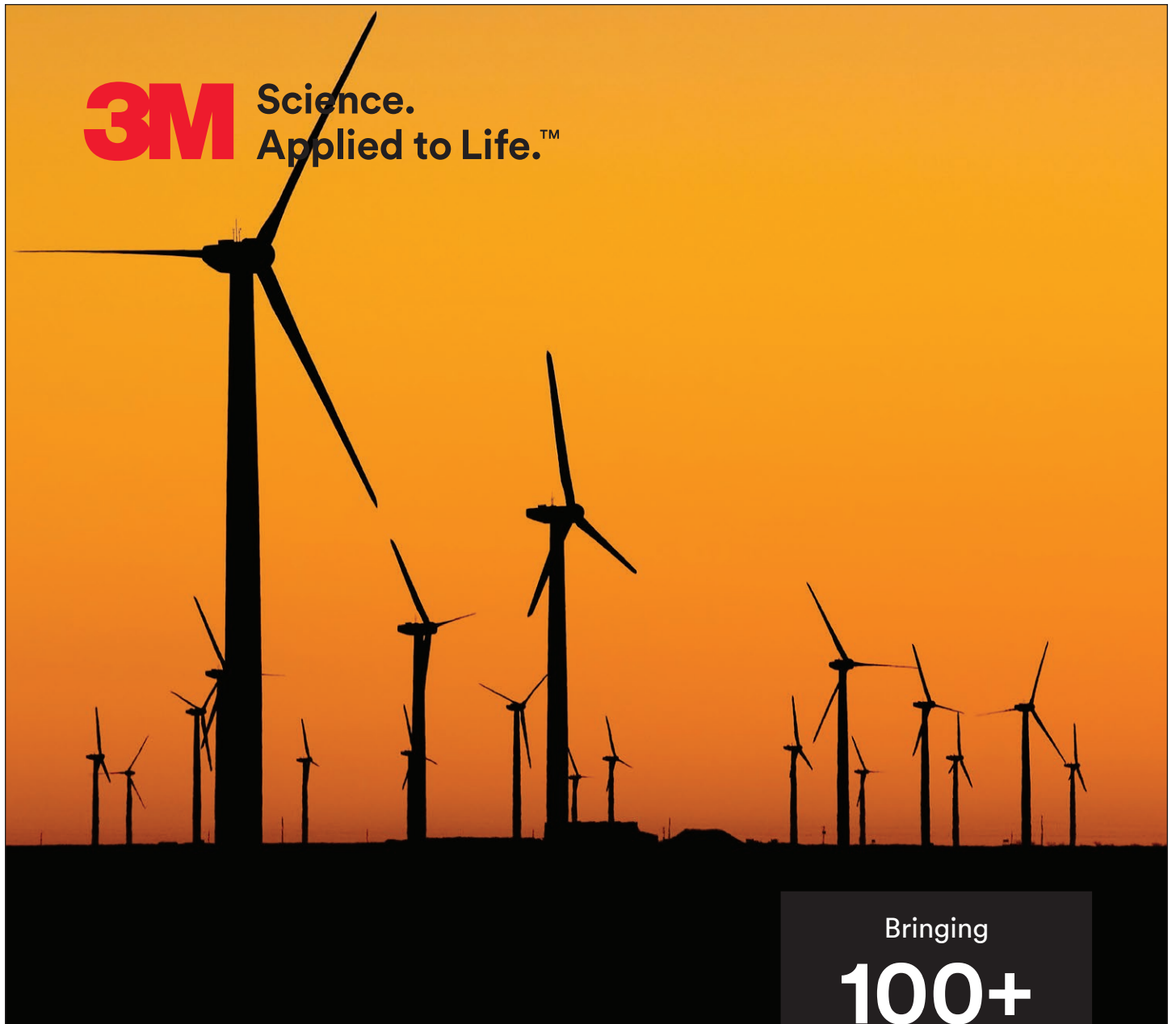


### SIBA FUSES

#### SIBA Fuses

SIBA Fuses is a source for circuit protection applications, from solar power to wind power, and energy storage. They have been working for over 75 years in semiconductor fuses, including ULTRA RAPID, medium, and high voltage, standard European, miniatures, electronic fuses, and a wide range of DC rated fuses (24VDC - 6000VDC) for all types applications, including Power Conversion, Rectifiers, Inverters, Converters, Drives, UPS, and Traction Applications.

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



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### SKF

SKF Group is a global supplier of bearings, seals, mechatronics, lubrication systems, condition monitoring systems, and services which include technical support, maintenance and reliability services, gearbox and gearing components refurbishment, bearing remanufacturing, engineering, consulting, and training. The SKF Life Cycle Management approach applies SKF's expertise in a wide range of technical areas to help customers, both OEMs and the aftermarket, optimize machine productivity and efficiency.

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



### STEGO, Inc.

STEGO develops products that heat, cool, ventilate, illuminate, and control temperature and humidity for enclosed electronic control systems. For over 35 years, they have offered Thermal Management solutions, which ensure the electronics in their customers' installations are safe from extreme climatic conditions.

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



### United Equipment Accessories, Inc.

UEA is an international manufacturer located in Waverly, Iowa. Their product lines include slip rings, hydraulic swivels, cable reels, and shift controls for a variety of industries and applications around the world. Founded in 1952, UEA is a family-owned company which solves problems through innovative design and manufacturing solutions. UEA is ISO 9001:2008 Certified for quality control throughout the entire company and is able to create custom solutions for each of their customers.

[www.uea-inc.com](http://www.uea-inc.com)

## Condition Monitoring

# bachmann.



### Bachmann electronic

Bachmann integrates its condition monitoring solution in the automation and links the measured values to other operating parameters. This increases the diagnostic reliability of the condition monitoring; fault patterns can be compared to the current operating situation and interpreted with greater accuracy. A systematic control enables mechanical loads to be reduced. In this way, adjusted operating conditions can extend the lifespan of partly damaged parts up to the next plannable maintenance date. Besides the hardware and software, Bachmann's system offering includes worldwide Monitoring Service to evaluate the measured data collected with the CMS module in extensive analyses.

[www.bachmann.info](http://www.bachmann.info)



### Gastops Ltd.

Through the use of MetalSCAN, it is now possible to monitor the progression of this damage on-line and to provide multi-level warning to maintenance and operations organizations before failure occurs. It is available for the full range of popular wind turbine models. The product provides bearing and gear protection and health monitoring for these complex multi-stage, highly loaded devices which incorporate a range of rolling element bearings and gears. The MetalSCAN sensor is installed in the full-flow of the gearbox lubrication system in a suitable location ahead of the system filter.

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



### SkySpecs

SkySpecs monitors the condition of wind-turbine blades using fully automated drones and intuitive software to identify damage and analyze severity. They measurably reduce downtime, drive up efficiency, and streamline the inspection and repair process. SkySpecs are members of AWEA and Wind Europe.

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

## Construction Products & Services | EPC Contractor

# BLATTNER ENERGY

### Blattner Energy, Inc.

Blattner Energy is an EPC contractor in renewable energy construction with more than 30,000 megawatts installed across North America. Blattner provides complete EPC services for utility-scale wind projects, including post-tension concrete tower supply and installation. Blattner also serves utility-scale solar, energy storage, and high voltage transmission and substation projects. Blattner has a history for responding to client needs, delivering on aggressive project schedules, and self-performance on all major work activities to ensure high levels of safety, quality, and overall client satisfaction.

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



### CONSERTEK LM Group, Inc.

CONSERTEK is actively involved in the field of infrastructures related to renewable energy. They are distributors of Sabre and Hughey & Phillips product lines. They offer design and engineering services using TSTower and Guymast Drawings software. They also provide fabrication civil implementation and construction; foundations and excavation; grounding systems; tower erection and installation; complex foundation and tower reinforcement; instrument installation; commissioning survey, inspection and maintenance analysis and report; and design, fabrication, and supply of anemometric instrument supports and accessories to suit all common instruments. Compliant to IEC 61400 standard. MEASNET certified.

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



### 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 listed in the Top 400 in ENR's largest contractors in the United States.

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



### Signal Energy, LLC

Signal Energy, LLC is a turn-key EPC/BOP renewable energy contractor with more than 9,000MW of utility scale project experience. They provide design and construction services for wind, solar, infrastructure, and other power projects. Signal Energy has the ability to provide in-house support of critical work scope including erection services and electrical system design (collection systems, transmission lines, substations, and interconnection facilities). Signal Energy, LLC is the renewable arm of the EMJ Corporation.

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



### Surespan Wind Energy Services

For over 40 years Surespan has designed, supplied, and built large construction projects across Canada and the United States. With the rising demand for alternative energy sources, Surespan has been involved in the installation of nearly 500 wind turbines. They own two powerful lattice boom mobile cranes, the Liebherr LG 1750, to serve the wind industry. From major component change-outs to turn-key installation, they have the equipment, training, and people to ensure the project is done safely and efficiently.

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



### Wanzek Construction

Wanzek Construction is a new construction general contractor, renewable service provider featuring a fleet of cranes to meet their customers' needs. With a portfolio of nearly 10GW of wind energy projects, Wanzek's team has installed a variety of turbine types and sizes. Wanzek's Renewable Services Division is an Independent Service Provider (ISP). They specialize in comprehensive wind power maintenance services using a regional deployment strategy, helping their customers maximize their investment in renewable power generation.

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

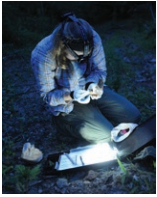


### Worldwide Machinery Pipeline Division

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.worldwidemachinery.com](http://www.worldwidemachinery.com)

### Consulting Services



### Civil & Environmental Consultants, Inc.

CEC provides biological monitoring services that support 401/404 permit applications, reducing the need to hire additional consultants. CEC's federally approved bat surveyors and wildlife biologists maintain an excellent rapport with numerous U.S. Fish & Wildlife Service regions while serving as advocates for clients.

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



### DNV GL

DNV GL unites the strengths of DNV, KEMA, Garrad Hassan, and GL Renewables Certification. Their 2,500 energy experts support customers around the globe in delivering a safe, reliable, efficient, and sustainable energy supply. They deliver testing, certification, and advisory services to the energy value chain including renewables and energy efficiency. Their expertise spans onshore and offshore wind power, solar, conventional generation, transmission and distribution, smart grids, and sustainable energy use, as well as energy markets and regulations. DNV GL's testing, certification, and advisory services are delivered independent from each other.

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



### Electrical Consultants, Inc.

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

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

# TEAM-1 Academy

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TEAM-1 Academy has a sterling reputation and extensive experience in the Wind Industry matched by no others. TEAM-1 has conducted thousands of training sessions with zero accidents/injuries. TEAM-1 maintains GWO (Global Wind Organization) accreditation as a global training provider for Wind Industry specific courses.

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Training sessions can be held at your site or at one of our training centres in Ontario or Western Canada.

The TEAM-1's Advanced Wind Turbine Rescue Training sessions are highly regarded as the most practical and straightforward in the industry. Training is performed by members that deal with emergency response on an on-going basis and provide hand-on experience and knowledge to your sessions.

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**EPI Group**

EPI offers environmental, geophysical, geotechnical, and HSE support service to windfarm developments. Their team provides solutions to geophysical/geotechnical surveys and construction, as well as the full suite of environmental mitigation and monitoring services for marine operations. They support site investigation and hydrographic survey operations from the planning cycle through delivery of final site report. They have worldwide experience working in shallow and deep water rig/site survey, wind farm projects, cable/pipeline route surveys, geotechnical investigations, pipeline/infrastructure inspection, and related survey activities.

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



**ScottMadden, Inc.**

Energy supply in the United States is on the cusp of significant changes. Renewables offer one solution by increasing fuel and geographic diversity as well as lowering emission profiles. The scale and scope of renewables will continue to expand, supported by favorable policies and declining technology costs. Strategies for sound operation and management will become increasingly important as renewable markets mature and technologies become more common on the grid. At ScottMadden, they work with clients to understand and effectively use clean and renewable sources of energy, such as wind, solar, bioenergy, and nuclear.

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



**Westwood Professional Services**

Westwood is a multi-disciplined engineering and surveying firm with experience gained from supporting more than 35 GW of wind projects across the U.S. since 1997. Their services include site evaluation, permitting, civil engineering, electrical engineering, geotechnical engineering, land surveying, aerial mapping/LiDAR, water resources, GIS, and construction support. They have offices across the nation and are licensed in engineering and surveying in nearly every state.

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

**Contractors**



**Mammoet USA South, Inc.**

Mammoet provides logistical services such as shipping, transportation, erection, and installation for mechanical and electrical turbines. Additional services include consultancy, new builds, re-powering, and maintenance.

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



**Rosendin Electric, Inc.**

Rosendin Electric recognizes that renewable energy, including wind power, is an integral part of the future of power generation. Rosendin installs underground and overhead 35-kV collection systems, fiber optic SCADA systems, turbine and tower wiring, as well as substations and overhead transmission lines to connect generating plants to utility grids. Their experience portfolio ranges in size and location, having completed single projects that range from 1 MW (Distributed Generation) to 900 MW (Utility Scale) and over \$100M with a geographic reach not limited to the continental United States.

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

**Cranes | Hydraulic Equipment | Aerial Devices**



**JPW Companies**

JPW Companies owns and operates crawler and hydraulic cranes to 600 ton capacity for new installations and maintenance work on wind components. Riggers and heavy rigging also are available, as well as heavy haul and blade trailers. JPW has a 100,000sq. ft. AISC and ASME certified steel fabrication facility and erections crews located in Syracuse, NY.

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



**Liebherr-Werk Eignen GmbH**

Liebherr-Werk Egingen GmbH manufactures Liebherr Mobile and Crawler Cranes for the wind industry. The economical, high-performance cranes from Liebherr have been used for decades in the construction of wind power plants. The cranes are available in various load capacity classes and are precisely tailored to the needs of the wind power industry. Liebherr faces the development of increasingly powerful installations and increasingly high towers by producing optimized cranes and new boom systems reaching especially high carrying capacities. Telescopic mobile cranes drive on public roads and can therefore be transported economically. Lattice boom crawler cranes offer high load capacity and lifting height. They can drive with a full load.

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



**Manitowoc Cranes**

The Manitowoc MLC300 now offers a NEW 3,5 meter wide boom that allows the use of the extended upper boom point. The extended upper boom point on the new wide boom expands the capabilities of the machine. The MLC300 with this boom combination delivers outstanding capacity and versatility to invested capital for large maintenance, repower, and install of 80m towers.

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

**Education | Research Development**



**Appalachian Energy Center**

A Small Wind Energy Hands-on Workshop is held every year at Appalachian State's Small Wind Research and Demonstration Site located on Beech Mountain, NC. Participants learn about the typical costs, economics, and maintenance involved with a distributed wind energy project, as well as explore a variety of distributed wind energy technologies and successful case studies. There are both classroom and "hands-on" activities for workshop attendees.

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



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[www.universitycollege.du.edu](http://www.universitycollege.du.edu)

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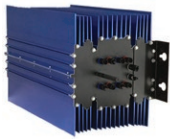
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**Alencon Systems**

Alencon builds a variety of power conversion products that can be cost effective enablers of PV alongside existing wind installations. Using Alencon's DC-DC optimizers, turbine manufacturers can integrate PV with wind using the resident capability already found in that turbine's converter, eliminating the need for additional BoS equipment such as inverters, which can result in a large cost savings.

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



**Continental Fan Manufacturing, Inc.**

Continental Fan is a supplier of fans for nacelle ventilation, GCU (generator control unit) cooling, and tower ventilation.

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



**Ingeteam, Inc.**

Ingeteam offers power converters, generators, PLCs, CMS, SCADAs, and O&M services for wind turbines up to 12MW for onshore and offshore applications. The company provides tailored electrical solutions and ongoing support throughout the entire product life-cycle, from research and design to production and testing, commissioning and after-sales services, technical training and support. For example, their low- and medium-voltage power converters are optimized for DFIG and FC topologies. Full-power converters are specifically designed for each generator technology (PMG, IG, EESG). And, air-cooled, air/water-cooled, and full water-cooled solutions are available for harsh environments.

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



**Mersen**

Mersen (previously Carbone Lorraine) designs and manufactures multiple solutions for both the original-equipment and replacement wind energy markets: slip ring assemblies, signal transfer systems, brush-holders, brush rockers, power and grounding carbon brushes, lightning protection systems, surge protection devices, fuse and fuse gear, bus bars, high power switches, and cooling devices. They also offer customized reengineered solutions for equipment retrofit and maintenance services for motors and generators (in-situ commutator and slip ring machining, motor inspection, technical support), training programs, and a full range of specifically designed maintenance tools and measuring devices.

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



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**Morningstar Corp**

Wind, gas, or hydro-generators, and other DC charging sources can be regulated using the Morningstar TriStar controller in diversion mode. The TriStar comes in 45A and 60A versions to control charging in 12V, 24V, and 48V battery systems. The TriStar provides 7 standard diversion charging algorithms. It is critical that the diversion load be sized correctly so that no damage is done to the batteries.


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





**SPX Transformer Solutions**

SPX Transformer Solutions provides medium and large power transformers up to 1200MVA, 345kV as well as power transformer, LTC, and circuit breaker components, including a line of Transformer Health Products. SPX Transformer Solutions also offers a variety of substation-applicable training classes for all skill levels and provides complete transformer service solutions for almost any manufacturer's units, including installation, maintenance, relocation, testing and engineering assessments, oil processing, dryouts and retrofits, corrective and preventative maintenance, load tap changer field retrofits, and repairs.

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



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**Thomas & Betts**

A Member of the ABB Group

**Thomas & Betts, a member of the ABB Group**

Thomas & Betts (T&B), a member of the ABB Group, is a wind-power system component and connections supplier, dedicated to making wind power more efficient, reliable, and economical. T&B provides these solutions by ensuring its products are made from high-quality materials with designs which reduce the number of parts, simplify installation, and reduce maintenance costs. Some of the T&B products available for the wind 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)

**Enclosures**



**Fibox Enclosures**

Fibox Enclosures specializes in corrosion-resistant polycarbonate enclosures for the electrical power generation industry. Their NEMA 4X enclosures protect products from hostile environments and resist impacts and UV damage, making them ideal for wind energy farms. Fibox can also customize their products to meet exact project requirements.

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

**Energy Storage | Grid Connection**



**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 currently leads the industry in 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)



**ESS Inc.**

ESS' All Iron Flow Battery, Energy Warehouse (EW) uses iron, salt, and water for its electrolyte and simple off-the-shelf materials for battery components. The EW is a durable, environmentally safe, long-duration storage system that's specially designed for time-shifting renewable energy on a daily basis, managing a facility's demand or TOU charges and smoothing intermittency of renewables on a constrained grid. ESS has designed this all iron electrochemistry to allow the EW to operate at high efficiency over an unlimited number of deep charge and discharge cycles, with no capacity fade over a 25-year operating life, and with minimal annual (O&M).

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



**Leoch Battery Corp**

Now offering advanced pure lead carbon technology batteries, Leoch Battery Corp's solutions provide high performance in partial-state-of-charge conditions with high power density and energy density. Their batteries have a small footprint, super fast charge acceptance, and long cycle life (2500+ cycles at 60% DoD). Built in ABS-poly-carbonate jars they are approved for wide operating temperature range (-30°C to 60°C). Added benefits include low self-discharge rate and an extended shelf life of up to two years.

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



**Parker Hannifin - Energy Team**

For over two decades, Parker's Energy team has been providing wind power solutions touching virtually every critical function in the turbine. From integrated lube oil filtration systems and compact blade actuation systems, to sealing technologies and power conversion systems, Parker has the custom, precision-engineered solutions that help onshore and offshore wind turbines generate energy more efficiently, while improving reliability and uptime. Their high efficiency wind power conversion systems deliver optimum power to the grid, featuring a scalable evaporative cooling system that lowers overall system cost, with up to 40% higher power throughput.

[www.parker.com/energy](http://www.parker.com/energy)



### Valence Technology

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

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

### Engineering



### Ayres Associates

Ayres Associates is a multi-specialty engineering firm providing an array of capabilities that apply directly to the wind industry including: survey, geospatial mapping and imagery services; site-civil engineering; construction management; transportation design; master planning; and environmental services. They perform energy-related projects nationwide, often in remote areas, and have procedures to facilitate rapid staff mobilization with a focus on communication and relationship building.

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



### Commonwealth Associates, Inc.

Commonwealth is a design firm offering consulting, planning and studies, and engineering and design services to the electric power industry. Services include: program management, owner's engineering, microgrid project development, auditing and compliance, environmental and specialized studies, permitting, land and right of way acquisition, unmanned aerial system inspections, and construction services for power generation, transmission line, distribution line, and substation projects throughout the United States and Canada.

[www.cai-engr.com](http://www.cai-engr.com)



### Ema Electromechanics, Inc.

Ema Electromechanics, Inc. designs and manufactures the model VDH/GSMI combined 34.5kV vacuum circuit breaker and high speed, mechanically interlocked grounding switch for wind power substations. This patented system is specifically designed for switching and grounding of wind collection circuits.

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



### FDH Velocitel

FDH Velocitel specializes in nondestructive testing for the conditional assessment of wind infrastructure. Foundation failures can occur as a result of under-designed foundations, construction issues, soil conditions, turbine modularity, and additional loads. FDHV services for wind turbine foundations include baseline condition assessments, analysis and modification design, and construction management. FDHV's structure solutions help support repowering efforts, life extension, asset management, and due diligence efforts. FDHV engineering professionals are licensed to work in all 50 states.

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



### Mott MacDonald

Mott MacDonald has participated in over 65 offshore wind projects over the last 15 years. They have worked on around 37GW of wind power production worldwide; roughly 10% of the world's capacity. Mott MacDonald's clients include owners, EPC contractors, power delivery utility companies, industrial facility owners, and independent power producers. As a multidisciplinary engineering and development firm, they have specific and recent experience providing design services for HV substations, transmission lines, and collector systems for key offshore clients.

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



### POWER Engineers, Inc.

POWER Engineers, Inc. provides owner's engineering, environmental, and engineering design services for medium voltage collection systems, site civil, communication networks, SCADA, and associated substations and transmission interconnect lines. They also perform up-front interconnection support and complete electrical system studies for developmental projects, as well as construction management, inspection services, and testing and commissioning for wind farm constructors and owner/operators.

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

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www.edf-rs.com



### Sargent & Lundy

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

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



### SNC-Lavalin



### SNC-Lavalin

SNC-Lavalin is a global player in the design, engineering, and construction of wind projects specializing in EPC, development support, feasibility studies, and analyses, e.g. geotechnical analysis, turbine and equipment selection, interconnection, underground or overhead collection systems, generation tie-lines, substations, turbine foundation, site, and project management. Their offshore experience includes monopiles, jackets, gravity base solutions, semi submersibles, spars, tension leg platforms, and offshore substation design. They work on projects from 50MW to 500MW+. SNC's Capital group will also provide both project development funding and equity.

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

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### Ulteig Engineers, Inc.

Ulteig is an employee-owned company delivering engineering, planning, surveying, and project management solutions to a wide range of public and private clients.

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

## Environmental Consultants & Business Services

### DersamGlobal Strategies

DersamGlobal is a business partner that helps their customers unlock their potential, tackle real issues and overcome complex challenges, and meet objectives and aspirations through a range of business development and strategic services. Before sending a service offer, they spend time with their clients working on a diagnostic, finding answers to the core questions; why, what, how, where, and when, and making sure they understand which need or challenge has been driving the request. They also pay attention to the expected benefits, possible obstacles, and their client's definition of success for the mandate.

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



**ecology and environment, inc.**  
GLOBAL ENVIRONMENTAL SPECIALISTS  
Offices throughout the United States and around the world

### Ecology and Environment, Inc. (E & E)

E & E offers all the professional environmental support required to site, permit, and operate wind energy generation and transmission facilities. E & E covers all the bases, from avian and bat impact studies to socioeconomic and noise analyses, to wetlands considerations and community outreach. The company operates offices throughout the US, with subsidiaries and affiliates around the world.

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

## Filtration Systems



### Hy-Pro Filtration

Hy-Pro Filtration provides filtration solutions for lube oil and hydraulic fluid, preventing gearbox and braking system failures in wind turbines. Their objective is to optimize the reliability of hydraulic and lubrication assets, keeping projects operating at peak productivity.

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

## Financial Services



### CleanView Capital

By using CleanView Capital's straightforward Clean Energy Ownership Program as a low-cost path to ownership, companies obtain more energy savings and greater overall value from clean energy systems than is available from power purchase agreements and other programs which provide only limited energy savings. With the Clean Energy Ownership program, companies keep the full amount of energy savings and incentive payments, all environmental benefits, and a substantial portion of the monetized value of any available ITC - with no upfront capital outlay.

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

## RODMAN CPAs

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### 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 CPAs Green Team provides renewable energy producers and businesses that pursue 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)

## Gearbox Manufacturing, Services & Repairs



### Bonfiglioli

Bonfiglioli designs and manufactures an extensive range of products for the wind energy sector, including planetary gearmotors and gearboxes for nacelle yaw control, blade pitch, and small wind main drives, as well as a complete range of AC electric motors and inverter drives. Bonfiglioli products are compact, lightweight, and versatile and help improve wind turbine performance and minimize maintenance costs of 1.0MW to 8.0MW turbines in on- and off-shore installations. New product features such as a torque limiter and integrated load cell help to monitor and measure gearbox performance, troubleshoot maintenance issues, and control and manage power, resulting in higher ROI and longer LTV.

[www.bonfiglioliusa.com/wind](http://www.bonfiglioliusa.com/wind)





### Milwaukee Machine Works

Milwaukee Machine Works is a North American manufacturer of wind turbine parts including, housings, torque arms, and gearboxes. MMW's machining of wind turbine gear boxes, torque arms, armature housings, and components spans close to two decades. They have the solution, technology, and machining expertise to satisfy their customer's stringent requirements. Their Leitz CMM also provides quality inspection capabilities for complex and large parts.  
[www.milwaukeemachineworks.com](http://www.milwaukeemachineworks.com)

### Generators | Maintenance & Repair Services



#### Integrated Power Services (IPS)

IPS provides wind repair services, field services, and distribution for fleet owners and operators across North America. They back everything from wind generator repair, generator unit exchange, up-tower, or in-shop service and repair with one standard for safety, quality, service, repair procedures, and commercial terms. Their single-source wind turbine service capabilities make owning or managing wind power fleets more predictable and profitable.

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



#### PSI Repair Services, Inc.

PSI Repair Services offers fast, affordable repairs for the electronic, hydraulic, and precision mechanical components that drive a turbine's pitch and yaw systems and down tower electronics. PSI uses current diagnostic tools to detect failures down to the microchip level. They service printed circuit boards, H-bridges (a.k.a. hub converters), IGBTs, PLCs, controls, VRCC units, hydraulic pumps, servo motors, transducers, and much more. Solutions can range from minor repairs to full replacement printed circuit boards, with enhanced designs to improve performance and reliability. PSI also provides comprehensive remanufacturing services for unsalvageable, obsolete components.

[www.psi-repair.com](http://www.psi-repair.com)

### Large Wind Turbine Manufacturer (Over 100 kW)



#### Energys Wind Technologies Americas, Inc.

EWT offers an efficient product range based on direct drive technology with a high yield and low cost of energy. The combination of direct drive technology and advanced control features makes EWT's DIRECTWIND 250kW up to 900kW a solution offering energy yield and reliability. With over 600 turbines spinning, EWT has a certified and high performing product range targeted on the decentralized wind sector, including energy solutions integrating with other sources of generation.

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



#### ENERCON Canada, Inc.

Established in Germany over 30 years ago, ENERCON is an international provider in wind turbine design and manufacturing. With its gearless generator technologies, high manufacturing standards, and comprehensive long-term service agreements, the company's solutions are reliable and high performing. ENERCON's product line ranges from 800kW to 4.2MW. To date, the company has installed more than 27,500 turbines worldwide representing more than 46.4GW of installed capacity.

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



#### Goldwind Americas

Goldwind's GW136/4MW Permanent Magnet Direct-Drive (PMDD) wind turbine capitalizes on the scalability of the 3-megawatt platform to bring a turbine with a rated power of 4.0-4.2MW. The latest Goldwind turbine for international markets is designed for wind class IIA and features rotor diameters up to 136 meters. Goldwind's E-farm system has been integrated as a standard system in the GW4X turbine. Using LAC (Lidar Assisted Control) technology, E-farm can help increase efficiency of the turbine by adapting to changing wind conditions and optimizing the turbine power curve to achieve higher AEP.

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



#### Vestas

Vestas provides sustainable energy solutions. They design, manufacture, install, and service wind turbines across the globe, and have installed 85GW of wind turbines in 75 countries. Through their smart data capabilities and more than 71GW of wind turbines under service, their 22,500 employees use data to interpret, forecast, and exploit wind resources and deliver quality wind power solutions.

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

#### Lighting



#### Flash Technology

From their Franklin, TN facility, Flash Technology offers innovative MET tower and wind turbine obstruction lighting solutions and the remote asset monitoring systems that support them. An OEM since 1969, they help clients mitigate risk and meet the day-to-day challenges of obstruction lighting operations. Their ETL-certified and FAA-approved LED products serve airport, broadcast, telecom, utilities, and wind energy markets. Their support services include component-level training, installation, troubleshooting, and maintenance.

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

*SIBA FUSES is proud to introduce a new range of SSK-type fuses in the switch-fuse combination. Our fuses can replace expensive circuit breakers and can be used on transformers rated up to 3,150KVA. SIBA's special SSK-type fuse maintains the minimum breaking current at lower dissipation than the existing products, and is specially designed for Wind Energy Applications.*

*One of the major challenges taken on by SIBA is the heating of fuses. Empirical work based on long-term test series involving the heating of the fuses ensures that we are able to cope with this challenge, and continue to further develop the SSK production series in order to meet the demands for regenerative energies in the future as well.*

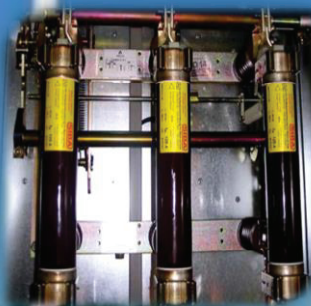


## FUSES

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**Call or email us today with any questions or for more information on our products and services!**



### Hughey & Phillips

The H&P HORIZON L-864 Red LED beacon has design features specifically for wind turbine applications. Light weight, compact, easy wiring, alarm contact, field repairable, and integrated GPS/PCELL allows the fixture to be quickly installed on new or existing turbines. At 17lbs and 9" tall, the fixture can easily replace larger and heavier fixtures while typically using the same system wiring. The unit can be field repaired reducing maintenance costs. The integrated GPS/PCELL provides sync and mode control without the need to additional controls. All HORIZON systems come with a 5-year warranty.

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



### Moltec Windpower Products

As a designer and manufacturer of tower and nacelle lighting systems since 2005, Moltec introduces its new LYS/LED purpose built lighting products. With options like the Quik-Fit II, plug and play electrical system, and a centralized emergency backup system, LYS/LED lighting products provide a balance between overall cost and performance, and the MOLFLEX Braided Grounding Straps help complete the system. Moltec lighting products come with a 10-year warranty and they will perform a "no cost" tower and nacelle lighting design consultation.

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



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### Phoenix Contact

Phoenix Contact's new LED tower lighting system for wind turbines makes lighting installation nearly maintenance-free. The complete solution ensures optimal lighting of work surfaces and escape routes. The LEDs have a long life, eliminating frequent bulb replacements. Due to the lower temperature operation, they also eliminate fixture heaters. The system features Phoenix Contact's QPD connection system for quick and easy installation. A central, uninterruptible power supply ensures lighting in case of power failures and eliminates the need for batteries in fixtures. Service technicians can conveniently read the UPS's charge level and the battery's expected service life.

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

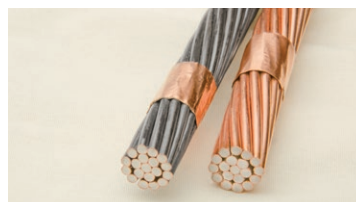


### Technostrobe

Technostrobe has been manufacturing obstruction lights for tall towers since 2001. Their LED lighting systems can be combined with LIDS (Lighting Intensity Dimming Solution) Technology to ensure the intensity of the lights on a wind farm are adapted to the surrounding visibility, thereby helping the site become more community friendly.

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

### Lightning & Surge Protection



### Copperweld Bimetallics, LLC

Since 1915, Copperweld Bimetallics has manufactured bimetallic wire and provided Copper-Clad Steel (CCS) for grounding applications. Benefits of Copperweld CCS include: theft deterrent, no scrap value, stronger than copper, corrosion resistant, made in the USA, and ASTM B910, B227, B228 Certified.

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



### ERICO

ERICO offers a family of lightning blade receptors as part of a complete range of lightning protection products for the wind energy industry. The receptors are available as a stand-alone component or part of a complete preconfigured blade protection assembly. Blade receptor assemblies offer replaceable disks and provide insulation of internal components to inhibit undesired leader initiation. The features of the receptor assembly provide a smoothing of electric fields which eliminates the potential streamer initiation point. The installation of the system offers a solution to a problem that is common to the wind turbine industry.

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



### Raycap

Raycap has enhanced the performance of its Strikesorb 30 Surge Protective Device for wind turbines. The enhancements upgrade the Strikesorb 30 to a Class I Surge Protective Device, in addition to its present Class II rating, per IEC 61643-11. The enhanced Strikesorb 30 provides systems designers additional installation flexibility with its compact footprint, in locations experiencing both direct and indirect lightning currents. The modules have UL Type 2 Component Assembly certification and feature a patented technology capable of handling multiple lightning surges without failure or performance degradation while offering continuous protection of the wind turbine.

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

### Lubricants



### American Chemical Technologies

EcoGear 270XP is a wind turbine lubricant made from polyether polyol and has been engineered specifically to eliminate disadvantages of other full synthetic oils. American Chemical Technologies, Inc.'s (ACT) polyether polyol based PAGs essentially clean systems with their natural detergency and the incapability of varnish formation while in operation. EcoGear 270XP has valuable filtration properties, better cold temperature start-ups, condensation and water forgiveness, extended service life, and offers low volatility in high temperature applications. The extreme pressure properties in EcoGear 270XP have been formulated with an additive package created by advances in lubrication used in aerospace technology. Once activated by high specific loads and corresponding temperatures, the additive package helps to equalize surface roughness without creating abrasion. EcoGear 270XP is a solution within wind turbine gearboxes where other lubricants experience short change intervals and insufficient load carrying capacity.

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



### BEKALube Products, Inc.

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

[www.beka-lube.com](http://www.beka-lube.com)



### Castrol

Optigear Synthetic CT 320 is formulated for use in wind turbine gear box applications, but it can be used for all types of enclosed gears – including heavy and shock-loaded gears and bearings where EP properties are required. It is suitable for use in gear boxes where high micro-pitting resistance and ultra-low water absorption is required. It is also capable in a wide range of applications in extreme environments. Optigear Synthetic CT 320 is fully compatible with nitrile, silicone, and fluoropolymer seal materials.

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

## KLÜBER LUBRICATION



### Klüber Lubrication NA LP

Special gear oil is required to maximize the efficiencies and longevities of large gear systems. Klübersynth GEM 4-320 N reaches high levels of resistance to wear, cleanliness, anti-foaming behavior, and service life. The lubricant remains stable over many years of service and cycles of filtration. In addition, their formulations can protect and prolong the lives of gearboxes which are running with damages.

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



### Petro-Canada Lubricants

HARNEX 320 Wind Turbine Gear Oil is a synthetic lubricant formulated for lubricating wind turbine gearboxes for reduced downtime and less maintenance. HARNEX 320 is designed to provide anti-wear/extreme pressure (AW/EP) protection and corrosion control under tough conditions. HARNEX 320 is part of a select group of gear oils that have GE service fill approval for 1.x and 2.x platforms with Winergy gearboxes. In addition, HARNEX 320 meets the technical requirements of Shanghai Electric, and is approved for use in any gearbox on a Shanghai Electric wind turbine.

[harnex320.com](http://harnex320.com)

### Metal | Metal Cutting Machines



### Samuel, Son & Co., Limited

Samuel, Son & Co., Limited is a metal service center and metal manufacturing company. Since 1855, Samuel has been in the metal business throughout North America in multiple market segments. With a diverse product line, they are able to supply all market segments, especially the energy markets.

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

### Operations & Maintenance (O&M)



### Duomar, Inc.

Duomar is a manufacturer of high performance polymeric coatings for wind energy. Their product line includes a durable, easy to apply leading edge protection system, an innovative "Icephobic" coating to prevent accumulation of ice on turbine blades as well as a full line of blade repair products. Their tower and blade coatings provide more than 20 years of protection even for the most challenging offshore and coastal turbines.

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



### EDF Renewable Services

With 30 years of experience and 10GW of energy under contract in North and South America, EDF Renewable Services helps optimize plant performance, maximize availability, and minimize downtime. With services including full O&M, Blade Services, Asset Management, and 24/7/365 Monitoring, they bring an owner-operator sensibility to all projects. Their development group, EDF Renewable Energy, has over 9GW of wind, solar, bioenergy, and storage developed in North America.

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



### HYTORC

From the foundation bolts to the blades, HYTORC has developed solutions for nearly every bolting application in the wind turbine industry. For custom projects, their experienced engineering team is available to custom design the most efficient solution, with simple operation and economical pricing in mind. HYTORC's mission is to ensure customers' jobs as safe and efficient as possible. All of their products are covered by a worldwide, one-year, no-questions-asked warranty, which includes free parts and labor. With authorized repair facilities located globally, fast and professional service is always available.

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

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



### Power Climber Wind

Power Climber Wind helps wind turbine OEMs, owners, and service providers manage their operation and maintenance costs by providing reliable access equipment and expertise to improve employee safety, productivity, and retention. They offer a range of solutions such as turbine service lifts, IBEX climb assists, tower access platforms, 360° blade access solutions, safety equipment, and training globally.

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



### Sentient Science

Sentient Science works with wind operators and suppliers to provide life extension to wind assets and ultimately reduce the operator's cost of energy by a goal of \$10/MWh. Sentient's DigitalClone Live technology uses a material science-based approach to calculate the earliest point in time cracks initiate within the subsurface of each individual component. Sentient provides a watchlist over time with life extension actions that prevent unplanned and major maintenance events from occurring. Sentient works with suppliers to design longer-lasting products and help them digitalize their product offerings.

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



### Spider by BrandSafway

From single point tower access systems to 360° blade access platform solutions to custom designs, Spider has the modular platform components, ease of supply and transportability, engineering expertise, and installation know-how to get wind turbine repair work done safely and productively. They offer a variety of suspended platforms as safe, productive, and cost-effective alternatives to cranes, ground-based lifts, and rope access solutions. Reconfigurable for blade or tower access, their modular platforms are made in the US and available for rent, sale, and aftermarket support in 25 locations in the Americas. They offer Wind Access Safety and Training courses to keep their customers working safely and compliantly.

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

## Project Developer | Operator

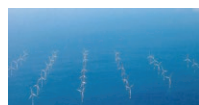


### BayWa r.e. Wind, LLC

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

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

## Recruiting | Staffing Services



### EnergeiaWorks

EnergeiaWorks' exclusive focus on clean energy markets provides them an advantage in locating the right talent for those in the renewable energy business. EnergeiaWorks provides access to in-demand clean energy experts, consultants, and executive level candidates; even those who are not actively job searching. Their clients represent a cross-section of the industry, from start-up to Fortune 500 companies in North America and globally. They work with leading EPCs, utilities, OEMs, distributors, developers, integrators, and financiers who understand the value of having a recruiter working with them to help grow their business and improve their bottom line. EnergeiaWorks' proprietary database of over 30,000 global contacts contains all the major players in solar and renewable energy.

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

## Remote Monitoring



### Electro Static Technology

AEGIS' WTG-MR Rings combine wind turbine bearing protection with continuous monitoring of shaft voltage levels from a remote location in real time. Combining an AEGIS Shaft Grounding Ring and a shaft monitoring ring in one, it ensures maximum uptime and reliability of wind turbines and is designed for OEM installation or easy up-tower retrofit. High-frequency currents induced on the shafts of wind turbine generators can reach levels of 60 amps and 1200 volts or greater, and can cause severe electrical damage, bearing failure, and catastrophic turbine failure. The WTG-MR safely diverts up to 120 amps of continuous shaft current at frequencies as high as 13.5 MHz and discharge up to 3000 volts (peak).

[www.est-aegis.com](http://www.est-aegis.com)

## Safety Equipment | Fall Protection



### 3M Personal Safety Division

3M's Personal Safety Division offers well-designed personal protective equipment (PPE) that provides employers a range of options for effective protection. From the most basic to the most specialized needs, 3M offers the health and safety protection workers need most, so everyone can perform at their best. 3M's specialists help companies build integrated PPE plans and programs supported by the latest technical innovations, training support, and resources to help employers make sure every worker stays safe.

[www.3m.com/workersafety](http://www.3m.com/workersafety)



### Corgo Industries

Corgo Industries provides standard and custom made lift bags for the wind turbine industries. The COR-600, the COR-1000, the lift buckets, and the COR-350, COR-061786 200lb bags are all designed with the consultation of men and women in the field to create these purposeful lift bags. Corgo Industries has worked with manufacturing materials to fit extremely hot and extremely cold climates.

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



### Tech Products, Inc.

Tech Products, Inc. is a global source for identification products. Since 1948, Tech Products, has provided products to mark everything from transmission towers to distribution systems. Their Everlast product line is used in pole marking, substation signage, and transmission tower identification.

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

## Software Supplier

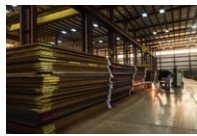


### JobNimbus

JobNimbus offers a fully mobile sales and production management software with features including interactive boards, customizable workflows, and photo uploads. Enter new leads and move them through the sales pipeline. Everything in JobNimbus is organized into job folders, including notes, emails, tasks, contracts, photos, estimates, and more. The entire pipeline can be viewed and interacted with in a digital whiteboard to see where everything is and what's up next. With a mobile app (iOS, Android), JobNimbus provides tools in the field to capture lead information, take and upload pictures to a job folder, and create estimates on the spot. The app works in offline mode to provide uninterrupted productivity anywhere. Featuring integrations for canvassing, QuickBooks, and EagleView, JobNimbus is a one-stop solution for managing business from the field or in the office.

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

## Steel Supplier



### Leeco Steel

Leeco Steel, headquartered in Lisle, Illinois, with 10 locations, maintains a large inventory of carbon, HSLA, and alloy plate steel originating from world-wide mills. Leeco Steel's quality service and collective buying power provides flexibility in securing product, agility in reacting to changes, and the ability to keep their customer's operations competitive in today's ever-changing marketplace.

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

## Testing | Inspection Services



### BladeEdge

EdgeData's BladeEdge, is an automated analytical software tool which transforms raw data from aerial inspection into actionable intelligence for the wind industry. For wind farm owners, leveraging unmanned aerial inspections, which are up to ten times faster than human teams, helps improve wind farm planning, safety, and efficiency, ultimately extending blade infrastructure lifespan and reducing costs. BladeEdge's proprietary software stitches the photographs together and transforms the data, enabling wind farm owners the ability to schedule maintenance, extend blade life, enhance turbine performance, and prevent condition-related revenue loss.

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



### Megger

The MIT410/2 is a handheld field rugged instrument that performs the fundamental test of electrical system reliability, insulation resistance. It also performs a regime of corollary tests which help the operator fine tune the final assessment. It offers preventive and predictive maintenance on generators and cables up to 200 gig ohms. The unit is rated CAT IV 600 volt protection from arc flash/arc blast. It also measures ac and dc voltage.

[us.megger.com](http://us.megger.com)



### MISTRAS Group, Inc.

MISTRAS Group is a provider of asset protection services for the North American wind energy industry. Their Rope Access Center of Excellence performs at-height inspections, light mechanical services, and condition-monitoring on wind turbine blades, towers, gear boxes, and transformers all over the continent. Their solutions include non-destructive testing (NDT) for internal and external inspection, laminate and coating repairs, drone inspections, blade installation and repair support, and fleet-wide condition-monitoring.

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



### Q-Lab Corporation

Wind turbines are often exposed to sunlight, moisture, and heat and can experience UV degradation and corrosion. As such, comprehensive accelerated testing of parts and assemblies used in wind turbines help assure the quality of parts used and helps develop new, innovative materials and processes. Q-Lab provides accelerated weathering and corrosion test equipment and test services.

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



### UL, LLC

UL is a global, independent safety science company, continually expanding to meet the needs of customers and to deliver on UL's public safety mission. UL provides safety, performance, and function testing services for the assessment of wind turbines and turbine components that must comply with international, national and regional regulations and standards—as well as meet the needs of insurers, developers, and investors. UL is further advancing in the field of renewable energy, in particular for on- and off-shore wind turbines and wind farms. This combined technical expertise provides customers with global, one-stop wind energy services.

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



## WINDGUARD NORTH AMERICA

### WindGuard North America, Inc.

WindGuard's testing laboratory offers power performance measurements according to all established technical standards (for example IEC 61400-12-1). In addition, WindGuard has developed other methods to verify the power performance of wind turbines, implementing both ground-based and nacelle LiDAR technology. With the experience from hundreds of tests on turbine types from 30 kW to 7.6 MW, they are a reliable partner for verifying warranted power curves as well as prototype testing. WindGuard is committed to providing extensive scientific, technical, and operational services, which are unbiased and manufacturer-independent for onshore and offshore wind projects.

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

## Tools

### AS Tech Americas, Inc. (ATA)

ATA offers bolt tensioning equipment including electro-hydraulic and pneumatic pumps, tension cylinders - thread on and thru hole versions, hoses, couplings, and hydraulic nuts. They provide offer sales, service, rentals, and consultation for all bolt tensioning applications.

[www.astech-hydraulik.com](http://www.astech-hydraulik.com)



### Dakota Riggers

Dakota Riggers is a stocking distributor for Tuff Bucket products. These high-quality lifting buckets feature the innovative roll-down closure system. This closure system allows for the bucket to fully load, rated both right side up and upside down. Tuff Buckets are available in a variety of different sizes, in either heavy-duty canvas or vinyl-coated polyester material.

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

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### Hi-Line Utility Supply

With over 10,000 products in stock, Hi-Line Utility Supply is a "one-stop-shop" for tools, safety equipment, rubber goods, and services for wind farms, electrical utilities, and contractors since 1960. Hi-Line also custom grounds and jumpers, tool repair, fiberglass refinishing, and rubber goods testing at two NAIL-accredited test labs (Gilberts, IL and Millbury, MA). Both warehouses house a large in-stock selection of rubber goods. Hi-Line also provides the required certification documentation to meet the unique needs of wind farms.

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



### ITH Bolting Technology

Providing bolting technology products and services, ITH Bolting Technology's products include hydraulic bolt tensioning equipment, hydraulic torque wrench equipment, and electric and battery nut runners (torque multipliers). Services include repairs and calibrations (ISO 17025), on-site bolting, and technical design support for bolted applications.

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



### Janicki Industries

Janicki Industries is a privately owned, full-service engineering and manufacturing company. Janicki manufactures tooling for wind energy blades made of composite materials and metals. Janicki fabricates auxiliary equipment: hinges, scaffolding, fixtures. Janicki is capable of tackling large projects, utilizing precision five-axis mills, large facilities with overhead cranes, curing ovens, and large autoclave. Janicki has experience using many composite systems and metal forming, employing a 1,100 ton press. Janicki is proficient in transporting large products to a project location. They provide 100% in-house capability for the total tooling and equipment solution for wind energy customers.

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



### 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)



### Norwolf Tool Works, Inc.

The Norwolf X-Driver hydraulic bolting system is a fast, safe, thin, and versatile wrench. With one-piece piston design, no loose shroud, it's totally enclosed. Made from all alloy steel, the X-Driver power head includes interchangeable drives to fit all bolting applications. The M drive fits narrow confines while the V drive offers versatile reaction capabilities in a square drive tool. The standard A drive fits in tight spaces and is fast as well. A full line of accessories are available to suit specific bolting needs, including extended reaction arms and a variety of custom drives.

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



### Rad Torque Systems

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.

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



### Snap-on Industrial

Snap-on Industrial is a supplier of tools and protective equipment for professional technicians. Their Tools at Height tethered tool program includes more than 1,000 tools designed for work being performed at height or anywhere dropped or lost tools are a concern. All tools are designed with a tethered system to maintain or enhance the tool's functionality when used at height or near critical assemblies. Engineered, tested, and certified to improve safety and productivity for technicians working at elevated levels, Snap-on's Tools at Height use a retention system that is designed in conjunction with the tool so it doesn't inhibit the technician's ability to complete the job.

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



### Stahlwille Tools, LLC

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.

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

### Tower Foundations



### Con-Tech Systems, Ltd.

Con-Tech Systems supplies foundation solutions to suit all ground conditions. Their HRTB Solid Bar and Strand Systems are well suited for foundations on rock. Post-tensioning of these anchor piles to their design load eliminates anchor and foundation movements, and provides a high safety factor. Their single-step CTS/TITAN Hollow Bar IBO Micro Pile System is a solution for foundations on soils, particularly when collapsing soils such as sand and gravel are encountered. Ground conditions and "grout to ground" bond values are greatly improved during drilling and flushing of the bore hole through their grout injection process, resulting in shorter piles.

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



### Ridge National, Inc.

Ridge National's team performs in a number of areas, including electrical, mechanical, heavy civil, manufacturing, and maintenance with a strong focus on wind energy. They travel all over Canada to meet their clients' needs, whether it be general construction, construction management, design build, or EPC/BOP. Providing their clients with a single point of contact, they perform the following services: working with landowners to minimize impact on property; surveying to determine the optimal location to yield the greatest energy result; constructing access roads and performing upgrades to municipal roads, including all heavy civil components involved; manufacturing custom components for species protection; installing the underground collector system from wind turbine generators (WTG) to substation; building the electrical substation; complete tower build, including wind turbine generator (WTG) base pours; and restoring the land to its original state after heavy construction.

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

### Transportation | Logistics



### C.H. Robinson Project Logistics

As a global freight forwarder, C.H. Robinson Project Logistics has experience in developing and executing cost-effective, successful logistics plans for the transportation and management of heavy-lift and over-dimensional wind turbine equipment; from pick-up to final site. After a proactive analysis of all project requirements, C.H. Robinson Project Logistics helps customers develop solutions and contingency plans to help ensure shipping schedules are consistently met. C.H. Robinson Project Logistics offers several services including: detailed route planning; part/full charters; aircraft chartering and emergency rush air freight; accurate information documentation; timely status reports; and consulting services for complex letters of credit and bid documents. Their experienced team of professionals is available onsite at locations globally to manage the successful completion of technically demanding projects.

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



### Logisticus Group

Logisticus Group is a global supply chain partner, offering route/feasibility assessment, project management, risk analysis, transport engineering, and advanced technology solutions to support the execution of turnkey over-dimensional cargo transportation. Their leadership team has over 60 years of combined project management and logistics experience in the wind power, nuclear, oil and gas, power generation, military, trucking, rail, and shipping industries. This experience provides an understanding of the complex problems their customers face, and equips them to develop effective, customized solutions while being flexible enough to adjust to project demands quickly.

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



**Port of Stockton**  
CALIFORNIA

### Port of Stockton

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

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



### Port of Vancouver USA

To support transportation of wind energy components, the port has two Liebherr mobile harbor cranes that can lift 140MT each and 210MT in tandem, a multi-purpose crane with 51MT capacity, and crane operators certified in tandem and engineered lifts. Stevedoring equipment includes trailers and reach-stackers to efficiently move cargo. They have over 100 acres of laydown space and their nearly complete rail expansion project will triple capacity and reduce congestion by 40%.

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



### Port of Wilmington, Delaware

Port of Wilmington, Delaware provides 24/7 marine terminal operations with wind project handling experience since 2001. The Port offers two independent stevedores, prompt and efficient State permitting and police escort services, logistics coordination, Class 1 rail, local towing co. and ship agencies, onsite CBP and USDA, and FTZ. It has 6 open, project friendly berths, heavy lift capacity to 100 MTs, and 50 acres of outside storage with immediate access to the interstate highway. The Port services the Mid-Atlantic US and is the first deep water terminal on the Delaware River. It maintains 360 Quality, C-TPAT, and AWEA membership

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



### Port of Corpus Christi

Port Corpus Christi, situated on the Texas Gulf Coast, has 6 laydown yards, all highway and rail accessible, suitable for heavy lift and project cargo such as wind turbine components. The port provides a 45' deep ship channel (with expansion plans to 54'); dockside rail; three class 1 rail carriers; an on-campus short line railroad; a knowledgeable labor force; heavy lift capabilities; and open, covered, and dockside storages. The Port's new Nueces River rail yard features 8 tracks each 8,500' long. All of this provided with safety, security, and environmental management operations.

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



### Port of Longview

The Port of Longview has more than 10 years experience handling wind cargo. In 2016, Port of Longview discharged blades direct-to-rail, decreasing handling costs and reducing the risk of damaged cargo. The Port is served by BNSF and UP, offers double tracked on-dock rail, and a 70 acre paved laydown yard. Their equipment consists of 2 heavy lift Liebherr mobile harbor cranes, reach stackers, and other equipment for their customers' handling needs. Located on the deep-draft Columbia River in Washington State, just 66 miles from the Pacific Ocean with direct access to Interstate 5 and BNSF mainline, the Port of Longview offers a full service transportation destination.

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



### Stewart World Port Services, Ltd.

Stewart World Port is a deep sea multipurpose port located in Stewart BC. As Canada's most northerly ice-free port, Stewart is ideally located at the end of the Portland Canal and has paved access to British Columbia and Alberta. The location provides up to a full day advantage to Asian markets over southern ports and has favorable climate, low winds, and good anchorage.

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



### Transportation Partners and Logistics

TP&L's services can be introduced anywhere along the supply chain. They serve OEM's, project developers, and transportation companies. TP&L is also available to help plan rail load outs from port to pad. Their in-house engineer is open top loading certified and available every step of the way. TP&L's partners bring with them over 40 years of combined transportation experience in all sectors-port, truck, rail, and distribution services.

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



### Port of Olympia

The Port of Olympia's 66 acre terminal is situated in Puget Sound in Washington State. ILWU #47 longshore labor is available 24/7 to discharge wind component vessels and to load out to truck and rail. Easy truck access is available, with access to Interstate 5 in less than one mile. On-dock rail is supported by both BNSF and UPRR with switching by OYLO, their short-line carrier. A wide variety of heavy lift equipment is on-site for operations including top picks and a 140-ton Gottwald mobile harbor crane.

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



Whether you need a system for wind blade production or repairs, contact us today to learn how Mankiewicz can provide your complete coatings solutions.



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## Utility Poles



### Bell Lumber & Pole Co.

Bell Lumber is a 110 year old family-owned wood pole manufacturer, supplying wood utility poles to contractors, developers, and utility customers across North America.

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



### Valmont Utility

Valmont Utility provides custom engineering and manufacturing of steel, concrete, and hybrid pole structures for electrical transmission, substation, and distribution applications. Operating globally, Valmont Utility has 12 North American distribution facilities and 3 in global regions meeting the high stakes delivery challenges.

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

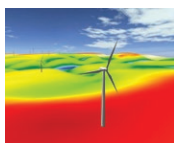
## Wind Assessment | Forecasting



### EAPC Wind Energy

EAPC Wind Energy is a wind consulting firm offering bankable wind resource and energy assessment, wind farm design, turbine site suitability analysis, project due diligence, noise and shadow flicker assessment, visual simulations, and met tower sales and installation. EAPC Wind Energy is the exclusive North and South American (excluding Mexico and Brazil) sales and support agent for WindPRO.

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



### Meteodyn

Meteodyn develops wind energy software and custom IT engineering solutions. Available wind software solutions for wind projects and running farms include, meteodyn WT software and meteodyn Forecast. meteodyn WT software includes tools such as wind resource assessment, annual production assessment, wind farm design in complex terrain, turbines layout, IEC compliance, site suitability, and analysis. meteodyn Forecast is a wind power forecast system to predict wind production at short and very short term, wind farm optimization, and wind farm monitoring.

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



### WPred

WPred was founded in 2008 by a team of engineers and meteorologists with over 20 years in renewable energy and specializes in custom technological solutions. Working with wind farms to predict weather and wind intensity, WPred assists in forecasting wind power production and planning maintenance calendars.

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

## Yaw, Pitch & Blade Sensors



### Micronor, Inc.

MR200W Yaw Sensors are available integrating variety of position sensing technology and cable twist limit switches. Position sensing options include fiber optic, optical, magnetic, resolver, and potentiometer. Limit switches can be electromechanical or fiber optic. Special lightning resistant (electronic) or lightning immune (fiber optic) designs are available.

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

## Other Economic Development



### Iowa Economic Development Authority (IEDA)

The Iowa Economic Development Authority (IEDA) can offer assistance to wind industry companies seeking to locate a new facility or expand an existing facility in Iowa. The IEDA can help in any stage of the site selection process, from fact finding to property searches. The IEDA also administers a number of state and federal programs which can support companies in a number of ways, including employee training and facility construction or modernization. All phases of wind turbine construction are already happening within Iowa's borders, and Iowa's utilities are aggressively adding to their wind energy portfolios.

[www.iowaeconomicdevelopment.com/wind](http://www.iowaeconomicdevelopment.com/wind)

## Labor Trade Association

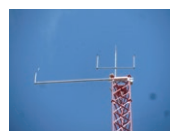


### Ironworker Management Progressive Action Cooperative Trust (IMPACT)

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)

## Met Towers



### Tower Systems Inc.

Tower Systems, Inc. has installed numerous meteorological towers on wind farms throughout the United States. They provide the tower steel, installation of foundations, tower, booms, and customer specific instrument package to meet their customers' requirements, as well as testing, commissioning, and documentation of the instrumentation. TSI also manufacturer's retractable booms, available in standard lengths of 8ft, 10ft, and 12ft, with longer lengths available upon request. The booms are designed for trouble-free operation and provide safe and easy access to instrumentation.

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

## Rescue and Safety Training



### TEAM-1 Academy, Inc.

TEAM-1 Academy, Inc. specializes in training for Working at Heights/Fall Protection, Confined Space, HazMat/Spill Response, many forms of Rescue, and much more. They provide Professional Safety and Rescue Training, Equipment Sales + Service + Inspections, and Consulting Services for the renewable energy sector, utilities, energy sector, Fortune 500 companies, industry, construction, health care, fire services, police, EMS, military, MOE, government, and numerous others.

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

## Track Conversion

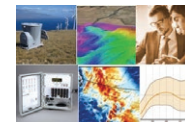


### Mattracks, Inc.

Mattracks, manufacturer of rubber track conversion systems, has expanded their line-up of tracks for commercial, large equipment with axle loads up to 10 and 20 tons. Mattracks offers over 100 track conversion models for everything from ATVs, UTVs, and trailers to pickups, tractors, 4x4's, and more for customers globally. Ideal for the tough terrain at many wind farm sites, Mattracks track conversions provide mobility and traction in mud, sand, snow, swamp, and muskeg. They provide users access to roads that can no longer be traveled by tires, with decreased impact to the vehicles and the environment.

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

## Wind and Solar Measurement and Consulting Services



### Vaisala

As the fuel for wind and solar projects, understanding weather is critical for the renewable energy industry. Vaisala provides weather measurement and consulting services with an 80-year reputation for reliability and decades of experience assisting clients throughout the entire project life cycle, from greenfield prospecting and due diligence to operational forecasting and plant optimization. Its customers include utility-scale energy players who require weather expertise to develop and operate efficient, reliable, and profitable projects around the globe using a wide range of measurement, assessment, forecasting, and asset management products and services.

[www.vaisala.com/energy](http://www.vaisala.com/energy)





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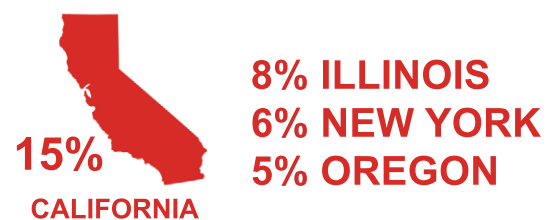


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# Storage Investments

## Paying off & paying back

by Michael Mo

As more renewable and sustainable energy capture facilities come on line, the need for energy storage solutions multiplies. Not surprisingly, according to a recent report by GTM research and the Energy Storage Association, the US Energy Storage Monitor, the energy storage market is undergoing explosive growth.

In the newest report, 233.7 megawatts per hour (MWh) of storage were deployed in the first quarter of the year, in the United States alone. That capacity was, according to the report, up from just 22.4 MWh deployed the first quarter of the previous year - an astounding 944 percent increase.

And, in keeping pace with the explosive growth of renewable energy adoption, the GTM report predicted that the energy storage market will grow more than 100-fold in the next eight years. In fact, Matt Roberts, the Executive Director has said that, a "...confluence of forces is putting us on a path to deploy more than 35 GW of energy storage by 2025."

The predicted expansion of energy storage has one easily anticipated outcome: energy storage is, and will continue to be, a major marketplace on its own. It's expected to jump past \$3 billion in annual revenue over the next decade.

An equally significant, though less expected outcome, is that the growth in the storage market will incentivize innovations. This will result in improved efficiency throughout the production chain, making renewable energy more cost effective, and profitable.

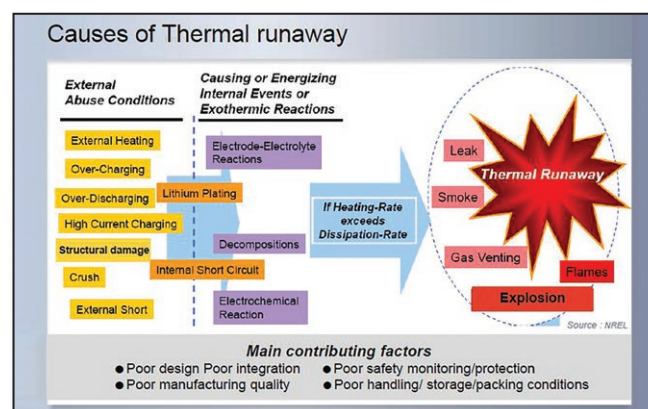
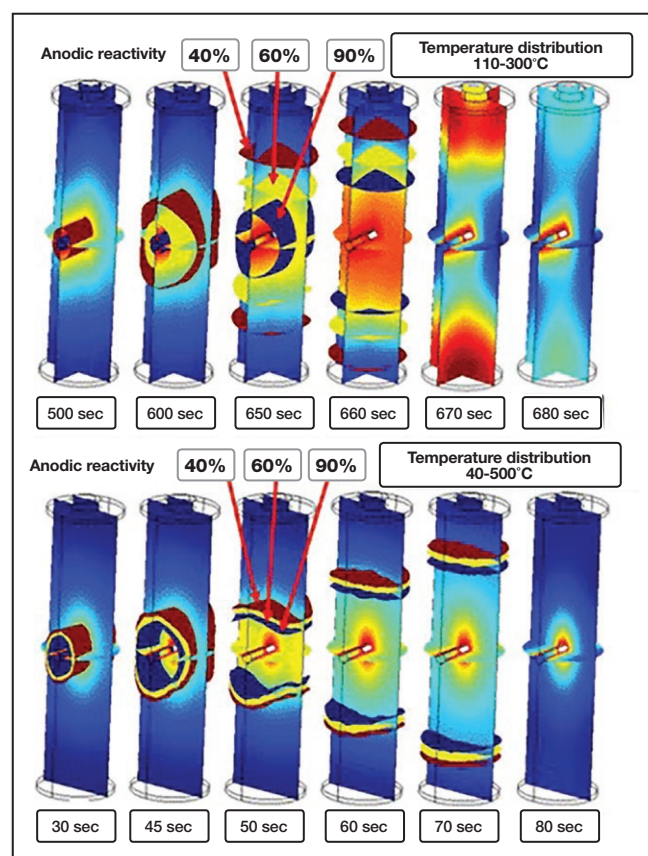
What's driving this growth? Lithium-ion batteries. They remain the core technology behind energy storage. According to the GTM report, "Lithium-ion batteries dominated the energy storage market for the tenth straight quarter, holding 96.5 percent of the market in Q1 2017. The majority of utility-scale projects deployed in Q1 2017 employed lithium-ion chemistry, and the technology is also favored in the behind-the-meter segment. Growing acceptance of lithium-ion is expected

to cause this trend to continue over the next few years."

Although some of the brightest young minds are toying with various replacements to lithium-ion batteries, these concepts have not made it far from the drawing board. Few are betting that a new discovery will displace 97 percent of the storage market any time soon. It's important to address the current issues presented by lithium-ion solutions - specifically heat generation, which remains a challenging drain on efficiency.

Unlike lithium-ion batteries used in other applications, such as electric vehicles or consumer electronics, the weight of the storage solution isn't a factor. This means that energy storage batteries are free to use active cooling solutions like water pumps and cooling fans. While those solutions reduce heat, they also need energy to operate, which, in turn, cuts into overall efficiency. In fact, in order to keep within safe heat levels, some active battery cooling solutions reduce the overall energy capacity by up to 15 percent.

Adding in estimated transmission losses of between 8 and 15 percent, power generators with inefficient active cooling systems in their storage facilities can lose up to 30 percent of their energy before it ever reaches the consumer.





## Integrated behind-the-meter energy storage system

Dynapower introduces the BTM-250; a 250kW energy storage system optimized for behind-the-meter energy storage applications where reliability and footprint matter, including demand response/demand charge reduction and backup power. The BTM-250 is a fully integrated energy storage solution coupling Dynapower's smart inverter with Samsung E2 batteries.

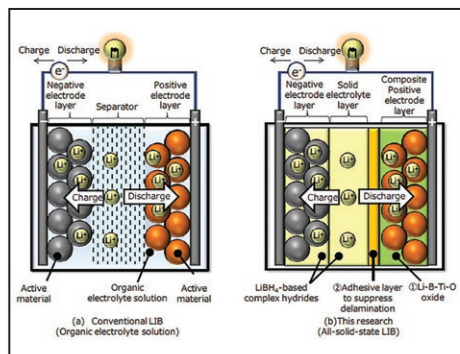
**Dynapower** | [www.dynapower.com](http://www.dynapower.com)



## Cost effective hybrid battery backup systems

SunWize provides industrial customers with reliable and cost effective power solutions. One of the most significant opportunities SunWize sees is the need for reliable battery backup systems for hybrid power sources, which can include fuel cells, traditional generators, thermo-electric generators (TEGs), grid power, solar, wind, and other energy input sources. In most cases, more than one power input type is used simultaneously along with a battery backup system. Key features of this system include: versatile and robust enclosure solutions, expansive input and output distribution block allows for up to 16 I/O controls, and flexible DC and AC energy input options.

**SunWize** | [www.sunwizepower.com](http://www.sunwizepower.com)



That's brutal.

The good news? Continued investment in passive cooling systems initially pioneered for batteries used in space exploration (where weight and efficiency are major factors) are ready to replace the less efficient, active cooling systems currently used industry-wide.

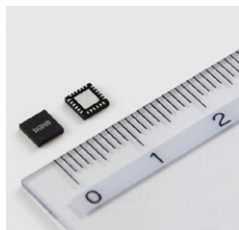
NASA has helped develop carbon-fiber cooling systems, which are proving both effective and efficient in thermal management of lithium-ion batteries: in many applications, they have outpaced traditional metal and liquid cooling systems. More importantly, because they are entirely passive, these systems bleed zero storage capacity from the battery.

Just imagine the impact of all energy storage becoming 15 percent more efficient. That means moving 15 percent more energy from production to consumer, with no increase in production. This isn't theory – it's the reality of what these new, passive carbon fiber solutions can achieve.

Strong growth and investment in renewables has increased the storage market to a level where investment in innovation can be successful. As those innovations are adopted, they can help make the renewable market bigger, stronger, and more dynamic. And since renewable energy growth has driven the explosive growth in the storage market, think of it as simply returning the favor.

*Michael Mo is the CEO of KULR Technology, which specializes in the thermal management industry through its pioneering use of carbon fiber.*

**KULR Technology** | [www.kulrtechnology.com](http://www.kulrtechnology.com)



## Power supply IC featuring high step-down ratio

ROHM has recently announced the availability of a DC/DC converter with built-in MOSFET which achieves the high step-down ratio (at 2MHz) required for 48V automotive systems such as mild hybrid vehicles. The BD9V100MUF-C integrates ultra-high-speed pulse control technology (Nano Pulse Control) created by combining proprietary circuit design and layout with original processes, enabling low voltage 2.5V output from 60V (max.) input at 2MHz (resulting in a step-down ratio of 24:1). This makes it possible to miniaturize peripheral components while at the same time configure voltage conversion from high to low voltages using a single IC, contributing to greater miniaturization and simple system design.

**ROHM Semiconductor** | [www.rohm.com](http://www.rohm.com)



## Inverter-integrated EV charger

SolarEdge's HD-Wave inverter integrated EV charger offers users the ability to charge electric vehicles up to 6X faster than a standard Level 1 charger. This charger offers an innovative Solar Boost Mode that utilizes grid and PV charging simultaneously. By installing the SolarEdge HD-Wave inverter-integrated EV charger, users benefit from the reduced hassle of installing a separate standalone EV charger and a PV inverter. Furthermore, the need for additional wiring, conduit and a breaker installation is eliminated. An additional dedicated circuit breaker is not needed, saving space and eliminating a potential main distribution panel upgrade.

**SolarEdge** | [www.solaredge.com](http://www.solaredge.com)



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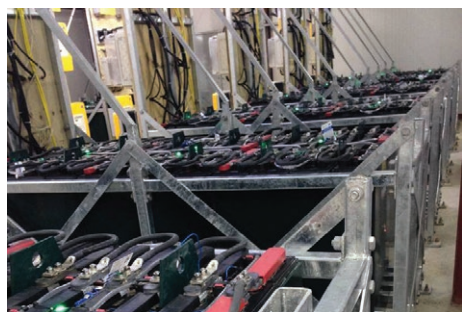
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# Find the Battery You Need

by John Connell



## BATTERIES ARE THE BACKBONE OF RENEWABLE ENERGY

(RE) systems, enduring constant charging and discharging (deep cycling) for years. There is no perfect, one-size-fits-all battery for RE.

But there is a best battery technology for your system -- and in this article, you'll learn exactly how to find it.

### First, a Crash Course in Battery Technologies

**Lead-acid batteries** are the most-used RE storage batteries. They offer high reliability, easy installation, and medium power density -- at a per-kWh cost 50-90 percent lower than other technologies.

Lead-acid batteries have been tested in laboratories and in the field for more than 100 years. Like the RE systems and cars they power, modern lead-acid batteries bear little resemblance to early models, with top manufacturers using robotic assembly, automation, and microscopically-optimized active material.

Two types of lead-acid batteries are most common: flooded, and absorbent glass mat (AGM). Flooded batteries are long lasting, affordable, easy to maintain, and reliable. They require ventilation for safe operation. AGM batteries, originally designed for the military to improve aircraft reliability, offer additional advantages: no maintenance; charging up to five times faster than flooded batteries; and higher current delivery. In many systems, AGM batteries save more than enough time and money on maintenance to offset increased manufacturing costs and slightly reduced capacity. (See "How to Select the Right AGM Battery" from July/August 2015.)

**Lithium-ion batteries** have the highest power density and lowest weight, but at a cost - up to 10 times as much as lead-acid batteries per kWh. Like some lead-acid batteries, they do not require regular maintenance. Li-ion batteries have a shorter lifespan than lead-acid batteries and have been available in large format since 2007.

Li-ion's high power density comes at the increased potential for thermal runaway and fires. For safety, li-ion systems require purchase of a separate battery management system (BMS). A BMS helps protect against cell damage, and reduces the risk of overheating, which can cause explosions and house fires. Check whether firefighters in your area have special training for lithium-ion fires; water can explode li-ion batteries, and batteries can reignite more than 24 hours after being "extinguished."

**Sodium batteries** have the lowest power density and surge capacity -- so you'll need more of them. They're often rated at 2.6kW, just 48Ah per stack (20-hour basis), instead of the standard rating. Sodium batteries cost 3 times as much as sealed lead-acid for the same capacity. They also have the largest footprint, and are more than twice as heavy as lead-acid per kWh. (Lead-acid, in turn, is heavier than li-ion.)

Sodium is new to RE energy storage. R&D for consumer products began in 2008, and the first commercial product was released just three years ago. Unlike other technologies, sodium batteries are slow to charge and discharge -- manufacturers recommend at least 12 hours of sunlight per day. There are no published safety standards or best practice guidelines.

### Recyclability

Lead-acid batteries are 99 percent recyclable -- more recyclable than an aluminum can. According to the U.S. EPA, they're also the most recycled product (>99 percent) in North America, with old lead-acid batteries recycled into new ones. (See "Will It Recycle?" from May/June 2016.)

Lithium-ion batteries are between 0 to 60 percent recyclable. They cannot be recycled into new batteries; all li-ion batteries use virgin-mined materials.

According to the U.S. Geological Survey, four out of five lithium-ion batteries are landfilled at end of life.

Sodium batteries have no historical recycling data, and no national recycling system. Only their cases are recyclable.



### The Truth about Depth of Discharge (DoD)

Manufacturers recommend DoD based on how low a battery can be drained without shortening its lifespan.

As an example, an 80 percent DoD rating for a sodium battery means that it can be drained until only 20 percent of its electricity remains.

For RE users, 80 percent DoD is the equivalent of traveling across the desert with your gas light on... when there's no gas station in sight. You can run on fumes, but for how long?

Every RE system needs a safety margin for stable voltage -- for high-wattage appliances, large loads, and days when low solar or wind production require extra battery power.

No matter which battery technology you select, comparison shop based on 50 percent DoD, and install extra battery capacity to ensure this safety margin.

### Keep the lights on (surge capacity)

Surge capacity is a battery's ability to handle short-term overload -- this is critical if you want to run high-draw loads such as refrigerators, microwaves, A/C, and other devices



### Ruggedized lithium ion battery for material handling

Valence announces its safe Lithium Iron Magnesium Phosphate chemistry platform in 24 volts in its new 24XP series. The 24XP series modules are designed for forklift and AGV/AGC applications with their inherent reliability, long cycle life, and zero maintenance. Specific materials and elements were chosen to meet the demanding environment of material handling including LiFeMgPO<sub>4</sub> chemistry for its safety profile, anti-loosening terminal threads designed for high vibration environments, internal cell frame for durability, maintenance-free for ease of use, built-in electronic monitoring for protection of investment, full service and support in US and Europe for peace of mind, and UL2580 (pending). The 24V battery is now available in both Group 24 and 27 sizes. The second battery module released in the 24XP series, the new U-Charge U24-24XP will be implemented into applications such as automated guided vehicles, forklifts, and robots. This 24V, 56Ah battery is a drop-in replacement for Group 24 lead acid batteries. In addition to all the 24XP benefits, it fully integrates with the Valence U-Charge Battery Management System (BMS) and can be put in series or parallel to create the right voltage and capacity for the application.

**Valence** | [www.valence.com](http://www.valence.com)



### Solar and whole-home energy monitoring

eGauge Systems, a manufacturer of energy monitoring systems, announced the development of eGauge Lite, a meter specifically designed for the residential solar market. This new meter provides homeowners with the energy status of their entire home, including grid and solar generation. The eGauge Lite is free of any ongoing fees, sports a lifetime data logger, and uses edge computing to process data before it reaches the cloud. eGauge Lite is packaged with all accessories needed to quickly connect and measure whole-home energy usage and solar production. The new meter also includes an intuitive graphical user interface to view real-time or historical energy measurements. Access to this information gives users the opportunity to optimize their energy performance and reduce utility costs.

**eGauge Systems LLC** | [www.egauge.net](http://www.egauge.net)



### New wide-web coating system

Babcock & Wilcox MEGTEC (B&W MEGTEC), a subsidiary of Babcock & Wilcox Enterprises, Inc., has launched the GigaCoater wide-web coating line for lithium-ion battery electrodes. Developed to provide high-volume production of battery electrodes, each GigaCoater can produce up to 3GWhr of electrode per year on average. The GigaCoater coating platform utilizes B&W MEGTEC's exclusive simultaneous 2-sided coating system. The dual-coating method, in combination with coating rheology and GigaCoater machine properties, maximizes production time and delivers in-line quality control. The GigaCoater maximizes manufacturing at a significantly lower total production cost with 50% to 70% less floor space than typical single-side coating operations, which allows for more efficient plant layouts, thermal efficiencies which deliver lower energy requirements, a wide-web width which significantly reduces the number of coils needing to be handled, simplified material flow enhancing overall throughput and higher automation which maximizes production volume.

**Babcock & Wilcox MEGTEC** | [www.babcock.com](http://www.babcock.com)



### Rapid EV charging station

Ingeteam's INGEREV RAPID 50 is the company's latest multi-standard rapid charge model for the INGEREV electric vehicle product range. INGEREV RAPID 50 is compatible with the CHAdeMO, CCS, and Type 2 AC standards, making it a solution for charging all types of electric vehicles. It is available in three different models (Trio, Duo, and One), depending on the charging standard required. The INGEREV RAPID 50 offers the possibility of simultaneous AC and DC charging. The INGEREV RAPID 50 features advanced local and remote communication capabilities via Ethernet, 3G, and Wi-Fi for integration in local and/or remote control centers, payment platforms, and charge managers using different versions of the OCCP protocol (customized or standard). Its 7" TFT color touch screen improves the user interface and also offers an advertising option. The charger design combines ease of use with maintenance simplicity. Its sturdy steel enclosure guarantees exceptional resistance in even the most adverse ambient conditions. The Trio model is compatible with all three existing charging standards, CHAdeMO, CCS, and AC, the Duo model includes CHAdeMO and CCS, while the One model only includes CCS.

**Ingeteam** | [www.ingetteam.com](http://www.ingetteam.com)



### Integrated hybrid storage solution for residential and small commercial

Darfon's H200 hybrid energy storage system integrates Lithium batteries (LFP), a hybrid inverter, and BMS into a rack enclosure. Just roll it in, install the batteries, connect the wires, and then drive away. The H200 is a DC coupled system designed to provide PV supported backup and arbitrage, and is available with 10, 15, or 20kWh battery options. Critical loads are supported up to 5kW continuously and 7.5kW for 1 second. The integrated hybrid inverter handles up to 6.5kW PV with two MPPTs, and back-feeds to the grid up to 5kW.

**Darfon Solar** | [www.darfonsolar.com](http://www.darfonsolar.com)

that can require 2 to 7 times more power during startup.

Each battery technology has a different surge capacity:

- Lead-acid has the highest surge capacity.
- Li-ion has a much lower surge capacity of ~280Ah. (For reference, air-conditioning requires 1,200Ah surge capacity.) To achieve higher surge capacity, users must add batteries or load-shed (cut power to appliances)
- Sodium has the lowest surge capacity (102A). This means ~5 minutes of output at 1kW, so loads must be limited.

Be sure your manufacturer offers their surge capacity specifications in writing. Check on whether or not the manufacturer has had recent recalls; this could indicate poor design, corner-cutting, or financial trouble that could leave you high and dry. Select the right batteries for your system, and you'll get excellent performance for many years to come.

*John Connell is the Vice President of Crown Battery's SLI Products Group. Crown Battery manufactures all its 99%-recyclable lead-acid batteries at its ISO-9001:2008-certified plant in Fremont, Ohio.*

**Crown Battery** | [www.crownbattery.com](http://www.crownbattery.com)





# Sheep's Wool Insulation

A natural, non-toxic, high-performance building material

by Andrew Legge

Insulation in the built environment has been undervalued for too long. Fortunately, that's changing. Indoor air quality is becoming a priority for a vastly expanding segment of the consumer base; with this growing focus on healthier spaces, more building and construction professionals are opting to incorporate sustainable, "high performance" materials into their projects.

## A (very) brief history of wool

Wool has been insulating sheep (and humans) for thousands of years, protecting them from the elements – from hot to cold, wet to dry. This highly dynamic fiber has continued to evolve over centuries, becoming widely popular for use in clothing and textiles. However, in the 1940s, as the focus in the garment industry shifted to war preparedness and building the economy, it began to be replaced by synthetic fibers. Since profit margins on synthetic fibers exceeded those of wool, the demand for wool began to fall away. So too did its cultivation and, ultimately, usage.

As the interest in wool declined over the years, people began to consider alternative uses of this versatile and adaptable fiber. One such use was insulation for commercial and residential buildings – a logical transition for "nature's insulator".

## "Green" by design

Sheep's wool insulation takes a biophilic approach to design and construction, resulting in a building material that is at once sustainable, renewable, and energy efficient. Today's wool insulation is often repurposed from sheep's wool that has been discarded by the textile industry, after being deemed too coarse for use in garments. The sheep who provide the wool, such as those who roam the hillsides of New Zealand, have a very light carbon footprint (much smaller than that of dairy cows) and are able to graze marginal land, eating only the grass that grows due to rainfall. Moreover, wool insulation typically maintains its thermal and acoustic insulation performance for the lifespan of a structure. When it has exceeded its useful life, it can be recycled or composted to biodegrade.

As an insulator, wool outperforms other mediums (with the exception of foam) from a thermal conductivity perspective. In addition, its inherent ability to absorb and desorb moisture against 65 percent relative humidity helps to ensure resistance to degradation over time. Furthermore, because it is a dense fiber that seeks to expand rather than contract, it won't settle. Remarkably, the amino acids in wool irreversibly bond with formaldehyde, nitrogen oxide and sulphur dioxide – preventing these chemicals from off gassing and escaping into the air.

On the production side, wool insulation can be made using repurposed carding machines (which have largely been collecting dust after what was once a thriving U.S. industry moved offshore). Additionally, wool's integrity as a fiber eliminates the need for glues, bonding agents, or high heat during the production process, resulting in a very low net embodied energy.

## Pulling the wool away from our eyes

Until recently, wool insulation had often been overlooked by consumers seeking a cheaper, manmade insulation option or – in many cases – by consumers unaware that a natural high-performance option existed. Unfortunately, the insulation materials that have dominated the U.S. market for the last several decades are potentially toxic, underperforming, and, too often, both.

While still widely used, fiberglass is a low integrity, synthetic fiber that is adversely affected by moisture, and subject to rot and mold – creating the potential for compromised indoor air quality and associated health issues. Cellulose insulation, made from recycled newspaper, sounds intriguing, but one might intuitively ask, "Is newspaper really a good insulator?" Cotton, or recycled denim, has a nice ring to it, but – again – is cotton an effective insulator? And what happens when it gets wet? While foam insulation has become a trending topic of late, it has a significant carbon footprint, generates excessive waste, has questionable efficacy over time, and "sticks around" long after its useful life. Mineral wool insulation is an interesting option, but it is also manmade, resulting in an embodied energy that is exponentially higher than that of natural wool insulation.

A common misconception about wool insulation is that it is not worth the additional upfront cost. Yet, it typically adds no more than half a percent to the overall construction budget. When you consider wool's extraordinary benefits – it excels at managing moisture, offers passive filtration, is sustainable, renewable, and durable – it's clearly a smart choice and good investment, not only for building occupants but for the planet as well.





## Wallet-sized energy efficient power bank

PRSRV (pronounced preserve) is an innovative, energy efficient power bank designed to preserve and extend the average device's battery life. PRSRV is the first power bank that can be used in two different locations simultaneously as it includes a charging station as well as a removable battery which functions as a charger on the run. This credit card sized battery is designed to fit discretely in a wallet to provide consumers a portable, wire-free, sleek power bank. PRSRV's economic design protects mobile's battery life and prevents overcharging by automatically cutting off electricity to the mobile once it is fully powered. Surplus power is then directed to charge the back up power bank, reducing energy consumption and efficiently charging first your mobile and then PRSRV. PRSRV's unique, patent pending design is compatible with both Apple and Android devices.

**PRSRV** | [www.innovation-101.com](http://www.innovation-101.com)



## A natural progression

As the demand for whole foods, organic products, and natural materials in general continues to build momentum, more consumers and building professionals are taking a second look at an insulator that nature has provided and perfected over thousands of years. Simply put, wool insulation harnesses the power of nature to improve performance within our everyday living/working spaces, while minimally impacting the environment. What's not to like about that?



*Andrew Legge is founder and managing partner of Havelock Wool, based in Reno, Nevada. Havelock Wool was established to address the increased consumer demand from people and companies seeking a healthier lifestyle and environment. Havelock is committed to improving best practices in sustainable, human-friendly insulation.*

**Havelock Wool** | [www.havelockwool.com](http://www.havelockwool.com)



## UL-listed snap-in mounting accessory

Legrand, North America announced that its Wattstopper High Bay Passive Infrared (PIR) occupancy sensors feature the first ever Underwriters Laboratory (UL) listed snap-in mounting accessory. The snap-in design, now standard on all HBP-100 Series installation products as well as the extender modules, allows for quicker and safer installation. These sensors help facility managers avoid down time and help contractors meet project deadlines while maintaining safety standards. The HBP-100 Series provide automatic control of individual LED and fluorescent lighting fixtures in warehouses, distribution centers, parking garages, and other indoor and low bay spaces. The HBP-100 series sensors passed one of the most significant tests for this type of product design called the UL Conduit Nipple Strength Test for Non-Metallic Enclosures, which requires products to withstand a 5 ft/lb impact without cracking the enclosure or separating the sensor from the fixture. Products with this UL rating ensure reliability and safety of people and property, reducing the likelihood of injury from electrical shock or fire and damage to fixtures or electrical box-mounted controls.

**Legrand, North America** | [www.legrand.us](http://www.legrand.us)



## New LTE tracker platform

Rexroth's energy-efficient axial piston variable pumps reduce diesel consumption in fork lift trucks - power class up to 3 tons load capacity. With size 28 in the A1VO axial piston pump series, Rexroth offers an even finer gradation for application oriented, easy to install solutions. The variable pumps supply different functions of the working hydraulics, such as lifting and lowering, or the steering. The new variant increases the scalability of the A1VO series, which Rexroth already offers in sizes 18 and 35. Despite the cube number of 28 ccm, the new size shares the same compact housing as the existing size 18. It can therefore be compactly installed in tight spaces. The connections, which can be positioned laterally or to the rear, are easily accessible. At a nominal pressure of 250 bar and a maximum pressure of 280 bar, the A1VO size 28 provides a high power density in a compact installation space and achieves an efficiency of nearly 90%. The high permissible self-priming speeds further complement this power comparison. Adjusting the cradle decouples the speed of the diesel engine from the pump power and produces the flow, according to the actual need. The speed in continuous operation and at maximum swivel angle has been set to 3,200 rpm, as a result, the A1VO size 28 covers a wide performance range.

**Sequans Communications** | [www.sequans.com](http://www.sequans.com)

**STMicroelectronics** | [www.st.com](http://www.st.com)



## Light towers for a bright, safe, and productive site

Atlas Copco has expanded its range of HiLight towers to seven models, including four advanced LED solutions. The comprehensive HiLight range gives users a variety of choices when it comes to sourcing safe and efficient light towers for multiple applications and industries, including construction, outdoor events, and industrial applications. The HiLight range includes the H5+, B5+, V5+ and E3+ LED light towers, plus the V4, H4 and E2 metal halide variants. Atlas Copco's latest LED light towers feature a unique, fully directional optic lens that maximizes practical light coverage while minimizing dark spots. A single HiLight LED light tower, depending on the model, can illuminate large areas with an average brightness of 20 lux. They also can run as long as 260 hours before needing to be refueled and consume less than 0.25 gallons of fuel per hour. Atlas Copco achieved this operational savings by designing the LED HiLight towers with dedicated power packs that optimize power output. The power packs also minimize the risk of under-loading the engine, which enhances efficiency and improves power pack longevity. The LED lamps are designed for portability and performance with heavy-duty floodlights that offer high ingress protection (IP) and impact protection (IK) ratings. The LED lamps also offer extreme durability without deterioration in lux level while providing instant light. The HiLights' LED bulbs withstand rugged construction sites, minimizing the need for replacements. The bulbs also require minimal fuel, which reduces CO2 emissions by 70% on each model.

**Atlas Copco** | [www.atlascopco.us](http://www.atlascopco.us)



## 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.

**IntelliEnergy** | [www.smallspacelighting.com](http://www.smallspacelighting.com)

# Tax Equity with Tax Rate Uncertainty

by Erik Hellman and Eric Seale



## MANY PARTICIPANTS IN RENEWABLE ENERGY FINANCE

anticipate Congress to pass federal tax legislation by the end of 2018. While generally attractive for economic growth, a reduction in the corporate tax rate—a likely component of the legislation—creates an uncertain environment for renewable energy investments. A number of large corporate investors with tax appetite, known as “tax equity,” have consistently reduced the cost of project development by monetizing tax benefits that developers (“cash equity”) are unable to initially utilize. By passing on some of this benefit to the cash equity, and by receiving some pre-tax cash from operations, tax equity can provide a project with much more favorable financing than traditional borrowing.

The tax equity market commonly uses three financial structures: prepayment lease, partnership flip, and inverted lease. Each of these structures provides a mechanism for the tax equity to receive the investment tax credit (ITC), or production tax credits (PTC), that are available for new renewable energy installations through the Consolidated Appropriations Act of 2016. In addition to tax credits, renewable projects also qualify for accelerated depreciation. Together, these allow the tax equity to reduce the tax liability it has incurred from its other activities. Cash equity often does not have the capacity to use the credits, or depreciation deductions. By using one of the three financing structures, the tax equity and cash equity can share the tax benefits efficiently.

In a **prepayment lease**, the tax equity is a lessor that buys the entire project from the developer, and then leases it to the cash equity (often the same entity) in exchange for rent. The cash equity pays some of the rent upfront using proceeds from the sale. This helps to reduce future rentals, ensuring that revenue from operations is sufficient to pay them. A prepayment lease efficiently passes all tax benefits to the tax equity, but leaves the cash equity without ownership of the asset. Reacquisition of the project during the term of the lease can be expensive.

In a **partnership flip** structure, the tax equity purchases a portion of the project. The cash equity owns the other portion of the project, and the two partners disproportionately share cash and taxable income from operations. When the tax equity achieves a required internal rate of return (IRR), the sharing percentages



“flip”, and a significant majority of the cash and taxable income is provided to the cash equity. The tax equity is not able to use all the tax benefits in a partnership flip structure, but the cash equity retains a controlling interest in the asset.

An **inverted lease** (also called a “lease pass-through”) is a unique structure where the tax equity acts as the lessee rather than the lessor. The cash equity fully owns the asset, and the tax equity pays rent to the cash equity while directly receiving the revenue from underlying production. As lessor, the cash equity transfers the ITC to the lessee, so the tax equity benefits from both the credit, and the revenue it keeps after paying rents. For its part, the tax equity makes a significant prepayment of rent upfront. The tax equity never owns the asset in an inverted lease, so it gets none of the accelerated depreciation, but the cash equity retains an undivided, and controlling interest in the project.

As tax equity contemplates a large investment in a renewable energy project, one of its most important criteria is its ability to achieve an expected IRR. Much of the return on the investment is in the form of tax benefits, so there is considerable risk in predicting future tax rates. This risk has two components: the direct reduction of tax benefits associated with depreciation, and the loss of tax appetite for credits because taxes have decreased.

Under all financing structures, a drop in tax rates directly affects the economics of the investment. It is common for tax equity to request an indemnification in the original documents, when it is concerned about future tax rates. An indemnification could require the cash equity to make a restitution payment to the tax equity, to offset the impact of a lower tax rate. A concern of such clauses is that the IRS could construe them as providing an unreasonable amount of risk mitigation. In those circumstances, the structure could be considered invalid, and lose its beneficial tax status.

If the tax equity anticipates a loss of tax appetite over time, the reliance on PTCs will come under increased scrutiny. Tax credits, in years with a small tax bill, will be all but useless to the tax equity. This may lead it to elect ITC rather than PTCs in wind power deals, just to avoid the uncertainty in future years; or tax equity may show more interest in solar transactions because of the comparably beneficial amount of ITC.



Yet another potential impact of tax rate uncertainty is the deterrence of new tax equity entrants into the market. Credit approvals are difficult enough internally without also having wavering confidence in the future of the tax system. Companies with plans to invest in renewables could wait until there is more certainty in the market, or they may instead direct their attention to other investments with less tax rate exposure.

Tax rate uncertainty may curb some enthusiasm in the tax equity market for renewable energy finance. It may deter new participants contemplating entry into the market, and it may change the types of tax credits that tax equity is willing to receive. Negotiations may also become more difficult as tax equity looks for ways to help reduce their economic downside. Despite the potential negative impact of a reduction in tax rates, we do not expect a significant change in the level of activity in the market, until the scope of the legislative changes become clearer.



*Erik Hellman and Eric Seale are Senior Vice-Presidents at Warren & Selbert Inc., which offers the ABC software for pricing tax equity financial structures.*

**Warren & Selbert Inc.**  
www.warren-selbert.com

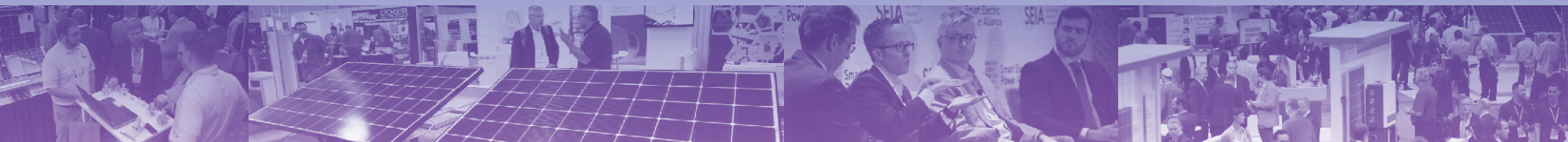


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Earlier this year the Massachusetts Department of Energy Resources (DOER) introduced its Solar Massachusetts Renewable Target (SMART) program, which expands savings and increases jobs in the second largest solar workforce in the country. New York adopted Reforming the Energy Vision (NY REV), and other states like New Jersey and Connecticut are stars in the region for total installations.

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NOVEMBER

- 06-08 **Microgrid 2017 Conference & Exhibition**  
Boston Park Plaza – Boston, MA; www.energystorage.org
- 07-09 **AWEA Wind Energy Fall Symposium**  
Albuquerque, NM; www.awea.org
- 14-15 **Energy Storage STUDIO**  
The Westin – Cleveland, OH; http://studio.energystorage-events.org
- 29-30 **Solar Business Festival 2017**  
Hilton Downtown Hotel – Austin, TX; www.sbf-texas.com

DECEMBER

- 04-05 **Solar Canada**  
Metro Toronto Convention Centre – Toronto, ON; www.solarcanadaconference.ca
- 11-12 **Solar Power New York**  
New York Marriott at the Brooklyn Bridge – New York, NY; www.events.solar/newyork

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/
- 27-28 **AWEA Wind Project O&M and Safety Conference 2018**  
San Diego, CA; www.awea.org

MARCH

- 07-08 **SEIA's Inaugural Codes & Standards Symposium**  
Santa Barbara, CA; www.seia.org/codes
- 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
- 20-21 **CxEnergy 2018 Conference & Expo**  
Rio All Suites Hotel and Casino – Las Vegas, NV; www.cxenergy.com

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Email information to the editor at [editor@nacleanenergy.com](mailto:editor@nacleanenergy.com)

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23	Solar Connections International	solarconnections.com
65	Solar Power Northeast	events.solar/northeast
19	SolarRoofHook	www.solarroofhook.com
3	Soltec	soltec.com
46	Stahlwille Tools	www.stahlwille.de
43	Team-1 Academy	www.team1academy.com
11	Thomas & Betts	tnb.com
50	Transportation Partners and Logistics LLC	tpandl.com

**Statement of Ownership, Management, and Circulation** (Requestor Publications Only)

- Publication Title: North American Clean Energy
- Publication Number: 0000-1370
- Filing Date: 10/23/2017
- Issue Frequency: 6 times per year (bi-monthly)
- Number of Issues Published Annually: 6
- Annual Subscription Price:
- Complete Mailing Address of Known Office of Publication: PO Box 1 Henry IL 61537  
Telephone: 1-309-356-5144 Contact Person: Ian Stuart
- Complete Mailing Address of Headquarters or General Business Office of Publisher: 515 University Ave., Suite 1, PO Box 1, Henry, IL 61537
- Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor:  
Publisher, Editor and Managing Editor: Ian Stuart, PO Box 1 Henry IL 61537  
Editor (Name and complete mailing address): Ian Stuart, PO Box 1 Henry IL 61537  
Managing Editor (Name and complete mailing address): Ian Stuart, PO Box 1 Henry IL 61537
- Owner (Name and complete mailing address): Ian Stuart, PO Box 1 Henry IL 61537
- Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities: None
- Tax Status: Has Not Changed During Preceding 12 Months
- Publication Title: North American Clean Energy
- Issue Date for Circulation Data Below: Sept/Oct 2017 thru Nov/Dec 2016

15.	Average No. of Copies Each Issue During Preceding 12 Months	No. Copies Single Issue Published Nearest Filing Date
a. Total Number of Copies (Net press run):	32,727	34,365
c. Total Paid and/or Requested Circulation:	17,778	17,798
d. Non-requested Distribution:	14,528	15,143
e. Total Non-requested Distribution:	14,528	15,143
f. Total Distribution:	32,306	32,941
g. Copies not Distributed:	422	1,424
h. Total:	32,728	34,365
i. Percent Paid and/or Requested Circulation:	55.03%	54.03%
16 a. Requested and Paid Electronic Copies	21,077	22,779
16 b. Total Requested and Paid Print Copies + Electronic Copies	38,855	40,577
16 c. Total Requested Copy Distribution + Requested/Paid Electronic Copies	53,383	55,720
16 d. Percent Paid and/or Requested Circulation (Both Print and Electronic Copies)	72.78%	72.82%

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