

# North American **Clean Energy**

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## **2014 SOLAR Buyers Guide**

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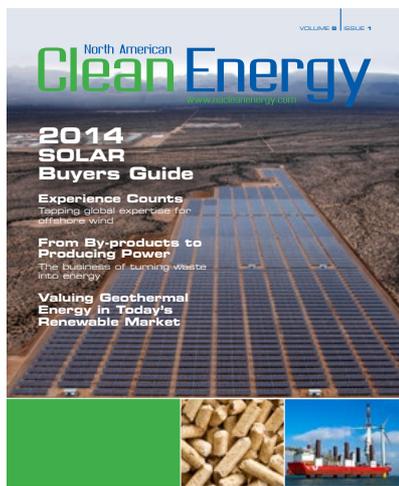


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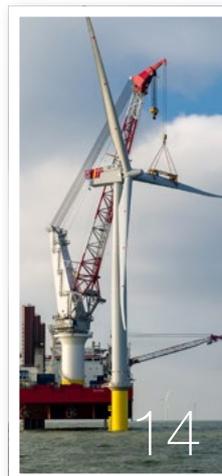
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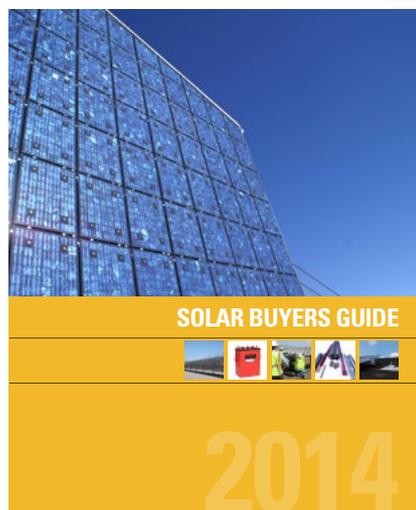
**On our cover...**

Duke Energy Renewables' (www.duke-energy.com) 10 MW Black Mountain Solar Project in Arizona, purchased from SOLON Corporation in May 2012. The solar array is equipped with 42,000 PV modules, which help to produce enough electricity to power around 1,900 homes every year.

Photo courtesy of SOLON Corporation (www.solon.com)

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Photo by Michelle Moore



**IT'S SOMETHING MOST OF US**, in North America at least, take for granted most days—and that's water. As many of us are struggling to ensure we get our eight glasses a day, many others don't even have access to a single, clean or safe cup of water. The statistics are quite startling actually: 768 million people still use unsafe drinking water sources, and 2.5 billion people worldwide lack improved sanitation facilities (based on numbers from the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, released in 2013).

It's estimated that every 20 seconds or so, a child dies as a result of poor sanitation. That's 1.5 million preventable deaths each year. According to the United Nations Development Programme, the water crisis claims more lives through disease than any war claims through guns.

Globally, diarrhoea is the leading cause of illness and death, and most of those deaths are directly related to a lack of access to clean drinking water and sanitation facilities ([www.unwater.org](http://www.unwater.org)). Although the majority of illness and death occur in developing countries (check out [www.water.org](http://www.water.org) for an interactive map with the estimated numbers per country), the United States isn't immune to the global water crisis—as shocking as that might sound as one of the wealthiest nations in the world. An increasing number of Americans are either homeless, or living in their homes without any electricity or water.

The Navajo people present one such example. A federally recognized, semi-autonomous Indian nation, the Navajo people live on the largest reservation in the US, which covers over three states in the Four Corners area of the southwest—yet, nearly half live in poverty. As per our top story (see page 08), “they light their homes with a single kerosene lamp that emits toxic gasses, and live every day without indoor plumbing, running water, or electricity.”

However, the Navajo reservation also presents an example of where renewable energy is now making a difference. Everyone might not have access to clean water or electricity, but we've all experienced sunlight. And, the Navajo nation is nothing if not abundant with sunshine. The creation of Plateau Solar Project has tapped into the power of the sun, transforming the living conditions of many of the elders, to ensure they have access to basic electricity, heat, and clean running water.

Another project in Australia is also relying on renewable energy to make a difference; only this time wind power is at play. By using wind turbines to convert saltwater to fresh water (instead of just for electrical use), a wind farm in Perth routinely generates as much as 40 million gallons of drinking water each day. Combining wind turbines with water desalination plants is an especially promising technology being presented to undeveloped countries, especially in Africa where water shortages are common (read more on page 22).

The United Nations suggests that each person needs 20 to 50 liters of water a day to ensure their basic needs for drinking, cooking, and cleaning. For many in this country, a simple 10-minute shower uses up to about 30 gallons of water (that's over 100 liters!). Utilizing renewable resources seems like an obvious solution for water-scarce regions across the globe and locally.

This issue, we bring you information on many of the products and technologies that could help make such a difference. Don't miss our annual Solar Buyers Guide (page 31), as well as the promise of offshore wind power (page 14) and the waste-to-energy solutions biopower can offer (starting on page 72).

We hope you enjoy the read, and take a moment as 2014 begins to be grateful for all you do have and might take for granted.

*Michelle Froese*



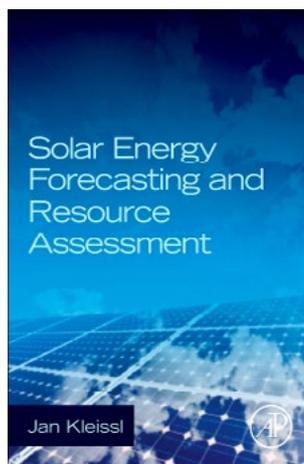
## Charge and change

Schneider Electric recently announced its Charge the World Change the World initiative, a philanthropic program created to give EV drivers an opportunity to have a meaningful impact on global sustainability when purchasing an EV charger. For every EVlink home charging station sold in North America, Schneider Electric will donate a solar-powered, battery-operated LED lamp to a family without access to electricity.

EVlink is a complete electric vehicle charging solution that delivers flexible, safe, reliable, and compatible charging of electric vehicles. Learn more by watching their YouTube video. For every 100 unique views, Schneider Electric will donate another light to a family in need.

Go to [www.youtube.com](http://www.youtube.com), and search “Charge the World Change the World initiative”

**Schneider Electric** | [www.schneider-electric.com/ca](http://www.schneider-electric.com/ca)



## Predicting solar

Recently released, “Solar Energy Forecasting and Resource Assessment,” by Jan Kleissl (2013) provides important insight for solar energy professionals, addressing a critical gap in the core literature of the field. As major barriers to solar energy implementation (such as materials cost and low conversion efficiency) continue to fall, issues of intermittency and reliability have risen to the surface.

Scrutiny from solar project developers and their financiers on the accuracy of long-term resource projections, and grid operators' concerns about variable short-term power generation, have made the field of solar forecasting and resource assessment especially significant in today's market. This volume provides an authoritative voice on the topic, incorporating contributions from an internationally recognized group of top authors from industry and academia.

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## Long-term roadmap for biofuels needed

The United States Environmental Protection Agency (EPA) should develop a new, long-term plan to reach its biofuels production goals, the Union of Concerned Scientists (UCS) told the agency during a public hearing in December 2013. The UCS believes a revised roadmap is required to meet the proposed biofuel volume targets for 2014, under the Renewable Fuel Standard (RFS).

The EPA proposal calls for scaling back the overall mandate, including reductions in corn ethanol and advanced biofuels, to account for the slower-than-expected development of cellulosic biofuels—as well as constraints in the fueling infrastructure that make blending more than 10% ethanol challenging. For the past two years, UCS has urged EPA to take advantage of the RFS's flexibility to adapt to the changing dynamics of the US transportation system. It asks the agency to adopt the much-needed task of overhauling the mandates out to 2022 and beyond, to provide the policy certainty the cellulosic industry needs to continue expanding.

*Full details on the UCS position, including policy analysis and fact sheets, are available on the UCS website.*

**The Union of Concerned Scientists (UCS)**  
[www.ucsusa.org](http://www.ucsusa.org)

## Prospering from the wind

Many of the world's most underserved citizens rely primarily on diesel generators for what power they have, which is expensive and polluting. Wind for Prosperity is a unique business innovation, designed to bring affordable electricity to energy-poor, wind-rich rural communities.

Utilizing Vestas' weather data processing capabilities to identify energy-poor, but wind-rich areas, Wind for Prosperity locates areas where wind hybrid solutions can power social and economic growth, bringing affordable and reliable electricity to rural populations that currently lack it. Anchored on wind power technology, Wind for Prosperity creates an opportunity for business, government, and financial institutions to combine their talents to improve people's lives and generate risk-adjusted returns for private investors.

Learn more at [www.windforprosperity.com](http://www.windforprosperity.com)  
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## Microbiologists reveal unexpected properties of methane-producing microbe

For 40 years, scientists thought they understood how certain bacteria work together to anaerobically digest biomass to produce methane gas—important in bioenergy and the major source of greenhouse gas. But, now microbiologists at the University of Massachusetts Amherst have for the first time demonstrated that one of the most abundant methane-producing microorganisms on earth makes direct electrical connections with another species to produce the gas in a completely unexpected way.

“We discovered that Methanosaeta have the ability to reduce carbon dioxide (CO<sub>2</sub>) to methane,” researcher and microbiologist Derek Lovley explains. “They do this by a remarkable mechanism in which they make electrical connections with other microorganisms, something methanogens have never been known to do before.”

Methanosaeta species are important for a couple of reasons. For one, they are so active in methanogenic wetlands that they are considered the most prodigious methane producers on the planet. This is a concern because atmospheric methane is 20 times more effective at retaining heat than CO<sub>2</sub>, and as tundra soils warm due to climate change even greater methane releases are expected. Also, methane produced in anaerobic biomass digesters is economically important as one of the few proven, economical, large-scale bioenergy strategies in use today.

Methane-producing microbial communities have been studied for decades, but as Lovley notes, “All this time we were missing a major pathway of methane production.”

His group’s study of Methanosaeta started when they found that digesters converting brewery wastes to methane contained large quantities of the microorganism Geobacter. Geobacter cannot produce methane, but it does break down more complex substrates to compounds that methane-producing bacteria can use.

The UMass Amherst teams knew from previous studies that Geobacter grow electrically conductive filaments, known as microbial nanowires, which can transport electrons outside the cell to make electrical connections with minerals, electrodes or other cells. Methanosaeta were the dominant methane-producing microorganisms in the digesters, and known to convert acetate to methane, but analysis of the gene expression in the digester revealed that Methanosaeta were also highly expressing genes for converting carbon dioxide to methane. The researchers speculated that Geobacter were feeding Methanosaeta electrons through their nanowires to promote Methanosaeta’s methane production from CO<sub>2</sub>.

Further studies in which individual Geobacter and a Methanosaeta species were cultured together confirmed these suspicions. Lovley and his colleagues used radioactive tags to demonstrate that CO<sub>2</sub> was being reduced to methane. They dubbed this transfer via microbial nanowire “direct interspecies electron transfer,” or DIET. It was confirmed when they used a strain of Geobacter genetically altered to prevent it from producing nanowires, and the process did not work.

Lovley says the discovery of DIET challenges the concept held for decades that natural, methane-producing microbial communities primarily exchange electrons through the production and consumption of hydrogen gas. DIET is a much more direct, and potentially more efficient mechanism for feeding electrons to methane-producing bacteria.

“Now we need to improve predictions of how methane-producing microbial communities will respond to climate change. Microbial communities using DIET may react much differently than those that rely on hydrogen exchange,” he says.

There are also short-term practical implications. “Once you realize that there are methane producers that can directly feed on electrons, you start thinking differently about how to optimize methane production from wastes,” the microbiologist notes. “Although generating methane from wastes is one of the oldest bioenergy strategies, and is practiced even in small villages in developing countries, its application on a large scale has been limited because it is slow.”

Trying to speed methane production in large-scale operations can disrupt the microbes’ highly coordinated activity and systems can fail. “Electrical circuitry that evolved for microbes to make methane from organic matter in swamps at their own leisurely pace may not match our wish for a faster process in waste digesters,” says Lovley. “Just as you need to upgrade electrical service in your house when you add more appliances, we made need to use synthetic biology or other engineering approaches to increase the capacity to move current through methanogenic microbial communities in digesters.”

More at <http://xlink.rsc.org/?doi=10.1039/C3EE42189A>

UMass Amherst | [www.umass.edu](http://www.umass.edu)



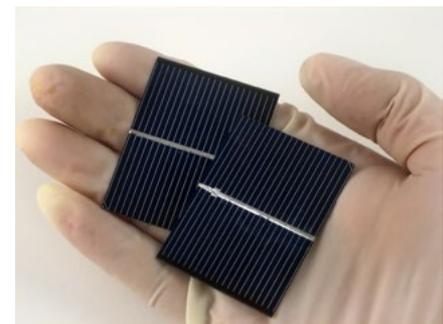
## Installed capacity of geothermal heat pumps to more than double by 2020

Geothermal heat pump (GHP) systems are being installed in nearly every region of the world in residential, commercial, institutional, and industrial applications with great success, according to a Navigant Research report. Despite recent setbacks in deployments due to the economic downturn, the future looks bright for the global GHP market. The research firm forecasts that worldwide installed capacity of GHP systems will grow by nearly 150% over the next seven years—from 52.7 gigawatts-thermal (GWt) to 127.4 GWt.

“The renewable energy policies that led to strong growth in the GHP market in the last decade are still in place, and will drive expansion as the global economy improves,” said Mackinnon Lawrence, principal research analyst with Navigant Research. “Although their overall penetration remains low, GHP installations are gaining traction in both the construction industry and the regulatory environment, and this high-efficiency technology will likely play a larger role in both new build and retrofit projects going forward.”

**Navigant Research**

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



## 100% renewables

Last November was a noteworthy month. According to the “Energy Infrastructure Update” report from the Federal Energy Regulatory Commission’s Office of Energy Projects, solar, biomass, wind, geothermal, and hydropower units provided 394 megawatts (MW)—or 100%—of all new electrical generation placed in-service in November 2013. There was no new capacity during the month from natural gas, coal, oil, or nuclear power. Renewable energy sources also provided 99% of all new electrical generating capacity in October.

**Federal Energy Regulatory Commission**

[www.ferc.gov](http://www.ferc.gov)



**From left to right...** Chavez John, Avee Arthur, Laverne Benally, Elsa Johnson, home recipient Louise George, Mark Snyder, Chip Johnson, and Gary Zarembski. Louise George received an EMPUS Bump-out and a new, super-efficient home as part of the Plateau Solar Project.

# Power to the People

## Bringing clean energy & water to rural Navajo elders

By John Connell

Navajo people living in the Four Corners Region of Arizona, New Mexico, and Utah have some of the most abundant sunlight in North America. In fact, they are the major electric supplier for the entire southwest through coal mining and coal-fired plants. Perhaps surprisingly, however, over 20,000 Navajo still live in homes without electricity, running water, or sanitation.

Among the hardest hit are elders with disabilities and health problems. Most have to traverse makeshift dirt roads twice a week to fetch water and wood (a 50- to 70-mile drive). Things many of us take for granted are foreign to this community. They light their homes with a single kerosene lamp that emits toxic gasses, and live everyday without indoor plumbing, running water, or electricity. A lack of power also means the Navajos can't refrigerate healthier, fresher foods, store medicine, access the Internet, or even use vital medical devices, such as oxygen respirators.

But, there is hope for change.

### The Plateau Solar project

Elsa Johnson grew up on the reservation, and knows firsthand the hardships that off-grid Navajos' face. Johnson left, but returned to the reservation some 30 years later only to find the living conditions hadn't changed. That led her to establish a Navajo non-profit, called IINA Solutions, to fight poverty on her native land (IINA means "life" in Navajo).

Johnson started the Plateau Solar Project with solar expert Mark Snyder, owner of Mark Snyder Electric and CEO of Global Solar Water Powers Systems Inc. (GSWPS). He is a master electrician, an inventor, and a solar homebuilder.

"We created the Plateau Solar Project to bring essential electrical, water, and sanitation services to Navajo elders 62 years and older, who desperately need them," explained Snyder. "Each installation is designed for a 25-year lifespan. It delivers sustainable solar thermal power for hot water, space heating, and electricity—and creates jobs for the Navajo people."

Once IINA Solutions was awarded grants from the USDA Rural Development Program and the Renewable Energy Investment Fund, the team faced a daunting challenge.

### A solar system torture test

If there's one thing the desert can be, it's unforgiving. Temperatures in Navajo country range from a blistering 110 degrees Fahrenheit (43° C), down to -30 degrees Fahrenheit (-34° C). Aside from hitting those in the community hard, such extreme conditions wreak havoc on batteries and other equipment that are the backbone of any solar energy installation.

Previous efforts by different companies to set up a successful renewable energy site didn't account for these conditions, and millions of dollars of failed systems litter the landscape. Everything from failed batteries and inverters, which are crammed inside un-insulated metal boxes, to old refrigerators that once baked in the scorching sunlight, remain broken and used up from unsuccessful past project attempts.

"For this project to work, we had to work with nature and remove the variables that caused previous installations to fail," shared Snyder, who helped design and work on the Plateau Solar Project (PSP). "And because these homes are so remote, we had to make sure they were built to last. We couldn't let these people down."

Initially, the system was designed to protect the batteries, but upon further consideration, it was thought: "Why not make the building modular and multi-purpose?" Johnson, in turn, immediately thought to manufacture these structures to serve thousands of off-grid homes, thereby creating jobs for the Navajo people. And jobs that not only contribute to the community, but also the environment.

This led to the creation of the patent-pending Enertopia Multi-Purpose Utility Structure (EMPUS). This first-of-its-kind building is designed from the ground up to protect solar equipment from harsh weather for 25 years. The 8x20 foot (2.43x6 meter) building features R-42 super-insulation from P2000 and climate control, electricity, hot water, and a full bathroom.



EMPUS Bump-outs feature numerous solar-powered devices, and even store solar heat



Each EMPUS unit stores electricity in eight lead-acid batteries

In 2012, forty 4x8 EMPUS Bump-outs were installed—compact, low-cost, modular versions of the full units (without complete bathrooms).

### A solar device building

EMPUS Bump-outs feature numerous solar-powered devices, but what's most unique is that the buildings themselves store solar heat.

Solar thermal hot-air panels use advanced solar absorbers in the hot-air panels to heat the super-insulated structure. The unit itself absorbs heat in the daytime, and then releases that heat as it cools down at night. Two insulated ducts send excess warm air from the EMPUS into the home during the day, reducing the need for non-sustainable wood and coal-burning stoves, which degrade interior air quality. The EMPUS also features solar-powered cooling and ventilation.

Solar power comes from high-efficiency solar modules, with a two-kilowatt (kW) equivalent solar panel system. The array includes passive solar tracking to increase efficiency and reduce costs. A charge controller was also designed with a Navajo language voiceover for monitoring activity and alerting maintenance people of any abnormal conditions.

Inside the unit, a regulated, climate-controlled temperature maximizes battery life. Batteries are especially vulnerable because if they're left out in the rain, dust, or snow, they can die early. Dozens of batteries were field-tested for lifespan, durability, and performance before choosing advanced technology batteries. Each EMPUS unit currently houses eight to 16, 400aH, six-volt renewable power batteries.

Finally, a 500-gallon water tank and solar-powered pump provides clean, running water to a sink and/or bathroom in the elder's house. Water is hauled only from certified clean water sources. This is important in the area, as uranium tailings from earlier decades of mining have contaminated many wells, making the local water unsafe to drink.

### Building the future

"Navajo on the reservation face 50% unemployment—one of the highest rates in the nation," said Johnson. "This project creates green jobs by cross-training local workers to plumb, wire, and rewire homes, and install solar systems to meet or exceed industry codes and standards."

To keep their EMPUS module running continuously, each family pays a \$35 monthly fee that covers maintenance, servicing, and replacement of key components. In addition, each elder and another family member will receive training to help with non-technical tasks.

"We want to create our own trained workforce for a sustainable future," explained Johnson. "Ultimately, this project creates jobs for 25 years, while bringing vital electricity, water, and sanitation to the Navajo people using clean energy."

Today, the program is expanding to include energy efficiency, retrofitting, and home weatherization. Even wind turbines from Native American-owned Cherokee Wind are being included.

"By collaborating with nature," Johnson said, "we have designed and engineered an innovative, durable, and economical approach that's evolved from a single project into a much more long-term venture. Now, we've even renamed the project 'Plateau Solar and Wind,' and we're looking for new partners to expand our work to all indigenous communities here and worldwide."

Mark Snyder is excited about the future. "I'm so grateful to IINA Solutions, the five Navajo chapters, and all our other partners," he says. "After over 37 years in the renewable energy industry, there's still nothing more rewarding than improving living conditions, creating green jobs, training skilled workers, and bringing power to the people."

*John Connell is the VP of SLI products at Crown Battery Manufacturing Company.*

*Funding agencies for Plateau Solar Project are USDA Rural Development, Renewable Energy Investment Fund (REIF), administered by the Grand Canyon Trust. Contributions of time and donations by Engineers Without Borders also made the project possible. To learn more, visit [www.iinasolutions.com](http://www.iinasolutions.com) or [www.marksnyderelectric.com](http://www.marksnyderelectric.com).*

### Crown Battery Manufacturing Company

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



# Federal Oversight

## Wind energy & winged wildlife

By Matthew Ahrens

**FEDERAL OVERSIGHT OF WIND ENERGY'S** adverse impacts to birds, bats, and other wildlife will increase due to two recent developments: the pending first programmatic “take permit” under the Bald and Golden Eagle Protection Act (BGEPA), and the first criminal enforcement action for avian fatalities under the Migratory Bird Treaty Act (MBTA).

Wind farms face a somewhat unique environmental challenge—a clean source of energy with a potential dirty impact to wildlife. Debate over the correct level of governmental enforcement and regulation will continue, but impacts to bald and golden eagles, migratory birds, and other federally protected species play an increasingly significant role in the siting, construction, and operation of wind projects. Going forward, wind projects will encounter an increased need for comprehensive due diligence and a critical assessment of a project’s impact to birds, so as to ward off potential future criminal enforcement.

Although government and industry efforts have been made to safeguard wildlife—new voluntary federal guidelines have been issued, comprehensive pre-construction and post-operation studies have become more common, and wind projects typically implement mitigation measures (such as siting turbines away from known nests and other high risk areas, creating habitat buffers and using radar, underground transmission lines, and other methods to reduce the risk of collision)—until the legal requirements become clear, developers bear a burden to determine what needs to be done to comply with the law.

### Understanding federal bird protection laws

Currently, there are two federal laws that regulate the “take” of birds: the BGEPA, which regulates bald and golden eagles; and the MBTA, which regulates approximately 1,000 species of migratory birds. Violations can lead to civil and criminal penalties, and potential imprisonment for six months to two years per violation. Though felony prosecutions under the MBTA only apply to the actual or intended sale or barter of migratory birds and migratory bird parts, misdemeanor charges may be levied against any person who takes a migratory bird for any other reason.

The BGEPA doesn’t contain a distinction between felony and misdemeanor charges for first-time offenders. The BGEPA defines “take” to include: “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb.” However, the definition of

“take” under the MBTA is ambiguous, leading courts to disagree over whether the MBTA is limited to intentional takes or if it also includes incidental takes, which means a take that occurs as a result of, but is not the purpose of, an otherwise lawful activity.

To lower the risk of takes due to the construction and operation of wind energy projects, the FWS adopted the Land Based Wind Energy Guidelines (FWS Guidelines) on March 23rd, 2012. The FWS Guidelines are voluntary, and set forth five tiers of pre- and post-construction studies that seek to evaluate and address potential negative impacts of wind energy projects on species of concern, including migratory birds, bats, and bald and golden eagles. Additionally, on May 2nd, 2013, the FWS released the Eagle Conservation Plan Guidance Module 1—Land-based Wind Energy, Version 2 (FWS Eagle Guidance), which is designed as a supplement to the FWS Guidelines. The FWS Eagle Guidance is also voluntary, and lays out a staged approach to siting new wind power projects. It also contains in-depth guidance relating specifically to the protection of bald and golden eagles, and compliance with the BGEPA.

### Eagle “take permits”

In 2009, the FWS established new rules (50 CFR 22.26 and 22.27), providing for the issuance of two types of five-year incidental take permits under the BGEPA—individual and programmatic. Both permits authorize a take of bald and golden eagles when the take is associated with, but not the purpose of, an otherwise lawful activity.

To obtain an Eagle Take Permit, a project developer must:

1. Avoid and minimize take to the maximum extent achievable;
2. Conduct adequate monitoring;
3. Offset any remaining take through compensatory mitigation; and
4. Ensure the direct and indirect effects of the take are compatible with the preservation of bald and golden eagles.

An Eagle Take Permit qualifies as a federal action, and triggers the need for an environmental review under the National Environmental Policy Act (NEPA). On December

*Continued on page 10.*



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...continued from page 10.

9th, 2013, the FWS published a final rule in the Federal Register to extend the maximum term of the Eagle Take Permit to 30 years, since the average life of a wind project extends beyond the existing five-year term limit. The final rule will become effective on January 8th, 2014. To date, the FWS has not granted any Eagle Take Permits, even though roughly 15 applications have been submitted since the FWS authorized issuance in 2009.

Though, in September 2013, the FWS released a draft environmental assessment for a five-year Eagle Take Permit for the Shiloh IV Wind Project in Solano County, California. The Eagle Take Permit would allow the take of up to three eagles over the five-year term of the permit.

#### **Criminal enforcement action**

On November 22nd, 2013, Duke Energy Renewables, Inc. entered into a plea agreement with the US Department of Justice (DOJ), after being charged with two class B misdemeanors under the MBTA for the death of 149 migratory birds and 14 golden eagles at two wind facilities in Wyoming.

Under the terms of the Duke Settlement, Duke will be placed on a five-year probation, and be required to pay \$1 million dollars in fines, obtain an Eagle Take Permit, and implement a five-year environmental compliance plan. The plan must include comprehensive mitigation measures to minimize further avian impacts at four of Duke's wind facilities, and could cost up to \$600,000 per year.

It's worth noting, however, that as avian fatalities were discovered, Duke promptly reported them to the FWS, worked with the FWS to reduce future fatalities, and implemented numerous mitigation measures including monitoring, radar, and curtailment. The Duke Settlement acknowledged this concerted effort, reduced the fine, and dropped any potential additional charges. Nonetheless, such actions didn't absolve Duke from liability. This is because the mitigation measures voluntarily put in place prior to the MBTA conviction weren't sufficient to overcome the fact that the projects were constructed in a high-risk area, despite preliminary studies showing that avian fatalities would likely occur.

#### **Lessons learned**

The Duke Settlement offers several important lessons for the development of new projects. First, it's important to conduct extensive due diligence throughout the life of a wind power project, and to consult with the FWS starting at the earliest stages of development and continuing through operation as appropriate.

But, conducting all the recommended surveys and studies and consulting with the FWS isn't sufficient. If adverse impacts to avian species are identified, it's the developer's responsibility to move the project to a new location, or implement extensive mitigation measures to reduce the risk of avian fatalities.

As demonstrated by the Duke Settlement, the FWS's recommendations need to be given high priority, especially with respect to siting in high-risk areas. As aptly put by the DOJ in a November 22nd, 2013 press release: "Carefully siting turbines so as to avoid and minimize the risk as much as possible, is critically important because, unlike electric distribution equipment and guyed towers, at the present time, no post-construction remedies, except 'curtailment' (i.e., shut-down), have been developed that can 'render safe' a wind turbine placed in a location of high avian collision risk."

A second lesson learned: documented efforts to comply with the guidelines and communicate with the FWS will likely be taken into consideration when determining whether and to what extent it should bring an enforcement action should a violation of the BGEPA or the MBTA occur. Duke's good faith effort to reduce fatalities and documented coordination with the FWS did lead to reduced penalties.

Thirdly, the Duke Settlement demonstrates a strong likelihood of future enforcement against the wind industry, which, until now, hasn't encountered enforcement under the BGEPA or the MBTA. Prior to the Duke Settlement, there were no criminal convictions of a wind developer for the unintentional take of a bird protected under the BGEPA or the MBTA. According to the Associated Press, the FWS is now investigating bird deaths at over 18 wind projects, about a half-a-dozen of which have already been referred to the DOJ for potential enforcement, although the specific projects have not been publicly identified.

#### **Practicing due diligence**

Recent studies have estimated that there are over 900 million annual bird fatalities due to collisions with buildings, and over six million annual bird fatalities due to collisions with communication towers; whereas, according to the FWS's estimates, there are 440,000 annual bird fatalities due to collisions with wind turbines and met towers.

Consequently, the Duke Settlement is not necessarily an indication of widespread enforcement against any and all violations of the BGEPA or the MBTA, but it's an important reminder to wind developers and lenders that a high level of attention must be placed on due diligence, the careful siting of turbines, and the implementation of mitigation measures that would reduce the risk of a take under the BGEPA and the MBTA.

Here are some general recommendations for developers and lenders to consider during the process of developing and/or providing funding for a wind project.

#### **Prior to site selection/pre-construction**

- Initiate consultation with the FWS and state and local wildlife agencies;
- Gather information from publicly available sources to assess the likelihood of avian impacts at potential project sites;
- Site the project in previously developed areas, if possible, such as agricultural lands, to minimize impact to previously undisturbed habitat;
- Conduct one to two years of avian, bat, and wildlife studies;
- Site turbines away from areas with identified high bird and bat concentrations and create buffer zones around sensitive habitat in the project area;
- Provide training for construction and project personnel on how to avoid impacts to protected species during construction and operation; and
- Discuss the results of the pre-construction studies with the FWS and develop a strategy to mitigate any unavoidable adverse impacts.

#### **During construction**

- Continue to conduct studies and monitor impacts to protected species and maintain an ongoing dialogue with the FWS;
- Implement recommended or voluntary mitigation measures;
- Develop a Bird and Bat Conservation Strategy ("BBCS") as outlined in the FWS Guidelines; and
- Prepare an Eagle Conservation Plan and apply for an Eagle Take Permit if bald or golden eagles are identified in the project area.

#### **Post-construction/operation**

- Conduct several years of post-construction surveys and continue consultation with the FWS;
- Monitor the site periodically for any avian or bat fatalities;
- Immediately report any avian fatalities; and
- Work with the FWS and state and local wildlife agencies to implement additional mitigation measures to reduce the risk of future takes.

Since the law surrounding violations of the BGEPA and the MBTA against wind projects is still evolving, it's advisable for developers and lenders to err on the side of caution by preparing to avoid or minimize the risk of adversely impacting protected avian species. For developers, it's of crucial importance to conduct extensive surveys to identify the presence and potential impact to avian species, and to communicate with the FWS and local wildlife agencies prior to the construction of wind projects. For lenders, it's advisable to contact legal counsel at the start of the financing process to determine the current status of the law, the level of risk for a particular project, and the measures that the lender should request from the developer to minimize liability to the greatest extent possible.

*Matthew Ahrens is of counsel in the New York office of Milbank, Tweed, Hadley & McCloy, and is a member of the firm's Corporate Group, in charge of the Environmental Practice Area.*

*Milbank is well positioned to help clients keep abreast of this ever-changing field of law, and to advise on how best and most cost effectively to reduce the risk of unintentional takes of protected species during the development of wind projects.*

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# US Offshore Wind

## Global collaboration is key

By Michael Rosenfeld | Photos courtesy of London Array Limited

**THE UNITED STATES' STRONG PRESENCE** in onshore wind power, but its surprising lack of offshore wind projects has been well noted over the last couple of years (I even wrote an article about it for this publication in 2011). Even as countries such as the United Kingdom have proven offshore wind to be a viable market, the US has been slower to gain the same ground in potential project development.

Fast-forward a couple of years, and progress has been made. Granted, today the US still doesn't have any operational offshore wind farms, but a true North American market is slowly emerging. And, the opportunity has never been greater for this country to collaborate with the UK—which currently ranks as world leader in offshore wind—to fully invest in this nascent market.

### Bolstering capacity

Although the United States has been working to remove barriers and pursue offshore wind capacity, across the pond the UK has continued to make significant strides in bolstering its capacity. The UK currently leads the world in offshore wind with as much capacity already installed as the rest of the world combined. And, the industry is still growing.

Case in point: the London Array, which is the world's largest offshore wind farm, opened in the Thames Estuary in July of 2013. The project boasts 175 turbines capable of producing enough electricity to power nearly 500,000 homes. Move over to the coast of Essex, and one can find another example of ongoing progress at DONG Energy's Gunfleet Sands wind farm. Here, a recently added demonstration project is the first one in UK waters, consisting of two giant, 219-meter high, six-megawatt (MW) wind turbines.

According to a recent RenewableUK study, offshore wind capacity grew by a record 79% from July 2012 to June 2013 alone. So, why has the UK's progress been so accelerated, particularly when compared with the US?

### Committed to progress

The United Kingdom has favorable odds when it comes to offshore wind projects. For starters, they have ample natural resources not only in terms of offshore wind itself, but also in terms of experience working in harsh environments through the oil and gas industry (although non-renewable, these industries do provide valuable, transferable skills).

Perhaps the biggest success factor, however, is the UK government's support of the offshore industry. In addition to designating tens of thousands of miles around UK shores as exclusive zones for energy companies to lease and develop new offshore wind farms, the

UK government recently established an Offshore Wind Investment Organization (OWIO) to help promote inward investment.

The government has also introduced a new financing mechanism called Contracts for Difference (CfDs), which provides stable, government-backed pricing, to help offshore wind and other low-carbon energy developers secure the necessary upfront capital investment needed to kick-start a new project. With this type of support, UK offshore wind capacity could reach 18 gigawatts (GW) by 2020 and provide 17% of the UK's electricity (source: [www.renewableuk.com](http://www.renewableuk.com)).

### Local efforts

In spite of the fact that the United States still lacks a cohesive policy to support the offshore industry, there are still reasons to be optimistic about the US market. The University of Maine, for example, completed the first demonstration project in US waters this year, becoming the first organization to send electrons from an offshore wind turbine into the power grid in June 2013. In addition, the US now has a regulatory and leasing process for use of offshore waters by wind energy developers.

The Bureau of Ocean Energy Management (BOEM), which oversees this process, is now gathering information for developers who may be interested in leasing sites. On July 31st 2013, BOEM auctioned the Rhode Island/Massachusetts Wind Energy Area, which represented the nation's first competitive lease sale. The commercial lease sale for Virginia Wind Energy Area was held this past September.

The market in the UK has found success because of a variety of factors including policy, natural resources, and domestic expertise in offshore engineering. But, it's worth noting that the UK didn't build that market by itself. Companies from around the world, with

### Benefits of offshore wind

According to the Global Wind Energy Council, some of the key benefits of offshore wind are that it can provide:

- A greater wind resource, generating more energy from fewer turbines;
- Enough space for a large-scale project without the high property costs or constraints related to the surrounding area (such as on land); and
- Proximity to major demand centers, which translates into shorter transmission lines (compared to those required in many onshore wind farms).

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

expertise in manufacturing or other areas contributed as well, and continue to play an integral role in the market.

The United States could benefit from the same global participation by attracting companies from around the world with the experience to get the job done right. Projects like Cape Wind and Deepwater Wind are slowly progressing, even tapping into UK experiences. Cape Wind, for instance, is a \$2.5 billion project off the coast of Massachusetts, with a UK company providing the consulting services and strategic advice on such areas as environmental, health, and safety (EHS), as well as quality assurance and risk management. Yet, another company is offering technical assistance, which includes wind turbine reviews and site suitability assessments to the project.

Such joint efforts can ensure offshore wind becomes a successful global industry, providing a source of renewable energy around the world. According to the Global Wind Energy Council, the potential of offshore wind is enormous. It could meet Europe's energy demand seven times over, and the United States' energy demand four times over ([www.gwec.net](http://www.gwec.net)).

As the US offshore wind market continues to mature, there will be more opportunities for UK companies to provide services in all aspects of the US offshore wind market. It's this type of cross-border collaboration that will reduce worldwide carbon emissions, generate new jobs, and create a stronger, more viable, global offshore wind industry.

*Michael Rosenfeld is Vice Consul and USA Clean Technology Sector Lead for UK Trade & Investment, the British Government's international business development department.*

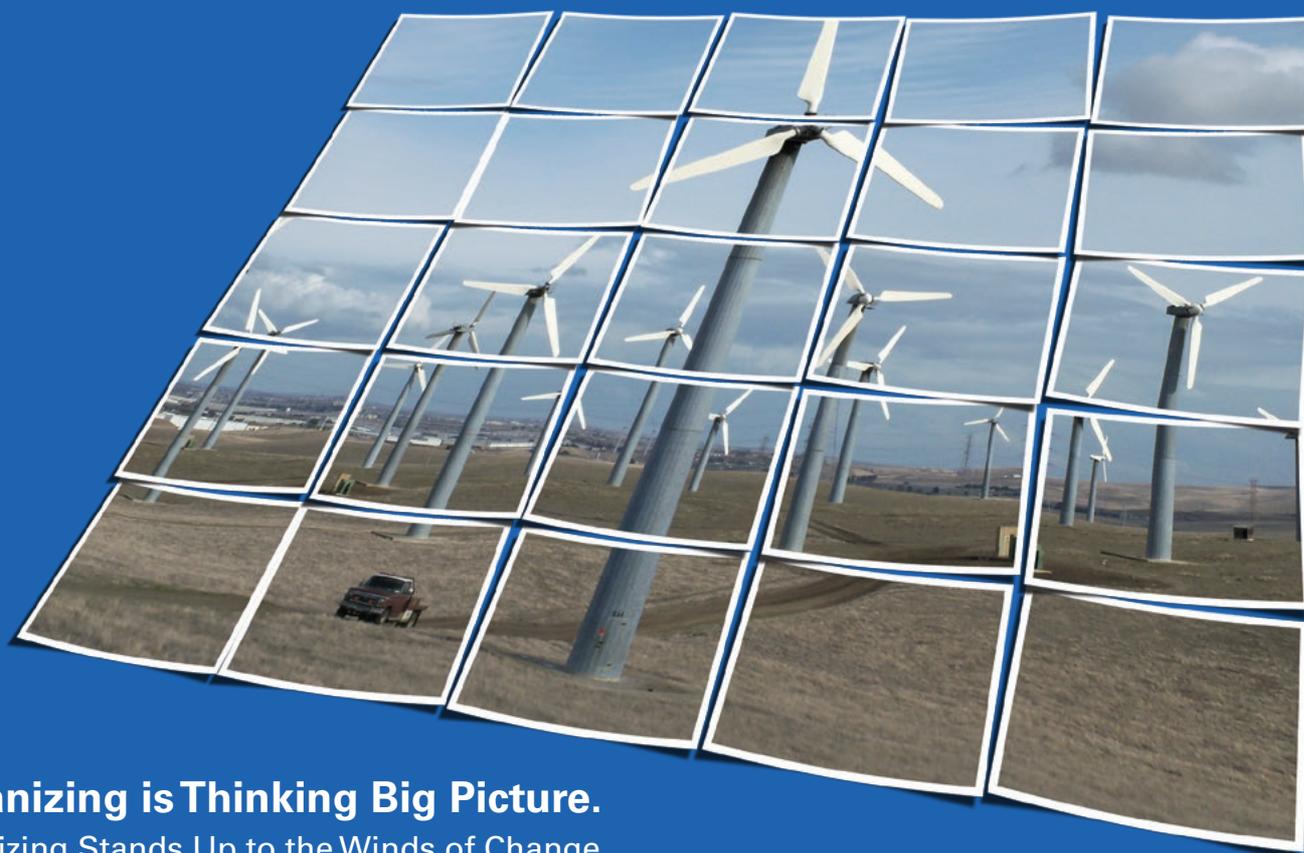
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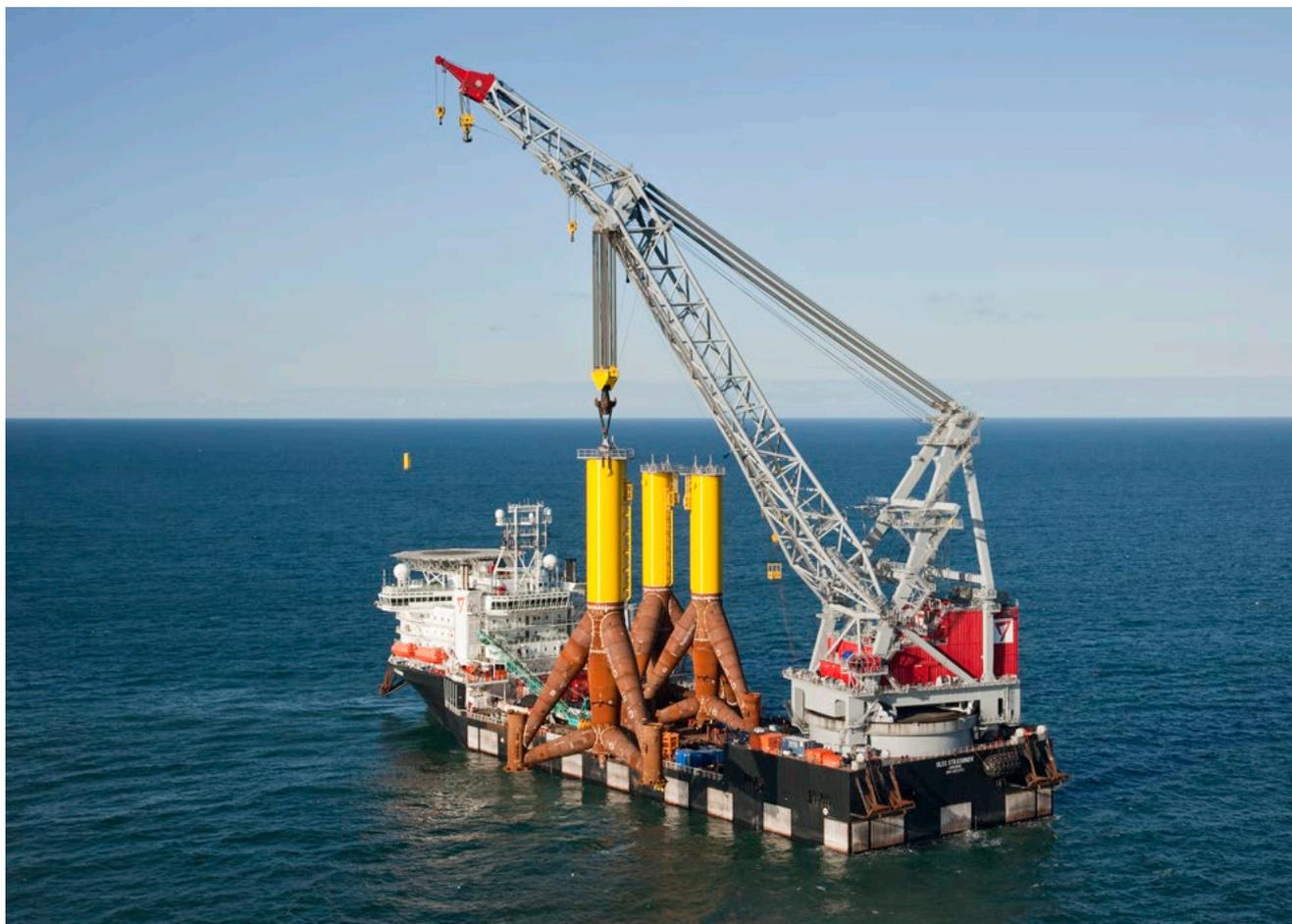
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# Guidance for the Offshore Wind Industry

## Making the most of oil & gas

Jane Bugler & Alan MacLeay | Photo courtesy of Seaway Heavy Lifting

When it comes to optimizing the clean power produced by wind energy, reaching out to the non-renewable oil and gas sectors seems like the last place to seek guidance. However, when it comes to charting the relatively new waters of the offshore wind industry, sharing of marine construction experience, safe methods of working, and recommended practices for safe and successful installations, are vital to the success of potential new projects—and the oil and gas certainly has enough offshore experience to offer.

The offshore wind energy industry doesn't exist in isolation, and learning from and integrating other maritime sector technologies and methodologies presents opportunities for mutual cooperation. It's also an imperative step as it relates to increasing safety levels. In Europe, for example, major marine contractors have become increasingly involved as wind power projects grow larger and further from shore.

Working safely and cost-efficiently in hostile waters is something the offshore oil and gas industry knows well, with marine contractors playing an important role. Many herein have worked diligently to aid in the production of guidance, designed to ensure safety so that 'zero incidents' occur, and that efficient and effective offshore operations are maintained. Transfer of such guidance to the offshore wind sector is intended to produce the same results, essentially saving time and—most importantly—saving workers from accidents and injuries.

### Safe lifting operations

On a typical offshore construction vessel, lifting is endemic to operations, and ranges from lifting of stores and spares handling through to complicated and heavy lifts. One survey showed there could be more than 200 different lifting operations on a single vessel.

Of course, each lifting operation has a risk of injury to people and/or equipment. Although many tasks are repetitive and of low risk, a percentage is considered more challenging or dangerous, requiring scrutiny and input to reduce any associated risks. It's also worth noting that many accidents tend to occur in what are perceived as low-risk, everyday operations. Sometimes the seemingly simple or routine actually harbor the most risk.

As a result, it's important to ensure that procedures are in place to try to ensure lifting teams remain alert at all times, regardless of the ease or difficulty of an operation.

Lifting is an integral part of the wind power industry. By learning from the experience of others, reinvention of the 'guidance wheel' isn't required. Currently, marine lifting

operation guidance is already in place\*. This lifting guidance is based on existing practices collated from major companies, and suggests improved methods for safe lifting. Intended for use in worldwide operations, the guidance demonstrates the essential components that should be included in company procedures for lifting operations, and offers advice on the steps within a lifting operation process that will promote safety.

Although the guidance was never specifically written for wind energy, the principles described are relevant to all offshore operations in any waters—and, so the wind industry can benefit from their adoption.

### Offshore vessels

One of the common activities specific to offshore operations is the transfer of personnel between vessels and other offshore structures. Vessel transfers can include movements of personnel at crew change and shift change from vessel to vessel, and between vessels, offshore structures, barges, crew boats, as well as to and from the quayside. Seems simple enough, but there are inherent risks involved.

A revision of the guidance (first published by the IMCA in 2010) related to vessel transfers sees an addition to include "and structures," signifying the inclusion of offshore wind turbines. This document provides guidance for the offshore industry on the safe transfer of personnel at sea. It covers risk assessment, training and competence, responsibility, equipment and communications, and focuses on the main methods of personnel transfer between vessels.

Looking at the primary methods of personnel transfer in detail, the guidance covers the main safety issues, providing information about the specialist equipment that may be involved—such as "surfers" (specially designed attachments to crew boats, larger vessels, and offshore structures, allowing personnel to step safely across), as well as special duties or responsibilities of personnel involved, particularly with regard to communications.

### Marine inspection

The Common Marine Inspection Document (CMID) is significant as it provides a standard format for inspection of offshore vessels. Its use helps promote safety and efficiency, and can help reduce the number of repeat inspections on individual marine vessels.

An inspection should be planned and undertaken in liaison with a vessel owner, and undertaken by a competent inspector. Vessel charterers and clients may consider the inspection report before commissioning any further inspections. As a 'living' document, the CMID may be kept and updated onboard a vessel, thereby reducing the time involved in an audit.

The CMID is regularly reviewed and updated in the light of regulatory and technical developments. A major review of the CMID was undertaken in May 2011 by a cross-industry workgroup, with input provided by contractors (vessel operators), charterers, consultants, and other interested parties. Since then, a further update has been published. The CMID database has also been updated to include marine inspection for small workboats, the type frequently used in the offshore wind industry.

### Safety flashes

Safety flashes and systems for incident reporting and analysis are an important tool for sharing vital information. A system currently exists for sharing such flashes to help those around the world identify potential hazards, share lessons learned, and avoid repetition.

A safety flash incident report should provide sufficient detail and communicate risks, precautions, as well as the necessary actions, without releasing information about the people or organizations involved. The report should be succinct, specific, factually correct, and written in clear language. All submissions need to be handled in the strictest confidence, and checked and published only with clear permission from the originator.

Such a system, and working to the suggested guidelines, will be invaluable in the North American offshore wind sector, where safe operations will be of paramount importance. Learning from sectors that have already worked offshore for over 40 years simply makes sound commercial sense.

*\* The International Marine Contractors Association (IMCA) is an international trade association representing offshore, marine, and underwater engineering companies, offering good practice guidance to the offshore industry on technical and safety issues.*

*Jane Bugler is technical director of the International Marine Contractors Association (IMCA).*

*Alan MacLeay is the engineering director for Renewables at Seaway Heavy Lifting, as well as chairman of the IMCA Renewables Workgroup. His presentation, "Synergies with Other Maritime Technologies,"*

*at EWEA Offshore 2013 in Frankfurt, Germany, expanded on the significance of offshore wind power adopting guidance from other industries.*

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# Evolving Codes

## Ensuring wind turbine safety

By Kenneth Boyce, UL LLC

Wind power generation resources continue to grow in North America and around the world, now representing a significant proportion of new electrical power capacity. In cases of rapid development and deployment of energy infrastructure—such as what is happening with new wind power resources—standards become a critical foundation.

Standards define consistent market expectations, performance benchmarks, and fundamental design features—and, most importantly, safety. As more turbines are installed, new technologies are introduced and the existing turbine population ages. Safety standards provide guidelines and support to ensure optimal design and performance of a safe and secure infrastructure. With this goal in mind, wind turbine standards are in a dynamic state of development.

### Setting the standards

The International Electrotechnical Commission (IEC) has published the IEC 61400 series of standards to specify essential design requirements for the engineering integrity of wind turbines. The standards cover many important aspects of the design, installation, and use of wind turbines.

Recognizing the complexity of turbines as sophisticated electromechanical apparatus, it's notable that only a small section of the IEC requirements focus on the electrical safety of the equipment, controls, and protection. Although the IEC requirements establish the need to evaluate most critical concepts of turbine design, as presently written they do not provide detailed guidance on how to evaluate.

To support the development of the best worldwide requirements for safety and performance, IEC Technical Committee TC 88 has agreed to a project to review any potential enhancements to the electrical safety requirements. IEC's efforts will continue to progress over the coming years and, so far, there has been significant activity within North America. Collaborative development of North American safety requirements for wind turbine systems not only includes product safety standards, but also installation codes.

### Raising the bar

The National Electrical Code (NEC), ANSI/NFPA 70, addresses safe installation of systems and equipment that aren't under the exclusive control of a utility, as addressed by specific requirements in Section 90.2. Published several months ago by the National Fire Protection Association, the 2014 Edition of the NEC contains important new requirements for safety of wind turbine installations in Article 694, "Wind Electric Systems."

This new edition applies to all wind systems under the purview of the NEC regardless of rating, eliminating the previous scope limitation to cover only turbines having a rating up to 100 kilowatts (kW). Another addition requires that wind systems be certified for the application. One of the new revisions also expands on the previous limitation for a maximum of 600-volt rating for wind systems for dwellings, to allow systems up to 1000 volts for other applications.

To promote safe design and easy installation of wind turbines, several wind turbine safety standards have been collaboratively developed. In addition to the electrical system



issues outlined here, these standard efforts recognize there are some unique North American issues, which require special consideration beyond the IEC standards. These include issues such as the fundamental differences between the installation requirements of the IEC 60364 series and the prevailing US codes (such as the NEC), as well as the recognized differences in other important North American safety requirements.

American National Standards for safety are known for supporting compliance with the requirements for exporters, buyers, owner/operators, and other involved parties, and compliance is an important measure for demonstrating due diligence in addressing workplace and consumer safety, supporting equipment installation and acceptance, and establishing confidence among customers.

The American National Standard for safety of small wind turbines was jointly published last year as ANSI/UL 6142/AWEA 6142\*. The ANSI/UL 6141 Standard for Safety for Large Wind Turbine Systems is presently under development. Developed using a balanced, consensus-based approach, they are established by standards panels comprised of equipment producers, users, technology experts, scientists, regulatory authorities, and other technical experts with an interest in wind turbines.

Both standards contain fundamental requirements related to wind turbine safety. These include important safety features, such as the electrical safety of the turbine and internal subassemblies, as well as the functioning of critical aspects of the control and protection systems. They don't, however, cover mechanical or structural integrity of the wind turbine system or subassemblies, which are coordinated with the mechanical and structural limitations specified in established performance and safety standards (such as the IEC 61400 series).

### Collaborating together

In the future, harmonization of the US national standards with the IEC 61400 requirements is an option. International harmonization is an important consideration in supporting global product development and distribution, where the relevant industries are supportive of the need for the effort. Such an effort would allow for national or regional differences to be defined as required to maintain suitability in different countries.

As the wind industry continues to refine product offerings and market strategies, additional consideration will be given to the benefits of harmonization. And, as the global wind infrastructure grows, compliance with relevant standards provides validation of design principles and establishes due diligence in addressing critical attributes such as safety. The IEC 61400 series of standards provides significant information for addressing safety and performance of wind turbine systems. Currently, a project is underway to expand the evaluation of electrical safety, which is expected to result in new requirements in several years.

In the meantime, addressing critical issues within the United States market has led to development of US standards. Evolving codes promote safety of wind installations, in part, through reliance on the evaluation of turbines to the applicable product safety standards. Collaborative efforts continue to lead to exchange of ideas, definition of best practices, and broader harmonization. Development of wind turbine standards, their use in design and development, and demonstrated conformance will all support the safest and most reliable wind infrastructure.

\* ANSI/UL 6142/AWEA 6142 is published by UL and the American Wind Energy Association (AWEA).

Ken Boyce is the principal engineer manager for Energy at UL LLC. He oversees standards development and technical operations for several renewable energy sectors, and is active in the standards and code development community, serving as chair for the National Electrical Code Panel 1.

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Kerite announces their upgraded Underwater Specialty Cable, custom-built for a broad range of applications that require direct contact with water, including offshore wind. Kerite's EPR insulation formula enables the cables to operate underwater without the need for an impervious barrier, such as a lead sheath making installation easier and cost-efficient. In addition to the discharge-resistant EPR insulation, the Underwater Specialty Cable offers numerous features, including an additional polyethylene jacket; stranded, filled 5 kV to 35 kV copper conductors (shielded by a non-conducting Permashield stress control layer); and a copper tape or concentric wire metallic shield. Galvanized steel armor wires with individual HDPE jacketing offer additional protection.

Kerite | www.kerite.com

### Gearbox oil change system

James Fisher Renewables, launches Ship to Turbine (STT), an oil change system that utilizes Sage Oil Vac patented technology. Current industry practices for oil exchange are not only extremely time-consuming and labor intensive, but also carry an inherent level of operational and pollution risk. Not only does the James Fisher Renewables STT have the potential to significantly improve technical utilizations and reduce turbine downtime, but also mitigates risks in offshore gearbox oil changes. Sage Oil Vac technology offers unique benefits, including an onboard filtration system that filters new oil to ISO-approved levels, plus fresh oil is heated for much easier flow.

Sage Oil Vac, Inc. | www.sageoilvac.com



### Offshore wind turbine

Suzlon Group unveils its new offshore turbine, the REpower 6.2M152 for the cost-effective generation of offshore wind energy. The new turbine features a rotor diameter of 152 metres, with the rotors sweeping an area larger than three football pitches. The nacelle alone is as big as two detached houses, and will be constructed offshore at a height of between 95 and 110 meters. The larger rotor diameter achieves an increase in energy yield of up to 20%, at wind speeds of 9.5 m/s. With a rated power of 6.15 MW, each REpower 6.2M152 turbine can supply around 4,000 homes with electricity.

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# No Substitute for Experience

## Learning from offshore wind construction challenges

By Joanna de Montgros & Chris Elkinton

*“The only source of knowledge is experience.” ~Albert Einstein*

When it comes to constructing offshore wind farms, there’s no substitute for hands-on experience. With less impact on real estate and undeveloped land, along with more powerful, stronger winds, offshore wind can play an important role in helping to meet the high electricity demands of heavily populated coastal areas—making it an appealing option for developers.

Offshore wind farm engineering is a significant challenge, particularly with the required foundations and larger turbines than are typically installed onshore. The time, manpower, and equipment required for the offshore transportation and installation of dozens of 500-foot wind turbines must be carefully orchestrated, so as to minimize the need for expensive vessels and to maintain a safe working environment.

Although it’s hardly surprising that some offshore wind farms—particularly those built in the early years—inflicted significant financial pain during their construction, it’s vital that the industry learns from these experiences.

One example is North Hoyle, one of the world’s first commercial-scale offshore wind farms, which was commissioned about 10 years ago in the UK. Important lessons were learned on this project, that were typical of the early stages of offshore wind construction—and which have contributed to the general experience and development of this sector.

### Lessons from North Hoyle

North Hoyle’s construction encountered challenges early on. To start, there were vessel problems when the newly built Resolution (the first self-elevating turbine-installation vessel in the world) was delayed in delivery. Other vessels had to be chartered to install most of the turbines at this site. The second problem was a flaw in the J-tube design, which posed difficulties for marine cable installation.

However, North Hoyle was a pioneering project and technical challenges were to be expected. The fact that this project is still operating smoothly 10 years on is proof that construction problems can be overcome. The project remains fully operational, and

produces enough clean electricity each year to meet the needs of approximately 40,000 UK homes.

‘Learning by doing’ on projects like North Hoyle has built up a substantial body of expertise in the offshore wind community, along with an understanding of what works and what doesn’t. And, these lessons are clearly being learned. Today, there are nearly 60 offshore wind farms up-and-running, construction horror stories are far less common, and financiers are more willing to put capital at risk during the construction phase.

### Laying the groundwork

Experience suggests that a majority of problems that arise in offshore construction can be prevented. The key, as in most challenges, is in properly carrying out the upfront groundwork—such as the environmental testing, permitting, and project development and planning. One case-in-point involved an offshore project that suffered a three-month delay due to problems with the collection and analysis of soil data. The delay meant this project chartered two more jack-up vessels than were initially planned. The last turbine was finally erected at the end of the summer weather window, pushing commissioning work into the more difficult weather of the winter season. In the end, this offshore project couldn’t be handed over to the operations team until the following year.

According to one of the engineers on the project, “If we’d used more experienced teams in specifying, managing, and undertaking the soil investigation work, the logistics would have been far simpler.” He adds: “The hard lesson we learned is that it’s far easier and less costly to identify and mitigate risks early on, rather than to fire fight during the construction phase.”

## New opportunities, new challenges

Even with the best of plans and the best of intentions, construction of larger wind power projects that are even further from shore, raises the stakes. New territory will most certainly bring on new challenges. The United States is already facing a potential challenge with the limited vessels available for offshore turbine installation in the country.

But there are technology step-changes on the horizon, which have the potential to revolutionize the industry. Floating turbine systems, for example, offer the potential to harness stronger offshore winds in deeper waters. These systems are already being tested off Norway, Portugal, Japan, and Maine.

Technical advances are slowly being matched by commercial developments, as project planners and investors move to new markets where regulatory regimes for offshore wind are untested. In these markets, new contractors will be engaged, such as Asian entrants to the turbine supply business and American installation crews.

These trends are exciting, but they also bring new risks that might raise the specter of the technical hiccups of the early days of offshore wind.

But progress need not be a barrier to investment. The key to securing finance will be forming project teams and supply chains, which contain the experience of people who have 'been there' and 'done that.' Involvement of companies with a track record in offshore wind will mitigate construction risks by embedding the understanding gained from grappling with offshore engineering challenges to date—such as the ones at North Hoyle.

Getting experienced people on board provides a strong knowledge base from which to respond to new technical and commercial developments in offshore wind construction. It ensures that the projects of the next decade are fully informed by the lessons of the past.



## Offshore verticality monitoring

The offshore wind market is developing rapidly, and most offshore turbines are founded on monopiles, which are driven into the seafloor using a hydraulic hammer. This process can take several hours, so verticality is a key requirement. Traditionally verticality, or inclination, is measured by hand-held inclinometers. But manual inclination measurements don't always result in an accurate representation of the inclination of the entire pile.

This has led to the development of Fugro's newly launched InclinoCam. The InclinoCam system enables continuous, real-time verticality monitoring without delays, and without the need for people on deck. Based on intelligent, visual object recognition combined, with vessel motion compensation, camera images and IMU data are synchronized using Fugro's StarPort technology to provide real-time information and allow for immediate correction of deviations in verticality.

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## Wind Lidar

To improve the yaw alignment of an underperforming wind turbine and maximize its energy capture, First Wind purchased a Wind Iris Lidar. The decision resulted from a successful field trial that used data from the nacelle-mounted Lidar to correct yaw error and increase total energy production. The Wind Iris collected wind speed and direction data ahead of the turbine for 30 days. Analysis showed an average yaw error of seven degrees. A correction factor was then applied to the yaw measurement, and 15 additional days of measurement using the Wind Iris revealed that the yaw error had been eliminated. By eliminating the yaw error, the annual energy production (AEP) of the wind turbine increased by 1.8 percent. Wind Iris is manufactured by Avent Lidar Technology, a joint venture between US-based Renewable NRG Systems and France-based Leosphere.

To learn more about Wind Iris, visit [www.nrgsystems.com/AllProducts/Wind%20Iris%20Lidar.aspx](http://www.nrgsystems.com/AllProducts/Wind%20Iris%20Lidar.aspx)

**First Wind** | [www.firstwind.com](http://www.firstwind.com)



## Hydraulic system pump

HAWE Hydraulics presents a new size to its V60N axial piston pump series. Its key parameters include displacement of up to 130 cm<sup>3</sup>/rev and peak pressures of up to 450 bar, displaying its enormous power. The V60N-130 type is particularly suited for load-sensing systems, working at operating pressures of up to 400 bar, supplying hydraulic consumers with different pressure levels and/or variable volume flows. Its field of deployment includes construction machinery and cranes. The load sensing system and wide selection of intelligent controllers turn the pump into an energy-efficient drive for hydraulic systems, which aid compliance with such emission regulations as Tier 4 in mobile work machines. Taking into account the high operating pressures during the design of the hydraulic system allows a size reduction of all components in the hydraulic control, to lower their weight. This is of interest for crane cantilever arms, which are built for length.

**HAWE Hydraulics**

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



Joanna de Montgros (left) is the head of Project Engineering, Renewables Advisory, DNV GL Energy. And, Chris Elkinton (right) is the offshore technical lead for North America, Renewables Advisory, DNV GL Energy.

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# VAISALA



**Left:** Cape Verde is just one example of a country with few natural resources and scant, fresh water supplies.

**Below:** Wind-powered fresh water desalination uses a proprietary logic controller, which makes extra fresh water when the winds are blowing. The system uses water storage like a battery to store the wind's power in water.



# Catching Waves

## A breakthrough in wind power generation

By Izumi Matsumoto & Chrissie Long

Power derived from wind has long been considered a worthy source of energy. Early turbines date back to as far as 200 BC, with the first electricity generating wind turbine designed in 1887 as a battery-charging machine.

Today, wind power is considered one of the fastest growing sources of new electricity, globally. There are over 150,000 wind turbines operating around the world in over 90 countries. Although wind power is clearly a growing industry with history, it's not without its challenges and it's still considered immature by many in the energy sector.

Abundant, renewable, clean, and cost-effective, wind energy has many advantages. It's actually one of the lowest-priced renewable energy technologies available today, costing between four and six cents per kilowatt-hour, depending upon the wind resource or project ([www.energy.gov](http://www.energy.gov)). However, wind energy must contend with conventional sources of power generation on a cost basis to be truly competitive. Wind is also intermittent, and good project sites are often located in remote locations, away from the urban centers that require the most power.

As a result, energy storage and transmission have been two of the primary issues facing modern wind farms. From better batteries to new transmission lines, ongoing efforts have been made to ensure any of the energy harnessed from the wind is properly maintained and supplied when feasible.

One new, groundbreaking technology is emerging, however, that could overcome some of the inherent disadvantages facing wind power. And, it involves water.

### Wind + water

The concept of combining wind and water materialized on a large scale in Australia. By using wind turbines to convert saltwater to fresh water instead of just for electrical use,

Australia has been able to smooth the peaks and troughs that are characteristic of the wind. Instead of storing excess energy in batteries, plant operators store it in fresh water. When the turbines aren't spinning, Australia can draw on this water to provide a consistent supply to homes and businesses.

A wind farm consisting of 48 turbines in Perth routinely converts salt water into fresh water, generating as much as 40 million gallons of drinking water each day. In Sydney, another 63 turbines power the desalination process, accounting for 15% of the city's water supply.

This model becomes increasingly significant as the world faces greater water shortages. Climate change, combined with increasing populations, is putting mounting pressure on existing water supplies worldwide. According to the United Nations, 85% of the world population lives in the driest half of the planet. Not surprisingly, many countries are looking for new sources of fresh water.

One of the most popular alternatives is to derive fresh water from the ocean. And now, perhaps one of the most renewable ways of generating clean water is via the wind.

### Wind-powered desalination

The country of Cape Verde, a small archipelago off the western coast of Africa, is just one of the countries under immense pressure due to few natural resources, scant rainfall, and limited fresh water supplies. The lack of water has stunted growth and resulted in massive emigration (today, more Cape Verdeans actually live outside the country than in



Orlando Sanchez, center, mayor of Santa Cruz, Cape Verde, investigates the turbine technology used to power desalination plants. He's working to bring more affordable water to his water-starved community.

it). Additionally, the islands have one of the lowest underground water resources in sub-Saharan Africa, after Djibouti.

As one of the only ways to access fresh water, the country has turned to desalination plants for 88% of its water supply. These plants are powered almost entirely by a series of small and inefficient diesel generators. It's been well documented that diesel exhaust contains various environmental pollutants and toxic air contaminants, including many known or suspected cancer-causing substances.

Using wind power, instead of diesel, for the desalination process would eliminate a dependency on fossil fuels. Placing the environmental benefits aside, it also lowers the cost of water from \$3 per cubic meter to \$1.6. This would essentially allow the country to develop its own agriculture base, and to redirect the money that previously went to fossil fuels to other needs.

Today, the renewable energy market is still nascent on the archipelago. Even though Cape Verde has exceptional wind energy potential, currently only three percent of power generation comes from wind power.

Combining wind with water is quite promising, however, and has received support from the local government and international entities. The government of Cape Verde has recently adopted an aggressive plan that calls for generating at least 50% of the nation's energy from renewable sources by 2020.

The German government has raised the challenge to 100%, pledging to help finance the transition. Furthermore, during the 5th Tokyo International Conference for African Development (TICAD-V), held in June 2013, the Japanese Prime Minister Shinzo Abe expressed interest in investing as much as \$160 million for water desalination in Cape Verde. With the support of Japan, a full conversion wind-powered desalination in Cape Verde is not out of the question.

Cape Verde is not the only country where potential for the wind and water concept

is high. With 1.1 billion people lacking access to clean, affordable water, and a demand expected to increase five times by 2050, pundits are calling water "the next oil."

Partnering wind turbines with water desalination plants is certainly one feasible solution to respond to the 21st century water crisis.

*Izumi Matsumoto is a masters in Public Administration candidate at the Harvard Kennedy School. He researches renewable energy innovations and policy. Chrissie Long, a freelance journalist, who is also pursuing a Masters in Public Policy at the Harvard Kennedy School, contributed to this report.*

*They have done work in collaboration with Wind4Water, a social enterprise pioneering the wind-powered desalination process, which is working in collaboration with Cape Verde to put several systems online.*

**Wind4Water** | [www.wind4water.com](http://www.wind4water.com)



### Quad ride-on tractor

Ideal for paved and off-road work, the new Ditch Witch RT120 Quad ride-on tractor is built around an exceptionally heavy-duty undercarriage to withstand punishing ground conditions and provide years of reliable service. With a best-in-class ground clearance of 15.5 inches (394 mm) and a 1,500-pound (680.4-kg) track frame that's engineered to tilt, the RT120 Quad helps operators more accurately dig a vertical trench on uneven terrain and be more productive around bar ditches and creek beds.

Featuring a 120-hp (89.5-kW), Tier 4 Deutz diesel engine, the RT120 Quad's three-speed, shift-on-the-fly transmission allows operators to quickly adjust to changing ground conditions. Standard rear steering gives the RT120 Quad a tighter turn radius, resulting in better jobsite maneuverability. The RT120 Quad also handles several attachments to productively tackle a range of underground construction tasks.

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### Braking/crowbar resistors

Vishay Intertechnology, Inc. introduces a new series of stainless steel braking/crowbar resistors, featuring industry-high pulse energy capability up to 3.46 MJ and a pulse-current capability up to 12 kA. The Vishay Draloric resistors are optimized as crowbar resistors for frequency converters for three-phase generators in wind power plants and heavy-duty applications. The ULDCR resistors feature a patented, self-supported, and compact modular design that's easily assembled. The resistors' component materials are also resistant to salt water.

Offering high operating temperatures up to 375° C (707° F), the ULDCR series provides resistance values from 1 mΩ to several ohms, with available tolerances of ± 5 % and ± 10 %, and a maximum expected change of resistance in service of less than ± 20 %. Higher pulse load capacity versions built to customer specifications are also available. The resistors are also manufactured without any organic compounds, the devices are RoHS-compliant and conform to Vishay "green" standards.

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# Three Main Factors

## Why full-power converters aren't overtaking the market

By Jared Kearby

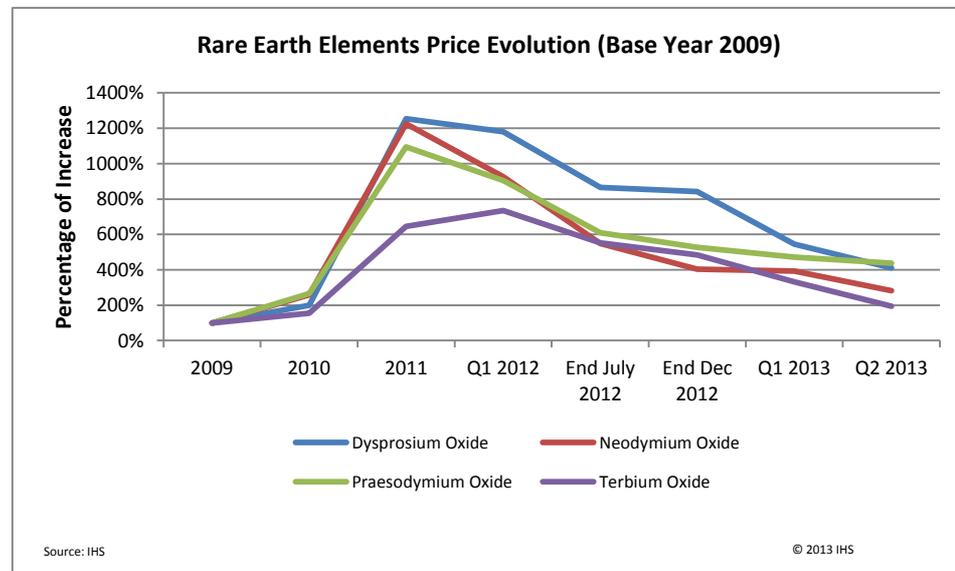


Table 1

**FOR THE GLOBAL MARKET,** doubly-fed wind converters, used in conjunction with doubly-fed induction generators (DFIG), are currently the technology of choice for new installations of onshore wind turbines, according to a new report\* entitled “The World Market for Wind Converters–2013.”

Overall, DFIG converters are forecast to outpace full-conversion products by a compound annual growth rate (CAGR) of 1.2%, from 2012 to 2017, reaching more than 9,100 units shipped in 2017.

Although DFIG converters will outpace the full-power converter market, there are a number of installations for full-power conversion solutions using permanent magnet synchronous generators (PMSG).

Three major factors, however, are hindering the sales of full-conversion products, which include:

1. High rare-earth material prices (see Table 1);
2. Lagging offshore wind development; and
3. China's high demand for doubly-fed converters.

### Material costs

In the first case, the high price of rare earth materials has led turbine original equipment manufacturers (OEMs) and generator manufacturers to reduce production costs by using less rare earth materials in their designs. These rare earth elements include dysprosium oxide, neodymium oxide, praseodymium oxide, and terbium oxide.

These higher prices have resulted in an emphasis on continuing the production of doubly-fed converter solutions. In 2013, doubly-fed converter shipments will have outpaced full-converter shipments by four percent, as shown in Table 2.

A number of companies, in fact, have re-aligned their strategies from a focus on offering PMG toward a focus on alternative solutions—such as doubly-fed induction generators. This is primarily due to the high cost of rare earth materials. It's estimated that, on average, 430 pounds of rare earth materials are used for each megawatt generated from a wind turbine.

Now, instead of a complete switch from DFIG to full conversion during the next five years, there will likely first be a shift toward medium-speed generators, using doubly-fed converters that are combined with a reduced gearbox. Over an extended amount of time, as rare earth prices settle, another slow transition will take place toward permanent magnet, full-conversion, low-speed generators without a gearbox. The swing in products has already started as medium-speed generators are currently being implemented, and the trend is projected to continue to hold for the next 15 to 20 years.

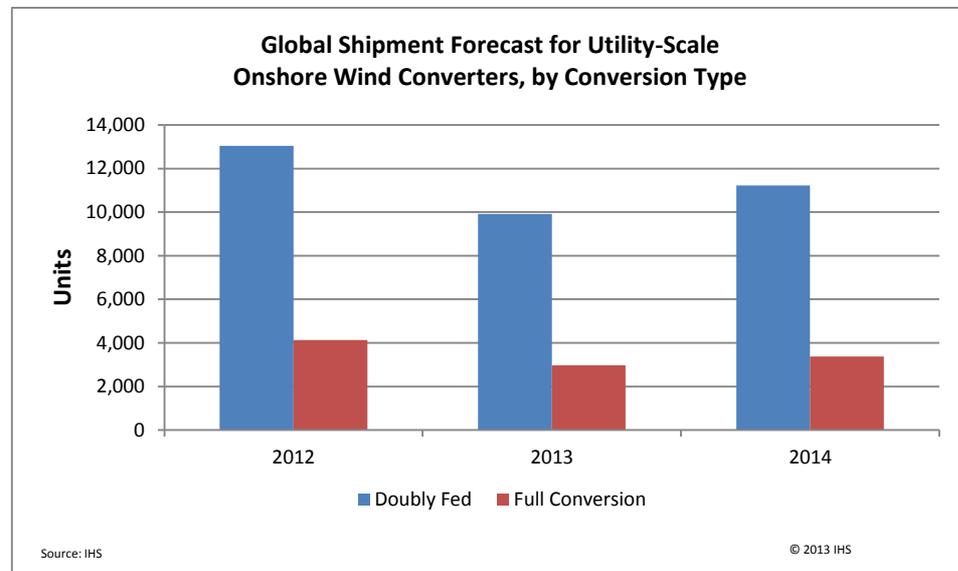


Table 2

### Offshore delays

The second factor impacting full-conversion product sales stems from a slowdown of offshore installations. Delays in siting permits and a lack of investment in 2012 and 2013 meant the anticipated growth in the offshore wind sector didn't quite take off as initially expected.

As a result, offshore, utility-scale converter shipments have been revised down by 14% from earlier 2012 projections. With close to 50% of shipped offshore converters bearing a full-conversion solution in 2012, the growth of the offshore wind market is projected to have a direct impact on the use of full-conversion products into 2017 and beyond. It's also forecasted that medium-speed wind generators, between 80 to 600 revolutions per minute, will outpace the onshore wind generator market with an 8.5% CAGR in terms of megawatt shipments from 2012 to 2017.

### Chinese wind power

A third factor affecting converter sales is the Chinese wind power industry. China has a significant impact on the converter market because of their large market size. Last year, the country accounted for more than 25% of global converter shipments for the onshore utility-scale market.

Given China's importance in the wind converter market, their continued use of DFIG solutions certainly hasn't added to and has more than likely brought down the sales of full-conversion products. In fact, China's doubly-fed converter market is forecast to grow at a CAGR of 3.7%, in terms of shipments from 2012 to 2017, with the full conversion market declining by a -1.8% CAGR (in terms of units shipped during the same forecast period).

In summary, doubly-fed converters are expected to remain the pre-dominant technology in wind turbines and are projected to make up 73% of total wind converter shipments in 2017. Full-conversion products, meanwhile, are projected to become the industry standard for wind applications in the next 20 years, as rare earth prices stabilize and offshore wind development increases.

\* Report from IHS, a global source of critical insight and information. Businesses and governments around the globe rely on the expert, independent analysis of IHS to make high-impact decisions and develop business strategies.

IHS | www.ihs.com

# Finding Clarity

## Local ordinances for distributed wind power

By Lauren Glickman & Annie Sznajder

Few people realize what a complicated issue permitting and zoning can be when it comes to wind energy, and this is particularly true of distributed wind power. In some cases it takes more man-hours to permit a small wind installation than it does to manufacture, deliver, and install a turbine.

Distributed wind, or small and community wind power, is the use of small to medium-sized turbines for local homes, businesses, and communities. Generally, these turbines provide electricity on the retail side of the electric meter, without need of transmission lines.

In order to appropriately regulate wind power, however, it's essential for local leaders to understand the different types of wind power technologies, as well as the various ways in which they can be regulated. The most significant difference exists between small-scale, distributed wind turbines that are designed for onsite energy generation, and large, utility-scale turbines that are engineered for wind farms that product power for the grid.

Granted, there are many other differences in wind power technology. But, scale is one that has the most significance to local leaders regulating the industry. Utility-scale and distributed wind energy have very different regulation requirements. Over the past several decades, much more attention has been given to utility-scale regulations, mainly due to the differences in turbine technology.

Until recently, distributed wind didn't make sense for many communities. The technology was too costly, and the proper city ordinances or regulations weren't in place. But, both of these things are slowly changing with time.

### **Making sense of regulations**

Local governments use zoning, building permitting, and public safety regulations to protect their community residents and businesses. These decisions have direct impacts on the expense, efficiency, and eventual success of distributed wind power. For instance, local government decisions to delay or increase compliance requirements for wind projects can interfere with community demand for this resource and raise project costs.

As a result, many county leaders interested in fostering wind power in their communities are carefully considering how to address the interests of local residents and businesses, while at the same time finding ways to make small and community wind power possible from a cost and permitting perspective.

As a means to this end, a report has been published, entitled, "County Strategies for Successfully Managing and Promoting Wind Power," which offers clarity on local ordinances for distributed wind power. The goal of this report\*—first published in 2012, in conjunction with the Small Wind Model Zoning Ordinance—is to assist county leaders and the wind industry in working better together to protect public safety and property rights—



*With the help of a federally funded Residential Energy Assistance Challenge grant, a Bergey windmill now generates up to 10 kW of electricity for the Millstream Heights Apartments, a subsidized elderly housing complex in Winter Harbor, Maine. (Photo by Tom Walsh)*

while, at the same time, minimizing project expenses, streamlining permitting procedures, and increasing efficiencies related to successfully implementing distributed wind power.

The report also serves as a useful tool for county elected officials and planners to learn about local wind ordinance development, explore key ordinance criteria, and consider best practices from other counties. For example, the permitting process is often a daunting obstacle for counties, wind developers, and would-be consumers to develop. Few counties have added allowances for wind systems (even small-scale turbines) to their zoning codes, which can add red tape and delays to potential projects.

In fact, in some places, unfamiliarity with wind technologies has resulted in a complete restriction of wind development to avoid setting a controversial precedent. Fortunately, the report's recommendations and the Small Wind Model Zoning Ordinance are now being implemented across the United States.

In follow up to this effort, the Model Ordinance and a newly published Companion Document has been created to provide a uniform process for projects of 100 kilowatts (kW) and under. The Companion Document specifically focuses on the purpose and reasoning behind the recommendations in the Model Ordinance, including technical information, safety practices, and lessons learned over time. An expanded Model Zoning Ordinance, which will include projects over 100 kW, can be expected in the first quarter of 2014.

*\* The National Association of Counties (NACo) and the Distributed Wind Energy Association (DWEA) have partnered to address some of the zoning issues related to distributed wind generation. The first step in this partnership was the publishing of the report, "County Strategies for Successfully Managing and Promoting Wind Power."*

*Lauren Glickman is the communications manager for the Distributed Wind Energy Association (DWEA), and Annie Sznajder is the program manager for the DWEA.*

### **Distributed Wind Energy Association (DWEA)**

<http://distributedwind.org>

# Hybrid Solutions

## Supplying reliable power to off-grid industrial sites

By Del Williams



**WHEN OFF-GRID ENERGY IS REQUIRED** at remote industrial sites, the available renewable sources typically come down to two options: solar or wind power.

As the sun tends to be more reliable than the wind, solar power is often selected. It's a fairly inexpensive option that provides enough clean energy to power anything and everything from industrial site sensors, meters, and pumps, to the controllers and communication towers needed to maintain proper site operation. However, with the decreasing costs of small, off-grid wind turbines, which now operate in even the most modest wind conditions, wind energy is becoming a more viable solution.

A third choice exists, however, that can meet the power needs required in remote locations without having to choose one renewable power source over another: a hybrid solution.

Hybrid systems that incorporate solar panels and small or medium-scale wind turbines are enhancing the reliability of off-grid energy, and form an ideal complementary relationship with each compensating for the weaknesses of the other system. Where solar is best during the daytime, wind power works throughout the night. Where solar is better through the summer months, wind power tends to rule the winter months. And, on stormy and overcast days, wind power remains the best option for generating power.

### Remote power solutions

Maintaining continuous, reliable power at remote, off-grid substations is a critical concern in industries ranging from oil and gas to telecom, to mining and the railroad industry. If power is lost, key measurement and monitoring equipment, along with data communications can lead to production shutdowns, costing tens of thousands of dollars per hour in some cases.

"An unplanned power outage can cost tens of thousands of dollars in lost production and unscheduled downtime," explains Tony Kaspari, an electrical engineer at Beabout Company, which provides consulting services to many industrial businesses in the Rocky Mountain area, including electric utilities.

With high costs at stake, it might seem like an obvious solution would be to simply connect to the grid. But, often times, the power demands at off-grid industrial sites and substations just aren't large enough to make connecting to the grid feasible. Building extra power lines isn't simple, and is often quite cost prohibitive. It can cost anywhere from \$80,000 to \$100,000 per mile to run power poles or lay underground power cables.

"It simply doesn't make sense to run power for small power requirements," adds Kaspari. "[Especially when] integrating a \$1,000 wind turbine, with a new or existing solar power system, can ensure that production stays online even during adverse weather conditions."

### Built to last

Weather is a significant factor when it comes to off-grid power systems. Often times, the substations found in remote locations face challenging elements, from storms, hail, and snow, to high wind chills and more.

"Remote power systems need to be designed for the worst case scenario, which is typically in the dead of winter," says Brent Busenlehner, president of ReadyFlo Systems, a system integrator of remote power and automated control systems.

Solar power, though relatively inexpensive, is not always reliable when paired with batteries for power storage. To generate power, solar panels must collect sunshine at sufficient intensity and at the right angle.

In many states, however, there's limited daylight in the winter months. For example, South Texas averages only four or so hours of sunlight per day come December and January, and the Dakotas get even less than that—averaging maybe three hours of sunshine, according to the Department of Energy. In the worst case, there's simply no sun for potentially long periods of time. Moreover if any snowfall covers solar panels, power isn't generated until the snow melts or the solar panels are cleaned off.

In such cases, wind power complements solar energy because it produces the most power precisely when solar power is reduced or unavailable, such as at night, in inclement weather, and during winter. Throughout the winter months, average wind speed tends to

be at its highest, as is the air density—two factors that contribute to ideal wind generation.

### Off-grid turbines

To enhance power reliability and build-in redundancy, many off-grid industrial substations are now being retrofitted with small, off-grid wind turbines. Available in several models for areas with differing wind speeds and climates, such turbines are now available to generate power at wind speeds as low as six miles-per-hour. Depending on the conditions, off-grid turbines have been shown to generate as much as 40 to 80 kilowatt-hours (kWh) a month per turbine.

Even at a minimum rate, the wind is pretty much guaranteed to offer some power nearly every night when there will be zero solar energy to harvest. And, a single wind turbine is able to power several devices. If more energy is required, several turbines can be combined together. And, the combination of solar and wind power extends system capacity, making the threat of a complete power outage unlikely—an important benefit in a remote location that's tough to access.

Another benefit of adding wind power to a solar energy system is that it lengthens battery life by reducing the depth and frequency of discharge.

"Adding wind power to a solar system could potentially double battery life" says Busenlehner. Since off-grid industrial devices or substations are powered by wind when solar power is unavailable, this avoids drawing down the system's batteries, increasing battery life. "Extending battery life reduces system maintenance and replacement costs, and the savings can be significant."

According to Busenlehner, in most cases, it's relatively easy to retrofit a remote, off-grid site powered by solar only. "It's as simple as wiring the leads from the turbine to the batteries and adding some fuses, switches, and amp meters for equipment protection," he says. "It's even easier to integrate solar and wind power into a brand new system—making hybrid systems ideal for remote locations."

*Del Williams is a technical writer based in Torrance, California. He writes about business, technology, environmental, health, and educational issues.*

### Primus Wind Power

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



### Upgraded power package

Availon North America, an independent service provider (ISP) to the wind industry, is now shipping a new and improved Total Power Package, which includes an upgraded battery pack and upgraded battery charger. This latest innovation resulted from customers' feedback. The standard, OEM-provided battery packs have six cells permanently mounted through gluing each cell to the battery frame. But, if one battery degrades beyond operational specifications, the entire pack and frame must be replaced, which is costly to the owner. Plus, the battery packs are heavy and difficult to move around.

As a result, Availon has created a removable and reusable battery frame with individual slots for each battery cell. Rather than permanently gluing each cell into its' respective slot, it's mechanically secured with a proprietary redundant capture system for easy replacement. The aluminum capture bar secures all batteries to the pack frame; then, each individual cell is held to the battery frame with an elastic tension strap that can easily be unhooked for quick replacement during maintenance. The battery pack frame remains bolted into position in each axis cabinet, so service technicians are no longer required to carry the battery pack frame up-tower.

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



### Light-wind turbine

Nordex SE is extending the "Generation Delta" turbine platform with the addition of a turbine for light-wind locations. With the N131/3000, customers will not only be able to choose from strong and moderate-wind turbines, but now also from a highly efficient system specially designed for IEC-3 locations. The N131/3000 combines the proven advantages of the high efficiency and low sound power levels of the Generation Gamma's N117/2400 turbine, with the benefits of a high nominal output, and the technical advances of the Delta platform.

A special feature of the N131/3000 is the substantially larger rotor. With rotor blades measuring 64.4 meters in length, the rotor diameter is 14 meters larger, producing a close to 26% increase in rotor sweep. For this reason, the N131/3000 will achieve substantially improved project economics compared with existing turbines, particularly at light-wind locations. In fact, the N131/3000 can derive up to 28.6% more yield from sites characterized by lighter winds.

**Nordex SE** | [www.nordex-online.com](http://www.nordex-online.com)



### Diaphragm valves

Asahi/America, Inc. is now manufacturing its true union and flanged Type-14 diaphragm valves in the US. Asahi Type-14 diaphragm valves are available in sizes 1/2" through 2", with one-piece molded bodies of PVC, CPVC, PP, or PVDF. Available diaphragm materials include EPDM, FKM, or three-layer EPDM/PVDF/PTFE. In addition to assembly, Asahi also machines two integral parts of their Type-14 diaphragm valves in-house: the valve stem and sleeve. Three different stems and two sleeves are needed to complete the 1/2" through 2" range of valve assemblies.

Asahi's Type-14 diaphragm valve features visual position indication, weir design for excellent throttling capabilities, and built-in travel stop to prevent over-tightening and eliminate compressive strain. For maximum corrosion-resistance, the Type-14 diaphragm valve's body and bonnet are manufactured of solid thermoplastic materials. Asahi Type-14 diaphragm valves can be electrically or pneumatically actuated.

**Asahi/America, Inc.**

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

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**CONVERSION SYSTEMS**



# Tool and Equipment Management

## Training future turbine technicians

By Andy Ginger

**IT'S ESTIMATED THERE ARE MORE THAN 225,000** wind turbines operating in 79 countries throughout the world ([www.globalwindday.org](http://www.globalwindday.org)). That's a lot of wind turbines—and, each and every single one requires routine checks and maintenance. A challenge facing the industry is ensuring enough technicians are fully trained to keep those turbines spinning at optimal capacity.

Although the wind power industry is still in its infancy in the United States, some technical schools and community colleges are beginning to implement wind power-specific education for students to learn about turbine design and control systems. However, to support technical schooling, the wind power industry must address some specific issues when it comes to tools and tool management.

### Overcoming obstacles

Two challenges currently exist related to tool and equipment management in the wind industry: education and required workers.

Training technicians to properly and safely use tools and equipment is especially significant in wind energy, as often time maintenance and repair crews must work at heights of well over 100 feet, depending on the project scale.

This is where suppliers fit into the equation. To ensure safe and proper tool use, some suppliers have developed product-specific user certifications for tools, equipment, and asset management. To help facilitate these certifications, the National Coalition of Certification Centers (NC3), a network of education providers and corporations that support advances and validate new and emerging technology skills in a number of industries (including wind power), have partnered with certain suppliers to develop tooling standards and certification.

But educational and certification programs can't benefit anyone if people aren't interested in a career in skilled trades—the second challenge facing the wind industry as discussed herein. There seems to be a current shift underway of young people shying away from engineering and maintenance vocations. The drought of skilled workers is leaving many good paying jobs unfilled. Some estimates have tabbed the number as high as 600,000 vacant skills and manufacturing jobs available in the US. Good opportunities are available to properly trained individuals.

### The face of the industry

To some extent, the skilled trades are facing an image crisis. The key to filling the employment gap in the wind maintenance and engineering industry lies in changing the view of this field. The industry is often synonymous with images of a noisy, dirty, and tough working environment, which offers little appeal to most. Such stereotypes are hampering the recruiting efforts of young people into skilled trades, and could hinder growth of the wind power industry.

The reality today is that many high school students think of a traditional, four-year college as their first option and, often times, a career in a skilled labor field isn't top of mind. However, in only two years, interested students can receive a technical degree and start working in a meaningful job that offers career advancement, and a decent living.

Gaining skills and working in the wind energy industry is a career that's highly automated. It's tough and challenging, but in a good way—with the appropriate knowledge and training. What students should be aware of is that a technical degree can often provide a much quicker path to employment, is often less expensive than a bachelor's degree, and comes with reasonable assurance that a job will be available following course completion. And, that job may be building or maintaining massive wind turbines.

For the wind power industry, the most applicable certification courses include multimeter, torque, and asset management. Multimeters are one of the most important tools used by wind energy technicians due to the sophisticated electrical and electronic components, as well as the monitoring systems employed in wind turbines.

A thorough understanding of torque is also important as wind turbines have more than 600 fasteners, and all of which require proper torque. Torque certification dives deep into how to identify bolt grades, metal grades, hardness, thread pitch, and lubricants, while applying the associated science. It should also include theory, such as application, hands-on training, and safety and calibration equations.

Technicians who complete asset management certification should leave with an understanding of general asset management principles, which consists of tool control theories, and foreign object damage/foreign material exclusion (FOD/FME) principles and prevention. Asset management certification provides practical advice and recommendations to manage tools, at a jobsite and in a wind tower.

Great opportunities exist to those who pursue a career in the skilled trades. But special skills and training are required to keep high-tech equipment, such as wind turbines, operating at their best. Promoting industry jobs and proper tool and equipment training are essential steps in ensuring the development of future wind power as a successful, renewable energy source.



Andy Ginger is president of Snap-on Industrial.

*Snap-on offers technical schools and colleges eight fully-developed training modules that teach technicians the proper and best way to use tools and equipment, in specific disciplines including wind power, to become more productive in their jobs.*

**Snap-on Industrial** | [www.snapon.com](http://www.snapon.com)

SEE AD ON PAGE 30



**CRANE RENTAL CORPORATION**  
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**Crane Rental Corporation**

**Brand:** Manitowoc  
**Product:** Manitowoc 18000 Crawler Crane  
**Max boom length:** 610 feet  
**Max capacity:** 825 US tons

**Key Features:**

- Well-suited for 100-meter towers, Crane Rental Corporation's three Manitowoc 18000s feature a 25-foot extended upper boom point;
  - Up to 380 feet of main boom maintains capacity for 125-ton nacelle lifts; and
  - Its 600-ton capacity Terex AC500 excels in handling blades, due to its quick set-up (plus, for maintenance work); and
  - Its Trail King Dual Lane trailer offers greater safety for transporting nacelles.
- Website:** www.cranerental.com



**Manitowoc Cranes**

**Brand:** Manitowoc

**Model:** Manitowoc 16000 Crawler Crane

**Max boom length:** 315 feet

**Max capacity:** 440 US tons

**Available attachments:**

- 16000 Wind Attachment, which boosts the maximum height and short-radius capacity of the standard Manitowoc 16000 crawler, enabling the crane to install most 2.5 MW wind turbines (and several larger ones) on towers ranging from 262 feet to 279 feet.
- Boom Raising System (BRS), which increases the available boom length to 351 feet, plus 25 feet for the extended upper boom point. The BRS is added to the 16000 Wind Attachment, allowing the crane to raise more boom to set wind turbines on towers up to 330 feet, without the need for an assist crane or outriggers.

**Additional features:**

- Increased flexibility, with optional 100 US ton capacity fixed jib, 200 US ton luffing jib, and capacity enhancing MAX-ER attachments;
- Independent, closed-loop hydraulic system delivers unmatched power and speeds; and
- EPIC system, featuring CAN-bus technology to offer smooth, precise, independent control—the crane can boom, hoist, and swing at same time with minimal power and speed losses.

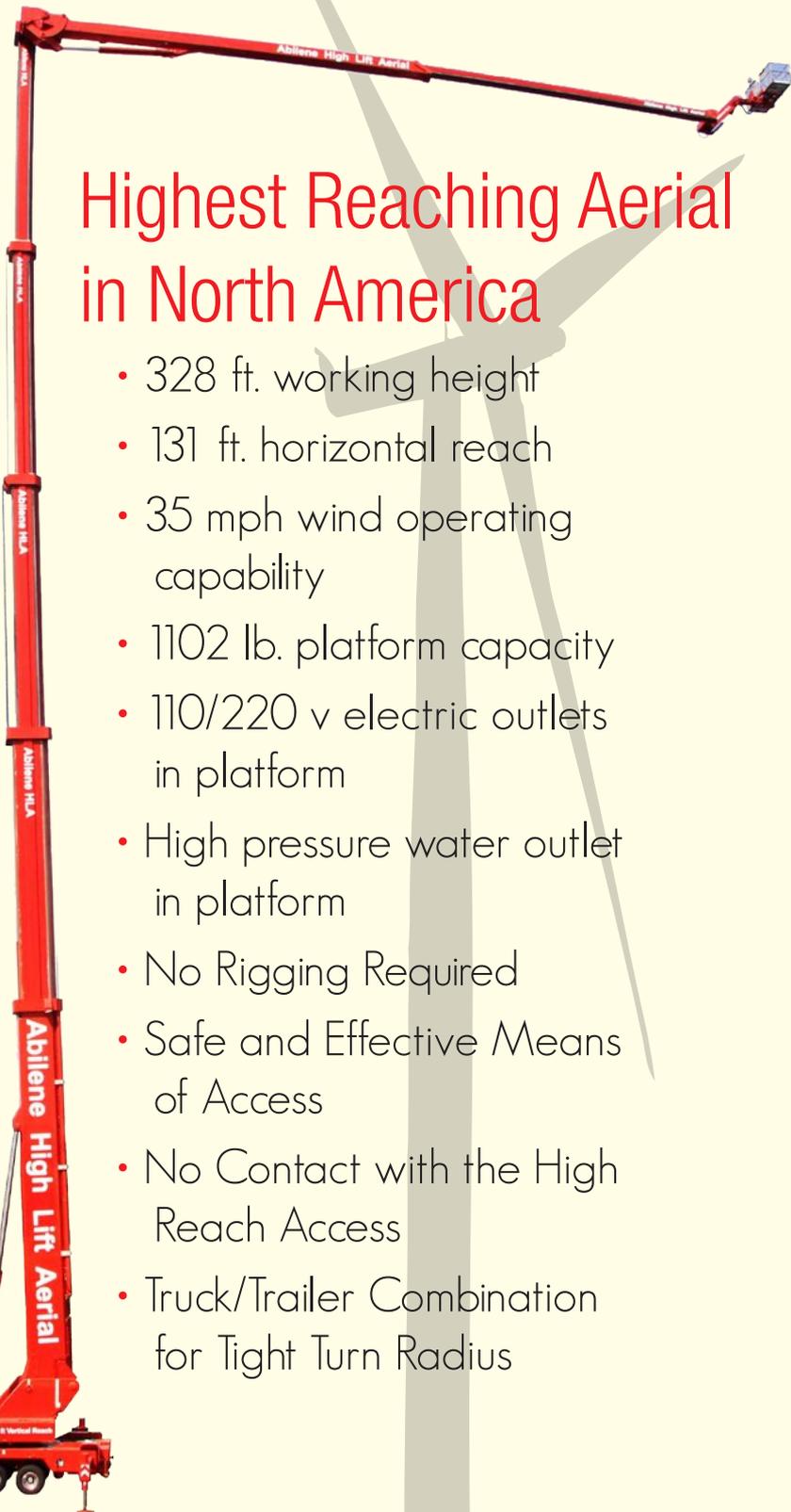
**Website:** www.manitowoccranes.com

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### Buckner HeavyLift Cranes, LLC

**Brand:** Liebherr

**Model:** LR1600/2

**Max boom length:** 453'

**Max capacity:** 660 US tons

**Available attachments:**

- Fixed jib lengths 39' to 118'; and Luffing jib lengths 79' to 315'.
- Derrick attachment system utilizes either a suspended tray or a ballast wagon, capable of using up to 770,000 pounds of additional counter weight to enhance overall lifting capacity.

**Additional features:**

- Liccon Software system, which produces interactive lift-planning and load-chart selection in real-time, enabling the user to efficiently pre-plan any potential lift situations;
- Ballast wagon/Tray system allows user to hydraulically manipulate the counterweight fore and aft—during an actual lift to avoid site obstructions; and
- The popular wind turbine configurations include: the SL3F using 276' main boom and 39' of fixed jib (for 80 meter towers), and the SL3F using 344' main boom and 39' of fixed jib (100 meter towers).

**Website:** [www.bucknercompanies.com](http://www.bucknercompanies.com)



### Liebherr-Werk Ehingen GmbH

**Brand:** Liebherr

**Product:** Liebherr Crawler Crane Type LR 1600/2

**Max boom length:** 472 feet

**Max capacity:** 660 US tons

**Available attachments:**

- Specially optimized fixed jib for wind power, allows for work on 80 m to 140 m towers;
- The luffing Jib has integrated heavy-lift vessel lifter capabilities; and
- Derrick and ballast systems are available.

**Additional features:**

- The new SL5DFB boom system offers leading capacities in the 660 US ton class—to more than a 500-foot hook height;
- Two-meter crawler shoes, with a four-fold drive are optional;
- An available narrow-track chassis allows optimal driving on narrow roads (the total width of the crawler chassis is only 19 feet); and
- The chassis is also available with optional radio remote control for driving and supporting.

**Website:** [www.liebherr.us](http://www.liebherr.us)



### ALL Erection & Crane Rental

**Brand:** Liebherr

**Model:** LTM 1750-9.1

**Max boom length:** 171'

**Max capacity:** 900 US tons

**Available attachments:** N/A

**Additional features:**

- The LTM 1750-9.1 offers unprecedented mobility, transportability, and quick assembly—all on a chassis no longer than that of a 600-ton crane;

- The road-friendly LTM 1750-9.1 can travel at less than 155,000 lbs GVW by easily removing the complete telescopic boom, the upper engine, and the rear outriggers;
- Once at a jobsite, the stronger than average boom can be self-installed with the aid of an auxiliary rolling power pack (without the use of a boom launch trailer); plus, the rear outriggers also self-install so that one outrigger can be done in less than 10 minutes; and
- The availability of crab steering mode on the fly offers a driver the ability to seamlessly switch between standard steer and crab steer without needing to raise an axle.

**Website:** [www.allcrane.com/FeaturedLiebherrLTM1750.aspx](http://www.allcrane.com/FeaturedLiebherrLTM1750.aspx)

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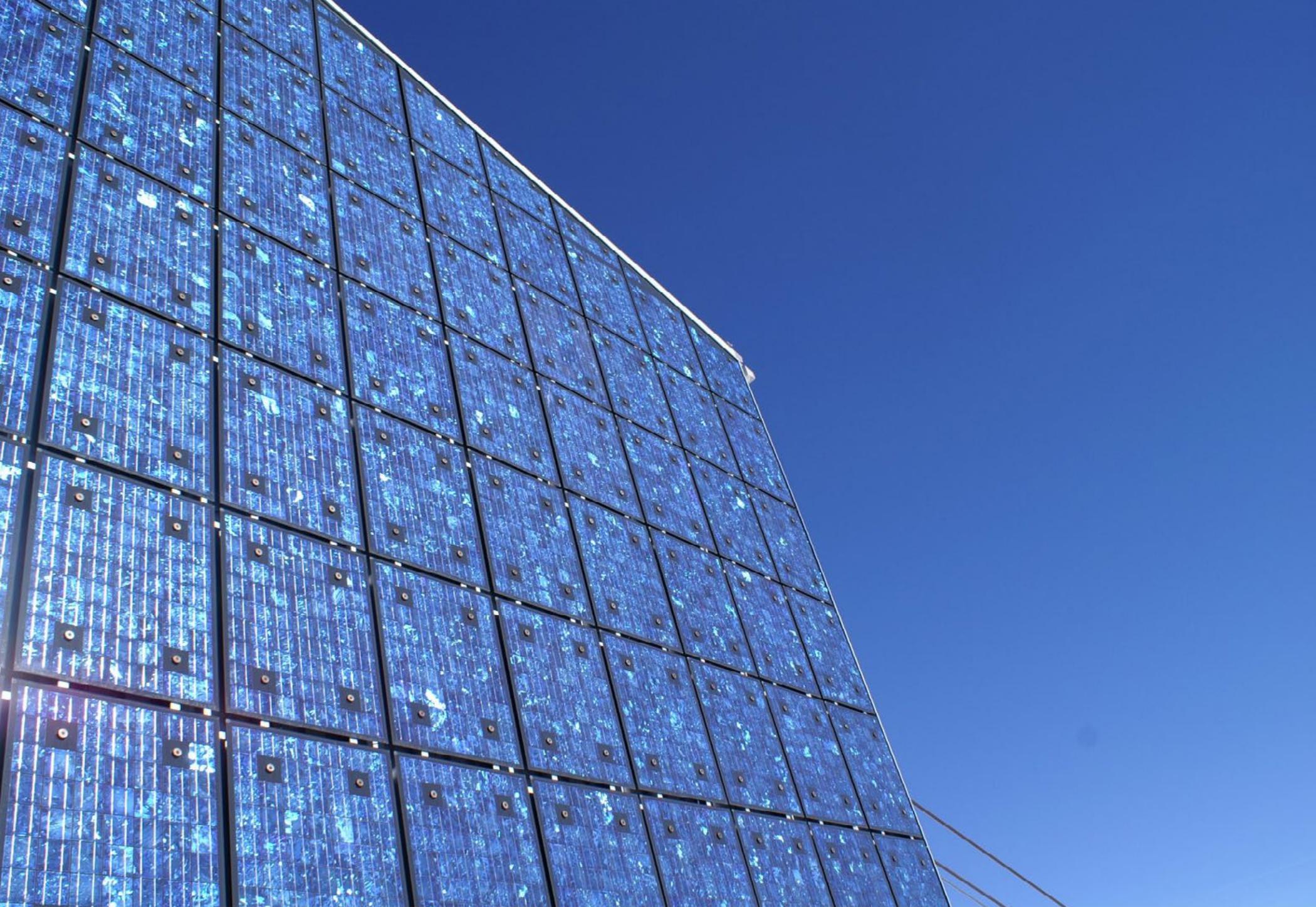


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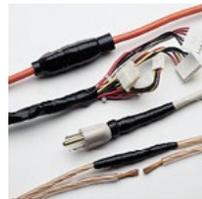


# 2014



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  - Solar simulation chambers
  - Solar water pumping

## ADHESIVES, SEALANTS & TAPES



### MOCAP

MOCAP's X Treme Tape is a self-fusing silicone insulating and repair wrap. This tape provides low-cost insulation, yet it's strong enough for extreme environments. It has no adhesive, as X Treme Tape bonds to only itself and will completely fuse into a single insulating wrap after 24 hours. The stretch-seal will retain its elastic memory, creating a permanent airtight, watertight seal in seconds. It resists low and high temperatures, as well as acids, fuels, oils, solvents, salt water, and UV rays.

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

## ALUMINUM EXTRUSION & METAL FABRICATION



**sapa:**

### Sapa Extrusions North America

Sapa Extrusions, a global manufacturer of aluminum profiles, works with customers to establish finished designs for custom features and improved end-use applications. Sapa's manufacturing capabilities include standard and custom extrusion, finishing (painting and anodizing), as well as full fabrication and logistic services. Sapa provides solutions to all solar market segments including: PV racking and mounting systems (open field, flat roof, and residential); solar thermal (H<sub>2</sub>O) applications; module frames and components; concentrated solar power collectors, inverter housings and components; and thermal management solutions.

[www.sapagroup.com/na](http://www.sapagroup.com/na)



### Elixir Industries

Elixir Industries offer full-service metal fabricating and processing, including: advanced CNC laser/plasma cutting; plate cutting; CNC punching and forming; CNC press braking; roll forming; MIG and TIG welding; powder coating; aluminum extrusion with fabrication processes; welding; and advanced CNC water-jet fabrication. Elixir Industries continues to offer new and existing customers lasting relationships based on quality, service, and adaptability.

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

## BALANCE-of-SYSTEMS (BOS)



**Blue Sky  
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### Blue Sky Energy

Blue Sky Energy is a manufacturer of PWM and MPPT solar charge controllers. Solar Boost charge controllers are deployed worldwide in battery-based off-grid systems. Used in a wide variety of applications—from industrial, telecom, pumping and traffic signals, to RV, marine, homes and lighting—Solar Boost charge controllers have a reputation for performance, proven reliability, and consistent quality at affordable prices. Blue Sky Energy's products are pre-dominantly manufactured in the US. Products are sold worldwide through wholesale distribution.

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



**Continental Control Systems LLC**

### Continental Control Systems

Continental Control Systems announces its new line of Certified WattNode Revenue electric energy and power meters for sub-metering applications requiring revenue-grade/utility-grade accuracy. The WattNode Revenue meets the accuracy requirements of ANSI C12.1, and was recently added to CA's list of eligible system performance meters. The WattNode Revenue offers a low-cost, high-accuracy option for bi-directional (production and consumption) energy metering.

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



**Ingeteam**

### Ingeteam, Inc.

Ingeteam has extensive experience in the design and supply of solar PV inverters, offering customers solutions for the equipment of large-scale PV plants. With a 500 MW production capacity in the US, Ingeteam offers: inverters with output powers ranging from 2.5 kW to 880 kW for grid-connected systems and integrated solutions for utility-scale projects; hybrid inverters for stand-alone systems; string boxes; and tools for inverter interconnection and display of the system parameters via web or PC.

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



**JOYCE**

### Joyce Dayton Corp.

Joyce/Dayton Corp. designs and manufactures jacks to move large arrays in utility and commercial installations. Actuators to move smaller trackers for PV, CPV, and CSP are also available. ComDRIVE jacks include gear reducers and motors, and can move 50 tons or more. Solar actuators, powered by DC motors, can move up to two tons. Joyce products are routinely adapted for individual customer needs. Joyce systems are being used to track nearly three gigawatts of power on six continents. Joyce provides cost-effective products and solutions to address solar project challenges

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



### Lufft USA, Inc.

Lufft has been involved in the production of precision climate measurement equipment since the company was founded in 1881. The precision workmanship of highly skilled specialists has enabled Lufft to be known as a manufacturer of quality solar and renewable energy products worldwide. Lufft products and equipment can be found wherever there's a need to measure or record atmospheric pressure, temperature, relative humidity, and other environmental variables.

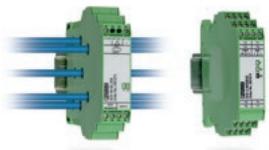
[www.lufft.com](http://www.lufft.com)



### Midnite Solar

Midnite Solar's KID is currently one of the most versatile, medium-sized, 30-amp MPPT charge controllers on the market. Ideal for small renewable energy systems, the KID allows for true input paralleling. As power needs grow, it's possible to add more modules to the array, and add on a second Kid.

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



### Phoenix Contact

Phoenix Contact's new Solarcheck system can monitor string currents in large-scale DC photovoltaic installations. Solarcheck provides continuous measurement of string currents and voltages, allowing immediate detection of faults and associated production downtime. This enhances system availability and increases the revenue generated by the PV system. The modular Solarcheck system is easy to integrate into existing network structures.

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



### Sunmodo

Sunmodo's best selling product, Ez Roof Mount kit with L Foot for shingle roofs, provides quality, reliability, and price performance. Not only is it easy to install, but it's watertight and durable when used with any composite or shake roof. Ez Roof Mount kit with L Foot has been certified under IAPMO ES for 100% IBC and ICC compliance, as well as for the watertight compliance UL 411 criteria. Available in clear or black.

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

## BATTERY | ENERGY STORAGE



### Advanced Power Products

Sun Xtender Batteries, from Advanced Power Products, are developed to offer flexibility when designing battery bank layout and configuration options for solar energy systems. Sun Xtender Batteries are constructed with valve-regulated lead acid (VRLA) absorbed glass-mat (AGM) technology, for a non-spillable battery that's maintenance-free. Thicker plates than the industry standard are pasted with a high-density formula for excellent cycling capability, better float life, and extended battery life. Robust intercell connections are fusion-welded for increased strength and lower resistance, in contrast to commonly used "through the partition" spot welds, which are often a weak point. Sun Xtender's copper alloy terminals provide an improved, low-resistance electrical connection.

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

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### 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)



### Rolls Battery Engineering

Rolls Battery now offers the new, six-volt FC-420. A flooded calcium stationary battery, the FC-420 provides a robust, lower-cost alternative to equivalent capacity-sealed (VRLA) models. Best-suited to float/stand-by applications, the use of calcium grids lowers internal resistance and off-gassing during charge, reduces self-discharge rates, and can sustain prolonged periods in float applications with nominal maintenance.

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



### GNB, Division of Exide Technologies

GNB'S valve-regulated lead acid (VRLA) stationary batteries for solar energy projects and storage are available in large-format, two-volt cells (Absolyte) and small-format, 12-volt blocs (Sunlyte). Made in the USA, they offer long duration and deep cycling, which is ideal for renewable energy applications.

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



### Telergon S.A.U.

Telergon's S6000 and S5000 DC load break switches are UL listed to the UL98B standard at 1000 VDC. They're typically used in string combiner boxes, re-combiner boxes, and inverters, and can be used to safely disconnect live, direct-current at up to 1000 VDC. Telergon's S6000 switches are rated for 250 amps 1000 VDC, allowing grounded and ungrounded configurations without the use of jumpers. The S5000 switches are available for 400 amps, 600 amps, and 800 amps, with external jumpers.

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

### COMPONENTS | ELECTRICAL PROTECTION



### ILSCO

ILSCO is a component manufacturer, supplying grounding, bonding, and connectivity solutions to the solar industry. ILSCO SOLAR lay-in connectors are certified to UL 2703, and feature stainless steel hardware. Some offer a unique, patent-pending clamp design, which eliminates the need to drill holes in the frame or add mounting hardware. The SGB-5 provides an elevated conductor wire way to accommodate various rack and panel designs, and is CSA certified.

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



### WILEY – a division of BURNDY

As PV technology has evolved, old grounding solutions are no longer proving as effective. To help meet the demand, BURNDY now offers the Wiley WEEB (Washer, Electrical Equipment Bond)—a simple, consistent, and low-cost method to bond PV module frames and racking. The WEEB is inserted between the module frame and mounting rail. When the WEEB's teeth pierce the anodized coating, the result is excellent conductivity without oxidation bonding the PV module frame with the metal racking structure.

<http://we-llc.com>



### Eaton

A global power management company, Eaton is making cost-effective, reliable solar generation a reality for utility and commercial customers. Eaton offers a complete portfolio of balance-of-system (BOS) solutions. Eaton's solutions are helping the industry maximize solar harvest, reduce installation costs, maintain reliable operations, and enhance project safety.

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



### U.S. Battery Mfg., Co.

U.S. Battery manufactures a variety of deep-cycle batteries, including for solar and renewable energy projects, which are all manufactured in the US and are distributed worldwide. Their RE-Series deep cycle batteries are available in both six-volt and two-volt configurations.

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



### MK Battery / Deka Solar

MK Battery is the supplier of Deka Solar Batteries for the renewable energy industry. The Deka Solar line includes Sealed VRLA Gel and AGM batteries, in multiple configurations, as well as select flooded products. The DEKA Solar GEL batteries are a premiere, deep-cycling choice for renewable energy applications. They are designed for use in even the harshest environments, using IPF technology (individual plate formation), Thixotropic GEL, along with 250 QC checkpoints—from raw materials to finished product.

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



### A123 Energy Solutions

The A123 Energy GSS is a fully integrated lithium ion energy storage system that's ready to interconnect to the grid, and includes power conversion, thermal management, and A123 Energy's proprietary AEROS controls suite. The standard containerized units are easy to site and permit, consuming no fuel or water, and releasing no emissions. They can also be customized to fit to the exact installation needs.

[www.a123energy.com](http://www.a123energy.com)



### OBO Bettermann of North America

OBO Bettermann offers a complete line of cable management products designed with solar installations in mind. Their cable tray systems help route cables along solar arrays and, with the unique line of self-connecting trays, installation has never been faster or easier. OBO Bettermann's surge protection products have been specially engineered for the solar industry to help protect valuable converters and other system components.

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



### Wohner USA LLC

Wohner produces AMBUS EasySwitch (AES) and AMBUS EasyLiner (AEL) 1000 VDC fuse holders for PV applications. These fuseholders are targeted at North American solar combiner box manufacturers who build to the UL1741 standard. The products offer a UL4248-18 listing at 1000 volts DC for 10x38 fuses as large as 30 amps. They are available with or without LED-indicator lamps. AMBUS EasyLiner mounts directly to metric dimension busbar, eliminating the need for comb-style busbars.

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



**Carling Technologies**

Carling Technologies offers maximum protection for PV systems with their CX-Series Circuit Breaker & Disconnect. This UL 489B-approved, best-in-class circuit breaker and disconnect features an innovative arc quenching design, which allows the breaker to handle high-amperage and DC voltage applications. With an industry best rating of 100 A, 600 VDC in a compact two-pole configuration, the CX-Series breaker guarantees maximum protection and efficiency for PV systems.

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



**Schweitzer Engineering Laboratories, Inc.**

Schweitzer Engineering Laboratories (SEL) serves the electric power industry through the design, manufacture, and support of products and services for power systems worldwide. SEL's power interconnect, protection, communications, control, and metering products are ideal for renewable energy and distributed power, including for photovoltaics and other renewables. SEL offers unmatched local support and a worldwide, 10-year product warranty.

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



**EPCOS, Inc., TDK Corporation**

TDK's broad line of power line chokes, with the ability to modify, offer an ideal choke for solar inverters. They cover inductance values 0.2 mH to 100 mH, and have a current capability to 54 A with double and to 62 A with triple power line chokes. Chokes are available for up to 1000 volts, with a resistance of 1.5 mOhm to 2800 mOhm. Rated voltage is 250 V AC for double and 690 V AC for triple variants. Designed for temperatures 40° C to 85° C (104° F to 185° F), they are available in vertical or horizontal versions.

[www.epcos.com/inductors](http://www.epcos.com/inductors)



**SCHURTER, Inc.**

SCHURTER is a progressive innovator and manufacturer of circuit protection, connectors, switches, and EMC products for the solar electronic and electrical industries worldwide. Three divisions—Components, Input Systems, and Electronic Manufacturing Services—provide customers with specific products and services, focusing on a clean and safe supply of power that helps make equipment easier to use.

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



**Rotek Incorporated**

Rotek Incorporated is a manufacturer of large-diameter slewing bearings and rolled ring forgings. Rotek slewing bearings are used in various applications, including in solar energy panels where tracking is critical. Offering full engineering support, Rotek manufacturers large-diameter, lightweight solutions with consistent repeatability, for intermittent or oscillating needs, as well as for any design scenario where precision is needed with other components.

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



**Semikron**

The Semikube platform is a solution that meets the market demand for a cost-effective, flexible, and compact power electronic system. It can be used for a wide power range, from of 75 kW to 1 MW. The total solution consists of a highly efficient heatsink, power electronic modules, gate driver, DC-link capacitor bank, and a sturdy metal frame.

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

**CONCENTRATED SOLAR POWER**



**Thermal Energy Products, Inc.**

Thermal Energy Products, Inc. is the original fabricator of "Solar-Wrap" Swivel Arm Ball Joint Insulation Blanket Assemblies. Their Solar-Wrap Assemblies, and already proven materials, remain to be some of the most widely used and a trusted choice, found in most CSP plants and ISCC solar plants worldwide. Founded in 1986, Thermal Energy Products has provided Removable Insulation Blankets for many industries such as power plants, refineries, solar, and more.

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



**California Sunlight Corporation**

California Sunlight Corporation offers a variety of solar energy systems, including active daylighting and micro-CPV. They also offer solar-powered portable devices, such as BBQs, solar ovens, and inflatable solar cookers. Based on multiple patented and patent-pending technologies of collecting and concentrating sunlight, these systems with automatic sun tracking are highly efficient, multi-functional, and cost-effective.

[www.california-sunlight.com](http://www.california-sunlight.com)



**Glasstech, Inc.**

Glasstech's CRB-S System has been specifically designed for CSP applications for high output, ease of operation, and high repeatability for forming flat glass into parabolic or cylindrical shapes. The glass shapes produced on the CRB-S system can be heat strengthened or fully tempered. Fully tempered glass provides increased impact and wind-load resistance. Plus, if broken, it's much safer than annealed glass. The system uses less energy than traditional sag process, and can process up to 189 glasses/hour.

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

**CONSULTANTS | BUSINESS & ENVIRONMENTAL CONSULTANTS**



**Ecology and Environment, Inc.**

Ecology and Environment, Inc. (E & E) offers all the professional environmental support required to site, permit, and operate solar energy generation and transmission facilities. E & E covers all the bases—from water supply, wetland considerations, and ecological impact studies, to land use, socioeconomic analyses, and community outreach. Operating across the US, with subsidiaries and affiliates around the world, E & E provides global energy industry experience, including environmental support for more than 3,4,400 MW of PV capacity. Their skilled, multidisciplinary project teams help solar energy developers get the green light faster when it comes to solar projects.

[www.ene.com/service/energy/solar.aspx](http://www.ene.com/service/energy/solar.aspx)



GLOBAL ENERGY SERVICES

**GES USA, Inc.**

GES provides construction and services for the renewable industry, globally. As a provider of multi-technology services, GES has worked with solar panels from leading suppliers, and with different manufacturers of inverter and tracker equipment. For the solar energy sector, GES provides: electrical and mechanical installation of solar panels and their associated infrastructures; control systems (they have developed their own control system and standard application), including permitting and 24/7 local control and remote supervision; as well as integral maintenance and operation of solar plants and associated infrastructures.

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



**REC Solar Commercial**

REC Solar, Inc., specializes in the design, construction, and maintenance of grid-tied, solar electric power systems, offering affordable solar solutions for commercial, government, and utility consumers. REC Solar is a full solar solution provider, offering comprehensive, end-to-end solar electric solutions that include quality equipment and construction, expert engineering design, as well as on-going service and support and affordable financing programs.

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

# The Center of Your Solar System



## CROWN RENEWABLE POWER BATTERIES

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



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

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

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

Contact us for more information: 419.334.7181  
[www.crownbattery.com](http://www.crownbattery.com)  
[sales@crownbattery.com](mailto:sales@crownbattery.com)



### Bureau Veritas North America, Inc.

Bureau Veritas North America, Inc. provides Quality, Health, Safety & Environmental services to private companies and public organization to validate integrity of construction, design, and operation of renewable and solar energy projects. They are involved in the global testing, inspection, and certification markets. Solutions to challenges arising from compliance with regulations and standards, reducing risk, and improving performance are also offered.

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



### Dillon Consulting Limited

Dillon offers a wide range of consulting services related to the resource, industry, government, and real estate sectors from offices across Canada. Their work includes infrastructure design and management, community planning and development, environmental services, as well as facilities planning and design. These major business areas are supported by professional engineers, architects, landscape architects, planners, and physical and social scientists, operating in over 30 distinct disciplines, including the solar energy industry.

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



### Wanzek Construction, Inc.

Wanzek Construction, Inc., a MasTec company, is a zero-injuries construction firm specializing in renewable energy sectors, including solar power. Wanzek provides full, turnkey construction services of a solar facility, including the civil work, installation of the system, AC and DC electrical, as well as the interconnection to include transmission and substation work as required. For over 42 years, Wanzek has been building long-term relationships with customers, fostering repeat work based on safety, experience, and trust.

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

## CONTRACTORS



### Blattner Energy, Inc.

Blattner Energy is a diversified engineering, procurement, and construction (EPC) contractor, providing construction solutions for the power delivery industry and leading expertise in renewable energy construction. With more than a century of experience building large-scale projects across the US, Blattner provides complete EPC services for commercial and utility-scale PV, CPV, and CSP solar projects. Blattner's proven project management skills and self-performance of all major work activities allow them to deliver the highest levels of safety, quality, schedule, and productivity on every solar project.

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

## DEVELOPER | EPC SERVICES

### KPV Solar N.A.

KPV Solar N.A. provides photovoltaic engineering, procurement, and construction (EPC). Working with clients along the way to help develop, finance, and build their solar projects, KPV Solar plans and constructs large-scale PV power plants for international investors. Based on a highly automated PV panel production technology, linear performance warranty, optimized planning, and technical support, they help deliver high electric yields, guaranteeing project return-on-investments.

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



### Rosendin Electric

Rosendin Electric has quickly established itself as an engineering, procurement, and construction (EPC) builder of mid- to large-scale solar PV and CPV systems throughout the United States, Guam, Puerto Rico, and Canada. With over 100 MW of project installation experience to date, Rosendin Electric is an employee-owned company, bringing turnkey expertise and EPC capabilities to develop efficient and cost-effective solar solutions to customers.

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



### Martifer Solar

Martifer Solar is a provider of fully integrated solutions for the successful implementation of solar photovoltaic projects. The company provides turnkey engineering, procurement, construction (EPC), project development, and operation and maintenance (O&M) services in the commercial and utility-scale markets. Martifer Solar has installed more than 400 MW worldwide among diverse segments, such as ground-mounted, rooftop, BIPV, and solar canopies.

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

## ECONOMIC DEVELOPMENT

### City of Milwaukee Solar Program: Milwaukee Shines

Milwaukee Shines, the City of Milwaukee's solar energy program, is a project of the Office of Environmental Sustainability. The program educates the public, provides training opportunities for professionals, and makes it easier to go solar by providing financing solutions. Milwaukee Shines supports the community's strong and expanding solar supply chain.

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

## ELECTRICAL WIRE, CABLE & CONNECTORS



### AerosUSA, Inc.

AerosUSA's wire and cable protection products and strain relief cable glands provide quality and durability to the solar industry. The Flexa cable protection products include: polyamide and metallic conduit systems; clamping and support systems; PG, NPT, and metric fittings; EMC shielding; and fiber-optic cable protection. Agro's patented lamellar technology guarantees performance in cable-gland strain reliefs. Short and long entry threads, as well as high-distortion protection ensures a guaranteed seal.

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



### American Wire Group

American Wire Group is a renewable energy cable partner, providing a variety of electrical cable and wire solutions to the solar market. Products include: 15 kV to 35 kV TR-XLPE/EPR; Aluminum ACSR/AAAC/AAC; PV AL cable; Bare CU; AL or CU clad steel; power cables; static/guy wire; control cables; fiber optic cables and hardware; and OPGW. American Wire Group also offers TowerGuard CCA 2 kV, which is ideal for inverter modules, and TE/Raychem products, which links solar power sources to the grid and beyond.

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



### General Cable

General Cable is a global wire and cable solutions provider for solar applications from the sun to the outlet. Engineered to withstand the harsh operating environments of solar power applications, their full line of SunGen PV wire is made in accordance with UL 4703 and CSA RPVU90, offers superior resistance to UV sunlight, and meets the requirements for direct burial. General Cable's STABLOY Brand MC Cable, an all-in-one metal clad assembly installed as DC feeder cables for connecting combiner boxes to inverters, eliminates the need to install conduit while providing increased reliability. From low-voltage DC and AC connections and medium-voltage distribution, to high-voltage overhead and underground transmission lines, General Cable has the offering to comprise a complete cable solution for solar power applications.

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



### Industrial Wire & Cable Corp.

Industrial Wire & Cable Corp. manufactures single-conductor photovoltaic wire in integrally insulated and jacketed XLPE, as well as in XLPE insulated with non-integral thermoplastic jacket constructions. PV wire is available with a 600-volt or a 1000/2000-volt rating, and is suitable for direct-burial installation. Industrial Wire & Cable Corp. offers solutions for nearly all PV wiring requirements. UL Listed and CSA Certified, their PV wire is built and tested to perform.

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

# TWO PARTS. ONE TOOL. ZERO ISSUES.



The Unirac Roof Mount introduces the **Power of Simplicity** to the ballasted flat roof solar industry, consisting of only two major components; a fully assembled ballast bay with 10 degree tilt and module clip. Easily design around roof obstacles, support most framed crystalline modules and bond the system with just the turn of a wrench.



Multi-Contact

MC

STÄUBLI GROUP

### Multi-Contact USA

Multi-Contact is a full solutions provider for PV connectors and junction boxes, featuring advanced contact technology. Its MC4 photovoltaic connector is the global industry standard, designed to meet all PV needs. The MC4 is now rated up to 1000 V UL, and is available for 8 AWG cable configurations. MC4-EVO 3 is fully compatible with MC4 connectors, and is currently the only solution rated at 1500 V TUV safety class II. Multi-Contact connectors are characterized by low-contact resistance and long-term reliability, thereby optimizing profitability. For safety and compliance, MC4 connectors do not cross-mate with connectors from other manufacturers.

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



**Remke Energy**  
PRODUCTS FOR A RENEWABLE WORLD

### Remke Energy

Remke Energy offers an expanded family of Helio-Link solar products, including: MC/Type 4 field wireable and bulkhead solar connectors; eight- to 18-gauge PV/USE cable; assembly and installation tools and kits; thin-film junction boxes and combiner boxes; custom cable assemblies; as well as grid-tie products for grounding, bonding, and termination. With shipping in one to two days, they offer 15,000 electrical products in stock at The Remke Energy Online Warehouse.

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



### Anderson Power Products

Solar SPEC Pak, from Anderson Power Products, meets the PV industry requirements specified in UL 6703A and BS EN50521, passing the same tests used to qualify solar panels. With power-handling capabilities up to 1000 V, it features a locking latch compliant with NEC 2008 section 690.33(C). The IP68 environmentally sealed shell has a flammability rating of V-0 per UL 94, weatherability rating of F1 per UL 746C, and a temperature range from -40° C to 105° C (-40° F to 221° F). The SPEC Pak shell holds up to four power contacts, 16 signal contacts, or a combination of both. Individual power contacts are rated to 40 A, with wire sizes from 20 AWG to 10 AWG (0.50 mm<sup>2</sup> to 4 mm<sup>2</sup>). Ground contacts are First Mate/Last Break, per NEC 2008.

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



### CAB Products

CAB Cable Rings & Saddles are a superior quality cable management system for larger-scale, ground-mount PV systems. Popular in the electrical industry for over 30 years, CAB Cable Rings & Saddles have been time-tested in the most corrosive electrical, utility, and industrial projects in the world. They offer an innovative, simple, and cost-effective solution for controlling all types of solar cables. Their labor and material costs can be up to two-thirds lower than typical cable trays.

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



### HARTING, Inc. of North America

Han Q 2/0, Han Q 3/0, and Han Q 4/0 connectors from HARTING introduce compact and robust solutions rated for up to 830 V and 40 A. Suitable for extreme environmental conditions, HARTING Han Q connectors provide reliable and durable connectivity solution for PV systems and energy storage devices. HARTING's Han-Modular connector family provides great flexibility and customization with off-the-shelf components. The capability of having signal, data, and power in one connector offers great flexibility and material cost reductions. Individual modules can be placed in metal or plastic (Han-Eco) and in different sized hoods and housings to create a combination that fulfills any connectivity requirement.

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



### HELUKABEL USA

HELUKABEL, manufacturer and supplier of cables and accessories, offers a complete line of cables and cable systems for PV installations. Their solar power products include the following: SOLARFLEX PV cables; pre-assembled cables; PVC control cables; all-weather and rubber cables; medium-voltage cables; as well as cable glands and connectors. HELUKABEL's cables have been thoroughly tested and are resistant to UV, ozone, oil, chemicals, ammonia, cuts, abrasion, and extreme temperatures.

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

### Quick Cable Canada Ltd.

Quick Cable offers a wide selection of battery tools and accessories for the solar industry and for energy storage needs. Products include: PV cables and connectors; inverter cables; battery and welding cables; and battery storage boxes. They also offer custom PV and battery cables options, as well as battery cleaners and additional accessories.

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



### Thomas & Betts

Thomas & Betts (T&B) is a supplier of electrical products that meet the increasing demands of today's power generation, transmission, and distribution systems. The growing use of solar power has enabled T&B to provide wire and cable management and protection solutions to the industry. T&B's Paired Equipment Solutions provides long-term connection and protection of solar power generation systems, while reducing product lifecycle costs.

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

## ENCLOSURES | COMBINER BOXES



**FIBOX**  
Enclosing Innovations

### FIBOX Enclosures

FIBOX is a global manufacturer of corrosion-resistant enclosures for the electronic and electrical industry, including the solar power sector. Their UL, cUL, and CE-listed, NEMA 4X and NEMA 6-rated enclosures protect components from demanding and hostile environments. With over 1000 off-the-shelf sizes, FIBOX also offers customized enclosures, helping products get to market quickly.

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



### Allied Moulded Products, Inc.

Allied Moulded manufactures a full line of NEMA Type 4X fiberglass enclosures, as well as JIC-sized polycarbonate enclosures. These products offer all of the advantages of non-metallic materials, including: increased strength; reduced weight; corrosion resistance; UV resistance; and ease of modifications. Along with Allied's line of enclosures, they offer many accessories, such as: back panels; hinged front panels; pole mount kits; and enclosure hole pugs for metal and non-metal enclosures.

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



### Can Solar Inc.

Can Solar Inc. offers a jA2 combiner box, which requires no internal cabling. All connectors, 35 mm DIN rail, and stoppers are formed on the combiner body. The jA2 has four fuseholder seats for positive and negative current paths, as well as one 3TE-type surge protector seat. Assembling a jA2 takes about four minutes, saving labor time. The jA2 is NEMA 4X, UL94V-0, and TUVus certified, making it ideal for outdoor and indoor small system uses. Taiwan and China patented; USA and Europe patent-pending.

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



### Modular Connections, LLC

Modular Connections, LLC is a premier manufacturer of pre-fabricated concrete shelters and enclosures, as well as concrete wall systems that are ideal for use during solar power project sites and as utility control buildings. Applications for the Modular Connections' product line include: control houses; equipment enclosures; storm-rated facilities; security; firewall systems, and more.

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



# Mother Nature tested. Underwriter approved.

## DuraTrack™ HZ

It's not the sunny days that challenge utility-scale installations. No sir, it's the days that Mother Nature shows you where you can put your wind-load calculations that tests your engineering. The unpredictable, itself, is exactly what the DuraTrack HZ single-axis tracker was designed to withstand and that's the reason more solar utility-scale project underwriters approve projects that include the DuraTrack HZ. They know that when the weather gets ugly, DuraTrack HZ performs beautifully and that's money in the bank.



[sales@arraytechinc.com](mailto:sales@arraytechinc.com) | 1.855.TRACKPV | [arraytechinc.com](http://arraytechinc.com)

**ENGINEERING | OPERATIONS & MAINTENANCE****4 S.T.E.L. Engineering, Inc.**

4 S.T.E.L. Engineering, Inc. is a structural design and engineering firm, designing and engineering solar canopies, ground mounts, roof mounts, and solar thermal systems for renewable energy firms. Their focus—delivering plans, designs, and calculations accurately and on time—is born out of a goal to provide clients with cost-effective structural engineering solutions for all types and sizes of projects. [www.4steleng.com](http://www.4steleng.com)

**EDF Renewable Services**

With 7,000+ MW of energy under contract, EDF Renewable Services ensures ongoing project profitability for project owners and investors by providing a full range of expertise and operation and maintenance (O&M) services, including: total project operations; balance of plant (BoP); asset administration; engineering support; and analysis. From their Operations and Controls Center, the company provides 24/7 remote monitoring, evaluates project performance, and conducts remote resets and technician dispatch. They are fully equipped to perform a full spectrum of services for any solar project. [www.edf-renewable-services.com](http://www.edf-renewable-services.com)

**NAES Corporation**

NAES is an independent services provider for the energy and related infrastructure markets, and has been for over 30 years. They offer facility operations and maintenance (O&M), maintenance and construction, technical support, and staffing. Dedicated to adding value by optimizing facility performance, NAES delivers results. [www.naes.com](http://www.naes.com)

**Next Generation Energy**

Solar engineering and design firm, Next Generation Energy, offers PV Solution Kits. These Kits are simple, affordable pre-engineered solar solutions, designed to make flush-mount installations easier. Next Generation Energy PV Solution Kits can be ordered in two to 20 module configurations, and include top-tier PV modules, micro-inverters, flashings, and mounting components—providing everything needed to complete a successful solar installation. [www.ngeus.com](http://www.ngeus.com)

**Northwind Solutions**

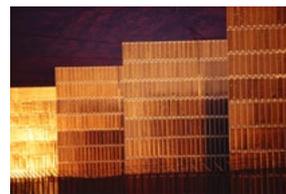
Northwind Solutions is a progressive, customer-focused service organization, dedicated to serving the North American renewable energy industry. They provide a complete suite of high-quality, essential services to project developers and asset owners. Northwind offers the solar industry turnkey operations and maintenance (O&M) services for PV projects. [www.northwindsolutions.com](http://www.northwindsolutions.com)

**Sargent & Lundy LLC**

Sargent & Lundy LLC help clients evaluate and implement solar projects as an integral part of the firm's business. They support owners, investors, contractors, manufacturers, and research organizations with diverse projects. Experience provided includes: owners engineer; due diligence; conceptual and detailed facility design; as well as grid interconnection for trough, PV, tower, and dish technology. The firm offers complete engineering, project services, and consulting for power generation and transmission, and has for over 120 years. [www.sargentlundy.com](http://www.sargentlundy.com)

**Westwood Professional Services**

Westwood provides a variety of services to the solar industry, including: civil and electrical engineering; aerial mapping and LiDAR; ALTA and topographic surveying; environmental and cultural resources permitting; and GIS services. They have nationwide experience supporting all stages of development and construction for distributed and utility-scale solar projects, ranging in size from 500 kW to 650 MW. Westwood's solar experience includes PV, CPV, and CSP in a variety of applications, including fixed-tilt, single and dual-axis trackers, and rooftops. [www.westwoodps.com](http://www.westwoodps.com)

**FINANCIAL SERVICES****Taylor-DeJongh**

Taylor-DeJongh (TDJ), an energy and infrastructure investment banking firm, has expertise across a broad spectrum of alternative technologies and renewable energy projects. TDJ has advised on over 260 power projects globally. They offer project development, capital structuring, and project financing services, with over 30 years of experience in closing energy projects. TDJ provides tailor-made capital solutions, and advises clients on corporate finance, capital-raising, and M&A transactions. [www.taylor-dejongh.com](http://www.taylor-dejongh.com)

**FOUNDATIONS****Cantsink Manufacturing**

Cantsink manufactures and installs helical piles, used as foundations for ground-mounted solar projects. Cantsink's helical piles are among the strongest available on the market—they feature a patented helix plate that's cold-formed and corrugated, making them up to 50% stronger than traditional piles. Cantsink Manufacturing provides fast turn-around of material and competitive pricing, along with engineering support for soils analysis and customized pile specifications. As of 2013, Cantsink acquired installation equipment for driven piles as well. They can supply beams of most any shape, providing installation services and engineering support. [www.cantsink.com](http://www.cantsink.com)

**Con-Tech Systems Ltd.**

Con-Tech Systems' CTS/TITAN Hollow Bar IBO Injection Bore System is well suited for anchoring solar collectors. They suggest designs with a simple layout, which allow for high production rate systems in all types of difficult ground conditions. As a result, the IBO piles can be shorter in length, reducing the overall cost compared to other systems. Con-Tech Systems also offers efficient anchoring solutions for transmission line towers. [www.contechsystems.com](http://www.contechsystems.com)

**HANDLING | MANUFACTURING****Alicat Scientific**

Photovoltaic cell manufacturers have often relied upon Alicat Scientific's sub-100 millisecond control speeds to prevent costly target poisoning in their vacuum deposition processes. Alicat's MCV series of mass flow controllers for vacuum marries this ultra-fast control speed to an integrated, positive shut-off valve to prevent contamination of the coating process when no gas is flowing. Alicat MFC's come with 200:1 turndown, 30 gas calibrations, as well as lifetime warranty and technical support. [www.alicat.com](http://www.alicat.com)

**GfE Metalle und Materialien GmbH / GfE Fremat GmbH**

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

## INSURANCE



ASSURANT®

On your terms.®

### Assurant

Assurant's solar group helps solar project developers and investors protect what matters to them most—the financial investments in their renewable energy projects. Assurant's solar group provides innovative insurance and risk management solutions to protect the financial health of commercial and residential solar projects. Assurant's warranty management program provides a single point of contact for all warranty components, making it easier to maintain solar projects throughout their projected lifespan. This coverage authorizes and pays claims, labor, and shipping for replacement parts on any warranted equipment, even after an original equipment manufacturer goes out of business. Assurant's solar group is a part of Assurant, Inc., a Fortune 500 company, that provides specialty insurance products and related services.

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

**TRAVELERS** 

*It's better under the umbrella®*

### Travelers

Travelers has insurance products and services for many sectors within the solar power industry, including R&D, manufacturing, transportation, installation, and permanent operations. They work with businesses across the size spectrum, from start-up to Fortune 100. Travelers serves specialized services, including: software developers; metal goods manufacturers; integrators; contractors; O&M services; and power providers.

[www.travelers.com/cleanenergy](http://www.travelers.com/cleanenergy)

## INVERTERS



### AE Solar Energy

AE Solar Energy's 3TL 600 Series transformerless inverter provides commercial-scale solar PV projects with a solution for design versatility and lower levelized cost of energy. It's lightweight and easy-to-install, bringing down balance-of-system costs. The 3TL offers market-leading 98% operating efficiency, improved uptime, and a compelling price-to-performance ratio. Also available is the 3TL 1000 Series, designed to keep pace with commercial market demand for higher voltage inverters.

<http://solarenergy.advanced-energy.com/string-inverter>



### Solectria Renewables

Solectria Renewables' SGI inverters range from 225 kW to 750 kW. The SGI 225-300 are transformer-based inverters with 97.5% CEC efficiency. The 500 kW inverter can either be transformer-based or optimized for direct coupling to an external transformer with 600 VDC to 1000 VDC. Solectria Renewables' newest SGI XTM's are designed to maximize ROI through high-efficiencies and customized integrated options. The SGI's offer options for utilities, including real power curtailment, VAR support, voltage, and frequency ride-through.

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

**OUR  
BATTERIES  
PASS THE  
TOUGHEST  
INDEPENDENT  
TEST:**

When you ship a battery to the middle of Africa it needs to work and work well – which is why we only distribute Rolls Batteries.

Lincoln Dahl, Managing Director of African Energy

**OUR  
CUSTOMERS.**



*Rolls*  
BATTERY ENGINEERING

see more of  
what actual customers  
think at [rollsbattery.com](http://rollsbattery.com)

THE BEST OFF-GRID BATTERY FOR OVER 25 YEARS



**Solectria Renewables**

Solectria Renewables' PVI 14-28TL transformerless, three-phase inverters with dual-MPP trackers come standard with AC and DC disconnects, user-interactive LCD, and an eight-fuse string combiner. Its small, lightweight design makes for quick and easy installation and maintenance. These inverters include an enhanced DSP control, comprehensive protection functions, and advanced thermal design, enabling high reliability and uptime. They also come with a standard 10-year warranty, with options for 15 and 20 years. [www.solectria.com](http://www.solectria.com)



**GINLONG (NINGBO) TECHNOLOGIES CO., LTD.**

Ginlong GCI-10K is a three-phase, transformerless, grid-tied string PV inverter. GCI-10K is designed with the latest SiC technology, realizing high efficiency (with a peak efficiency of 98%), inherently high reliability, and a low cost. Lightweight, with a compact design (only 88 pounds), Ginlong brings a unique wind inverter feature to this PV inverter, with an ultra-wide input voltage range (300 V to 800 V). GCI-10K has dual-MPP trackers and a maximum of three strings per MPPT, as well as Wi-Fi and web-based data monitoring.

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



**The Switch**

The Switch photovoltaic inverters are specifically designed for outdoor installation in harsh ambient conditions. The robust line inverters ensure future-proof power quality to meet the ever-stricter network requirements for harmonics, flicker, and fault ride-through. Each system component is chosen to maximize system performance, efficiency, and uptime for reliable power generation throughout the lifetime of the power plant, resulting in optimized levelized cost of energy and plant revenue.

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

**LIGHTING & SURGE PROTECTION**



**DEHN Inc.**

DEHN's unique SPD is UL 1449 3rd edition is approved for use on DC PV applications for 600 VDC and 1,000 VDC. It's also available for 150, 1,200, and 1,500 VDC systems. The SPD protects components within PV systems—such as inverters, combiner boxes, and panels—from the effects of lightning-related surges. DEHN has developed and introduced the DEHNguard (Y)PV SCI series for single- and two-pole applications. Both incorporate a switched, fused circuit in parallel to the MOV discharge circuit to permit the internal disconnect to operate arc-free. With over 100 years of experience in this field, DEHN continues to serve the electrical industry in the research, design, and manufacture of surge protection products, offering technical expertise to minimize the effects of lightning-caused transients.

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



**COTEK North America**

COTEK offers five different series of pure, sine-wave inverters for off-grid and back-up applications. Each inverter series delivers features to satisfy the demanding needs of the solar market. Quality and reliability are the trademarks of COTEK inverters, with models ranging from 150 W to 3000 W, and with a DC input of 12 V, 24 V, or 48 V. New products for 2014 include the SB series Inverter-charger, the SD series with parallel capability, and the full line SP series with DSP technology. [www.cotek.ca](http://www.cotek.ca)



**SMA America**

SMA's Sunny Tripower TL-US is a three-phase, transformerless inverter for decentralized commercial photovoltaic plants. UL listed for up to 1000 VDC maximum system voltage, it boasts peak efficiency of more than 98% and OptiTrac Global Peak for shade mitigation. It's suitable for 600 VDC and 1,000 VDC applications, and has two independent MPP trackers, all-pole ground-fault protection and integrated AFCI, as well as full grid management, monitoring, and communications features.

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



**Troutman Sanders LLP**

Troutman Sanders' Renewable Energy Practice attorneys represent lenders, tax equity investors, borrowers, and lessees in various solar and other renewable energy project loan and lease financings, as well as in the development, acquisition, and disposition of renewable energy projects in the US and abroad. Having served as counsel on over 300 utility-scale and other projects, Troutman Sanders understands the unique issues associated with renewable energy development and finance.

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**Raycap**

**Raycap Inc.**

Raycap's Strikesorb 35 Surge Protective Device (SPD) is specifically designed for DC power protection at PV plants. Strikesorb 35's unique characteristics make it the only Class I MOV-based SPD capable of withstanding multiple direct lightning strikes, while operating safely in systems rated up to 1,500V DC. It protects the sensitive equipment located inside the inverter or throughout the rest of the system. Strikesorb 35 has been tested and is compliant to EN 50539-11 and UL 1449 3rd Ed:2011.

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



**CITEL**

The CITEL DS60VGPV provides ultimate protection for photovoltaic installations. The DS60VGPV line of SPD's has been specifically designed for use in PV applications, and has been tested and certified to the stringent UL 1449 3rd Edition DC standards. CITEL's patented VG Technology maximizes surge-current handling capability, while allowing extremely low-residual voltage. VG Technology also offers an increased life expectancy of up to five times of that of the typical MOV-only SPD. Additionally, the DS60VGPV has already been tested to meet the next generation 2016 UL Standards, which require a robust Short Circuit Current Rating (SCCR) and Intermediate Current testing.

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



**Sol, Inc.**

Sol's 20/20 solar LED lighting system is designed for parking lots, perimeter security, and other areas. It delivers superior light performance in an architectural package that increases pole spacing and lighting uniformity. Simplifying installation, the unified design incorporates a low-profile LED luminaire, light engine, PV assembly, and pole that's powder-coated to the preferred color choice. The system is configured to requirement, and can run throughout the night and/or save energy with dimming.

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

# The Carport that Can Adapt to Any Project



**The Versatile, Reliable Park@Sol™**

The modular Park@Sol is more than just a solar mounting system. Regardless of the soil conditions or climate, the Park@Sol provides a variety of design options and is compatible with numerous foundation types, including Micropile.

**Custom configurations for single and double rows of parking with all aluminum construction and foundation spans up to 35 feet!**

ETL Listed components, 100% IBC Code compliance, PE stamped drawings, a standard 20-year warranty—these are a few of the expectations Schletter is proud to be known for.

**Schletter Adds Value with Services**

Schletter is known for providing many great services: geotechnical analysis (included with systems over 250 kW), in-house system design and engineering, and free training opportunities, to name a few. To better serve the interests of our customers, we've expanded this list to include **installation services.**

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**Racking Simply Doesn't Get Any Better.**



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

**MICROINVERTERS**



**APS America**

APS America introduces the first true three-phase, grid-tied solar microinverter—the YC1000-3. Programmable from 208 V up to 480 V, the YC1000 works with three or four PV modules (up to 310 W STC each), while allowing individual module monitoring through APS' advanced communications software. Priced competitively with conventional string inverters, and offering the design and performance advantages of microinverters, these units herald a new era for residential and commercial solar technology. <http://apsamerica.com>

**MOUNTING & RACKING SYSTEMS**



**Applied Energy Technologies**

Applied Energy Technologies' (AET) new ECO series of solar mounting offers customers a cost-competitive solution. Designed for cost-driven projects, the mounting system offers industry-leading installation, high shipping density (with dramatically lower freight bills), and full layout and loading analysis with every project. Lightweight for easy handling on the jobsite, and galvanized for corrosion resistance, AET's ECO series mounting system fits all panels available today. [www.aetenergy.com](http://www.aetenergy.com)



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

Passion for Precision

**MODULES**



**Silfab**

Silfab Ontario provides quality, high-performance poly and mono photovoltaic modules on a global basis. Currently, Silfab offers 60-cell modules up to 285 Wp and 72-cell modules up to 340 Wp. Beyond the high wattage capacity, Silfab also offers smart modules, which increase system performance by up to 20%, and provide module-level monitoring while incorporating additional safety features. Silfab serves developers and EPCs in the residential, commercial, and industrial solar rooftop markets, as well as for large, ground-mount, utility-scale PV power plants. [www.silfab.ca](http://www.silfab.ca)



**JSPV**

JSPV has been manufacturing and providing photovoltaic wafers, cells, and modules since 2008, under the management philosophy of providing only high-quality technology, products, and services. Their cell capacity is 600 MW, producing a polycrystalline cell efficiency of 17.2% to 17.4% and a monocrystalline cell efficiency of 18.4% to 18.6%. They also offer a module capacity of 400 MW, producing polycrystalline/monocrystalline modules of 1.65 watts to 300 watts with TUV and CE certifications. [www.jspv.co.kr](http://www.jspv.co.kr)



**Creotec Solar Mounting Systems**

Creotec's CREOTERRA ground-mount system features an innovative insertion rail design, which provides superior module retention without the use of clamps. The lay-in system significantly reduces labor, alleviates mechanical stress on modules, and produces straight rows. With over 600 MW installed worldwide, CREOTERRA is UL 2703 recognized and highly scalable. Custom construction plan sets, PE stamps, onsite training, soil studies, and pull testing are also available from Creotec. [www.creotec.us](http://www.creotec.us)

**Accurately Monitoring the Performance of your Solar Energy System**



To maximize the effectiveness of your solar energy system, you need to know how it is performing. A Kipp & Zonen pyranometer accurately measures the solar radiation available to your system in real time. Comparing this with the power generated allows you to calculate the efficiency of the system. A drop in efficiency indicates the need for cleaning, ageing or a fault, allowing you to schedule preventive maintenance and to monitor your return on investment.

Make that difference and contact Kipp & Zonen for the solutions available.



**DPW Solar**

DPW Solar designs and manufactures PV solar rack mounting systems under its POWER-FAB name for commercial, residential, and industrial applications. The POWER-FAB product line offers fully ballasted, high-strength mounting systems, designed for the professional installer, including: the CRS system; Ballasted Power Rail; POWER GRID; Power-Peak; Top-of-Pole; Multi-Pole; Side-of-Pole; as well as roof- and ground-mounted systems, and enclosures. [www.dpw-solar.com](http://www.dpw-solar.com)



## B-Line by **EATON**

### Eaton B-Line business

Eaton's B-Line business offers a Fixed-tilt Ground-mount and Ballasted Flat-roof racking systems for commercial and utility scale solar projects. The ground-mount system is configured to match each project site, featuring pre-assembled components, an optimized adjustment process, and an innovative module mounting process. The result is a simple, fast, and structurally reliable solution. The ARISTA rooftop racking system couples a simple, pre-assembled product with an elevated racking system, helping improve system performance while allowing better access to the roof. The solar team from Eaton's B-Line business is available to provide assistance for all solar projects—from the design stage to onsite training and support.

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



### EcoFasten Solar

EcoFasten Solar designs and manufactures solar mounting solutions for all roof types. GreenFasten is a cost-effective solar mounting solution for composition shingle roofs. With a patented watertight seal, GreenFasten provides three levels of watertight protection. It's easy to install with a single lag bolt. Or, for even faster installation, a self-drilling fastener can be used. All cut sheets and install instructions are available online for download. All products are made in the USA.

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



### HatiCon Solar

HatiCon Solar's Ground-mount system provides a simple and fast open-field PV installation solution, with minimal grading requirements and shallow embedment depth, which speeds installation. The flexible design requires no onsite fabrication. The patented, pre-assembled, adjustable click-style clamps adapt to all projects. HatiCon Solar's Ground-mount system is custom-designed and optimized for each site. The system is easily scaled from light commercial to utility-sized installations.

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



## ADJUSTABLE ROOF HOOK

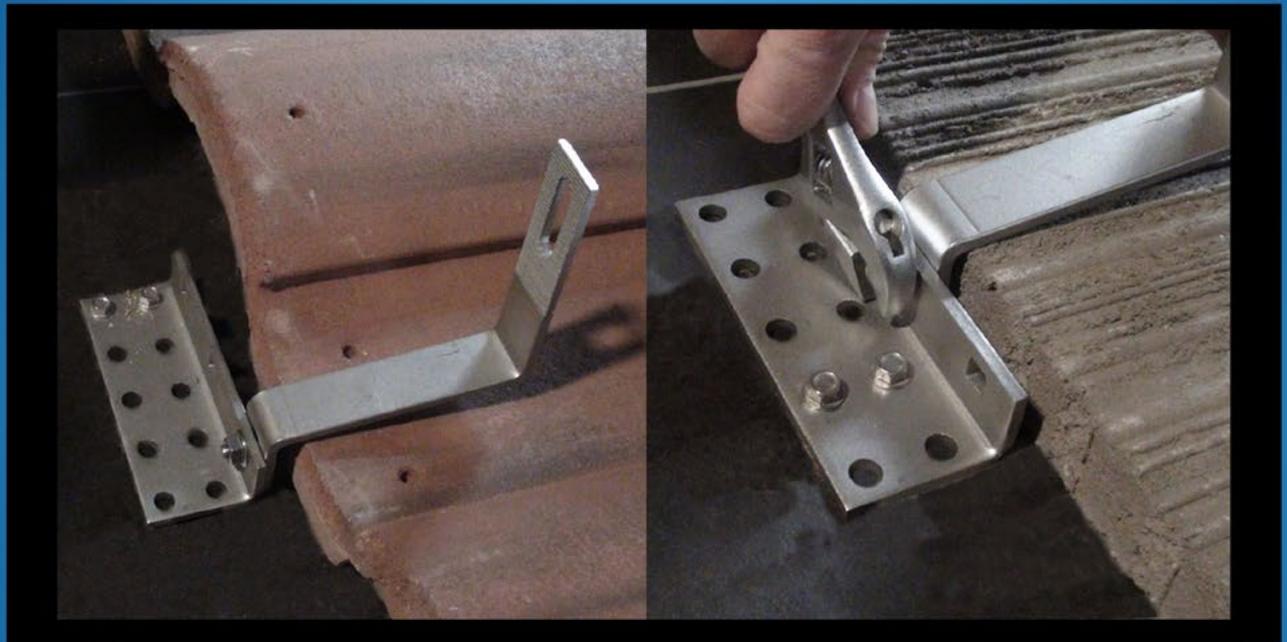
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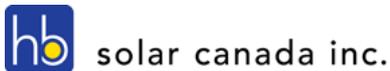
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**hb solar canada inc.**

hb solar engineers and designs mounting systems for all types of rooftop PV. Of low weight and low ballast, the SCIROCCO and BLOCKMOUNT ballasted mounting systems are available in 5°, 10°, 15°, 20°, 25°, and 30° tilts. SKYRACK flush mount system is designed for shingled and pitched-metal roofs. VICERACK and VICERAIL tilted mounting for metal rooftops are also available in all tilt angles from 5° to 30°. hb solar projects are delivered with sealed, third-party engineering drawings for building permit submission, and include all the hardware necessary to erect a PV racking system with integrated Clic Loc bonding/grounding clamps. They also come with a 10-year fully transferable warranty. [www.hbsolar.ca](http://www.hbsolar.ca)



**Kinetic**

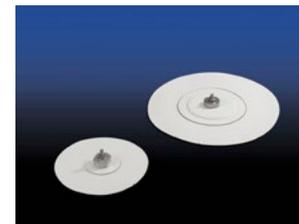
The watertight flashing kit made by Kinetic includes a baseplate that flush-mounts to the roof, a 9" x 12" black flashing that maximizes coverage of the penetration points, as well as stainless steel hardware. The baseplate is secured to the roof with up to two lag bolts and has a separate blind stud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

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



**Kinetic Solar Racking and Mounting**

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



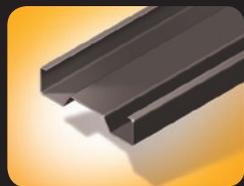
**OMG Roofing Products**

OMG PowerGrip is a roof-mount system for securing solar racks to thermoplastic (TPO and PVC) roofing systems. PowerGrip provides a secure connection directly to the roof deck. Once secured in place, properly installed PowerGrips limit rack movement and remain watertight. OMG PowerGrip assemblies are easy-to-install and compatible with most solar rack systems. Since they eliminate the need to cut open the roof down to the deck, the system saves time and labor. PowerGrips are available in two sizes to accommodate most applications, providing tensile strength of up to 2,000 pounds and shear strength up to 1,075 pounds. [www.omgroofing.com](http://www.omgroofing.com) | [www.olyfast.com](http://www.olyfast.com)

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Roll forming is used to make a variety of parts for the mounting and racking industry including purlins, complex hat sections and mounting posts for industrial ground applications.

**STRONG. DURABLE. COST-EFFECTIVE.**

These are the characteristics you need in solar panel mounting systems — and Roll Forming Corporation can deliver like no one else in the industry. As part of the world's largest custom roll forming group, with 11 affiliate companies in 10 countries, we leverage the very latest technologies and innovations from around the world to transform your unique vision into reality.

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**Ontrack Solar**

The new DXT1 Dual-axis Tracker with next-generation innovations simplifies installation and decreases maintenance. The Integrated Beams create a smooth, slide-in PV panel mounting system, eliminating the need for traditional racking. The full-length Fastclamp Bars quickly secure panels. The Split-panel Design virtually eliminates linear actuator failure. The Zero Center-of-Mass reduces wear on major parts. TCX2 Controller operates two DXT1 trackers. Available in the USA, pre-assembly is available. [www.ontracksolar.com](http://www.ontracksolar.com)



### Orion Solar Racking

Orion Solar Racking specializes in the development, manufacturing, and marketing of PV racking solutions. Orion has released a wide range of high-quality mounting systems, including roof- and ground-mounting solutions for residential, agriculture, industrial, government, commercial, and utility-grade projects. For example, the Orion Venus Series Flat-mount System is engineered for maximum flexibility, whether it be a small or big commercial or residential solar system. Made from lightweight aluminum, it's compatible with most pitched roofs, and can be mounted using different attachments depending on the roof material. Orion provides a technical support system for each project, complete with installation and code compliance documentation, as well as an online calculator.

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



### Quickscrews International Corp.

Quickscrews International Corp. is now stocking a tile roof hook that works in a wide variety of the most common tiles. The hook adjusts for situations when tiles are mounted on residential roofs with or without batons. The company also offers three different hooks made specifically for stone-coat steel or cal-pac rooftops.

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

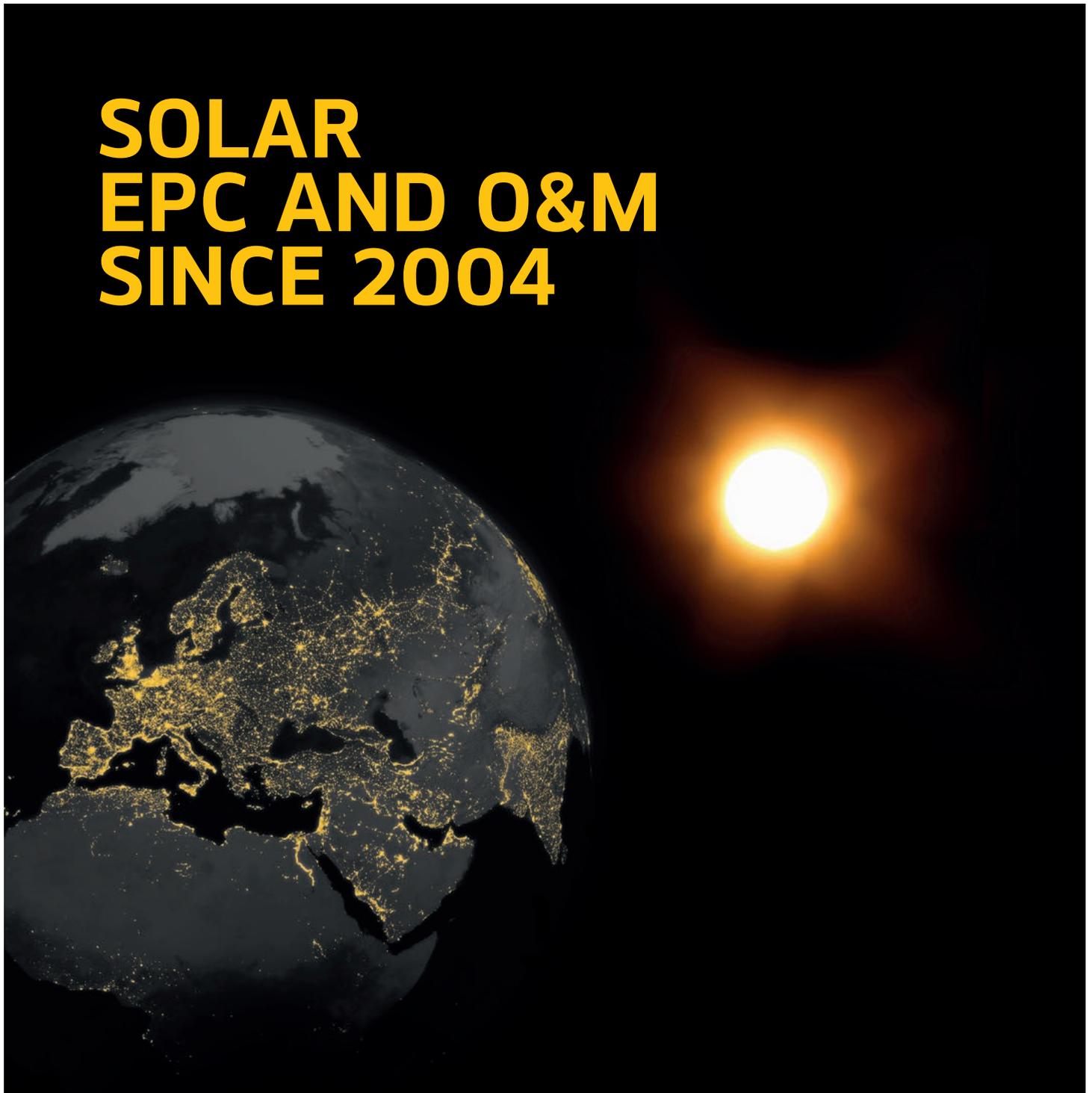


### Quick Mount PV

New from Quick Mount PV, E-Mount uses patented QBlock Elevated Water Seal technology to provide superior waterproofing on composition and asphalt shingle roofs. Priced at a modest premium over commodity roof mounts, E-Mount makes it possible to deliver Quick Mount PV quality even on cost-sensitive jobs. E-Mount's smaller, lighter flashing meets all roofing codes and installs fast and easy. Made in the USA, all of the stainless steel hardware is included, along with a 10-year limited product warranty.

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

# SOLAR EPC AND O&M SINCE 2004



Global Energy Services (GES) has been executing solar EPC projects since 2004 totalling close to 300 MW, and is currently servicing more than 350 MW worldwide. We are the global market leader in construction and services for the solar and wind industry. With over 4000 employees, 20 years of experience in renewables and an unmatched track record of projects all over the world, we are a trusted partner to the leading utilities, investors, developers and equipment manufacturers.

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





### RBI Solar

RBI Solar is a turnkey solar racking solution provider in the US. RBI Solar takes single-source responsibility for design, engineering, manufacturing, and installation of solar mounting systems. For instance, RBI's ground-mount solar systems are designed and engineered for each customer's site-specific conditions to minimize the field installation labor, and require no field welding, drilling or other onsite fabrication. With high-strength steel and corrosion-protection, UL2703-classified models are available for ground-mount and roof-mount solutions. As a specialist in ground-mount, as well as roof-mount, parking canopies, and custom-designed specialty solar structures, RBI provides complete solar racking solutions to solve virtually any structural mounting challenge.

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

## Leading Tracking Technology

At the heart of our solar power generation Dual-Axis PV units is an astronomic control system, co-developed in an exclusive partnership with SMA Solar Technology AG. This astronomical control system enables our photovoltaic panels to follow the course of the sun throughout the day, **generating up to 45% more power** than fixed solar panels.



Sonnen System Dual-Axis Tracking Systems features:

- Biaxial tracking system for photovoltaic installations
- Centralized monitoring via Internet
- Comprehensive safety concept: the safeguard
- Building integration feasible
- Additional yield up to 45% compared to fixed-mount installations
- Track-back function to prevent cross-shading
- 20-year warranty (depending on service agreement)
- Suitable for all panel brands
- Reliable, efficient and accessible



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### Schletter, Inc.

Engineered to be a lean system with fast in-field assembly, the new PvMini from Schletter combines elements from two of the company's most popular systems: the PvMax and Wind-safe. Created as a cost-effective, lightweight solution, the PvMini ballasted ground-mount system is ideal for landfills, residential sites, and areas with rocky terrain. A low-profile design and lightweight components mean fewer and smaller concrete foundations for the least invasive ballasted ground-mount solution on the market.

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



### S:FLEX, Inc.

S:FLEX, Inc. specializes in the development and sale of a complete range of rooftop, ground-mount, and carport mounting structures. The new flat-roof system, LEICHTMOUNT, is the newest addition to their portfolio, and is designed with quick installation and a low ballast in mind. In addition, S:FLEX provides easy assembly instructions, a detailed parts list, and all design assumptions and drawings for precision planning. Wet stamps and structural analysis are available upon request. S:FLEX's portfolio ranges from pre-fabricated and partially pre-assembled systems to tailor-made solutions.

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



### SolarDock

SolarDock is a non-penetrating, flat-roof, continuous support system for photovoltaic modules. Constructed of aluminum and stainless steel, SolarDock racking is built for strength and long-term reliability. Its pan-base design cradles PV modules, helping to prevent long-term damage such as micro-fractures in modules, while also protecting wiring and ballasts. SolarDock's commitment to safety and durability is demonstrated by its TUV Certification, 25-year warranty, and extensive wind testing and analysis.

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



### Solar FlexRack

Solar FlexRack offers a unique product line focused on maximizing labor savings on the jobsite. The Solar FlexRack 2HR Ground Mount offers a unique, pre-assembled unfolding design, unlike any other in the fixed-tilt racking arena. The all-steel design of the 2HR offers strength and material optimization for a lower cost per watt. The 2HR allows the option of using clips, direct bolt, or a combination of both for module mounting. All 2HR Ground Mounts come standard with integrated bonding and wire management, and a 20-year warranty.

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



### Sollega Inc.

Sollega Inc. is a solar PV racking manufacturer, specializing in ballasted commercial flat-roof and ground-mount racking solutions. The lightweight, stackable design is efficient to ship, and quick to stage and install. Made from HDPE-recycled plastic, mount all 60-, 72-, 96-, and 128-cell framed modules with a top-down single tool. High density, nine-inch inter-row spacing, 50 kW of racking fits on a 4' x 6' pallet. With integrated UL2703 grounding, Sollega provides full engineering support and PE stamp, along with a 25-year warranty.

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



### The Solar Tracker Company

The Mega Tracker is the first in the Goliath Class of single-axis trackers from The Solar Tracker Company. Designed to be economical to buy, install, and maintain, one tracker is 600 kW, providing huge economies-of-scale. A tracker is the single best way to increase the amount of energy generated by a solar system, increasing revenue and reducing the price per watt for energy. The Solar Tracker Company has a long and successful history in commercial and utility-scale projects, and their trackers can greatly improve a solar project's LCOE and ROI.

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



### Unirac, Inc.

Unirac's Roof Mount (RM) offers simplicity and ease-of-installation to the ballasted flat-roof solar industry. The system consists of only two major components, minimizing preparation work and installation time. Roof Mount makes it possible to seamlessly design around roof obstacles, support most framed solar modules, and bond the system with just the turn of a wrench.

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



### Zilla Corporation

Designed with solar professionals in mind, Zilla systems are ideal for flush-mount, ground-mount, flat-roof, and custom installations. The rail-less Zilla Phantom mounting system saves installation time and cost by providing a fully flashed mounting solution with integrated grounding without rails—resulting in a system that's quick and safe to install. The Zilla Phantom uses significantly less material than a traditional flush-mount system with rails, providing economical shipping, ease of handling and installation, and a streamlined design that offers savings, strength, performance, and value.

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



### Daetwyler Clean Energy

Daetwyler Clean Energy (DCE) is known throughout the international renewable energy market as a solar mounting hardware manufacturer. Their experienced engineering and global fabrication facilities provide economical solar mounting hardware direct to installers and project developers. In addition to DCE's Modu-Rack, they offer PV mounting solutions for rooftop (flat and pitched), ground-mount, and pole-mount systems, as well as parking canopies and custom systems.

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

# Increased Energy Output and Design Flexibility



## Silfab Smart Module

Optimized by **Tigo** energy | Powering the Smart Module

**Reduced Voc** – the maximum voltage of the module is fixed by Tigo Smart Curve technology and remains stable independent of the temperature

**Impedance Matching** – Panel-level MPPT with industry leading efficiency and reliability

**Fewer Components** – 30% fewer strings reduces the number of combiners, fuses, disconnects, home runs, single set of wires, etc.

**Faster Installation** – Less components to install, less wire to run = faster install times

**Advanced O&M** – Panel-level monitoring

**Safety** – Panel-level disconnect, compatible for NEC 2014

**Certifications** –  IEC 61215, IEC 61730 (pending)

**Patented** – Patent granted

**North American** – First 'Made in America Smart Module'



For more information contact Silfab  
[sales@silfab.ca](mailto:sales@silfab.ca)



### Silfab Ontario Inc.

240 Courtneypark Drive East  
L5T 2Y3 Mississauga  
Ontario, Canada

**Phone:** (905) 255-2501  
**Fax:** (905) 696-0267  
**Web:** [www.silfab.ca](http://www.silfab.ca)



### DH Solar

DH Solar offers dual-axis tracking systems that can increase efficiency up to 40%. In use for over 25 years, these tracking systems offer a timer-based controller that allows the tracker to track the sun's arch even on cloudy days. DH Solar also offers a fixed-pole mount system that has a manual seasonal adjust option, which permits solstice adjustments in the spring and fall. DH Solar's fixed systems are ideal for areas where dual-axis trackers might not get the most efficiency due to obstructions.

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



### DynoRaxx

DynoRaxx offers innovative solar mounting solutions. The DynoRaxx EVOLUTION(R) FR and the EVOLUTION PR was designed by installers for installers. With improved design and quality technical support, DynoRaxx crews will install more panels in less time and at a low cost, with their flat-roof and pitched-roof mounting systems. The new patent-pending, UL-recognized DynoBond grounding system is designed for commercial and residential installations.

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



### Ecolibrium Solar

Ecolibrium Solar is a supplier of simple, fast, and cost-effective mounting systems. Ecofoot simplifies the installation process by providing the lowest part count and universal module attachment. It's designed with 100% recycled HMWPE material, which protects a roof's surface. Ecofoot 2 is the first modular system that combines the benefits of polymer with integrated grounding and wire management. Ecolibrium Solar's hardware helps save installers countless hours from planning and installing more complicated systems.

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



### Mounting Systems, Inc.

Mounting Systems, Inc. racking systems for on-roof, flat-roof, and ground-mount applications are ideal for simplicity, flexibility, and ease of installation. For over 20 years, their racking systems provide optimal solutions for residential, commercial, and utility-scale solar installations. Mounting Systems' US-based engineering, supply chain, manufacturing, and quality management teams work together to ensure their products are of high quality, and are well engineered and reliable. Mounting Systems, Inc. is ISO 9001 certified.

[www.mounting-systems.com](http://www.mounting-systems.com)



### FABRACK Solar Inc.

FABRACK Solar designs and manufactures a diverse line-up of solar racking solutions, including flat-roof and ground-mount, or seasonal racking solutions. Adjustable racking can outperform traditional fixed racking by up to 15% or more per year. Their traditional, fixed-tilt array solution for a flat rooftop project, offers a unique design that automatically sets spacing and eliminates measurement.

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



### Opsun Systems Inc.

Opsun Systems offers custom-designed mounting systems based on the project needs. Their engineers design a unique layout for every project, and run extended simulations and calculations to verify each structure's integrity. This results in the creation of a robust structural mounting system, comprised of high-quality rails that currently use the most aluminum-per-watt in the industry. Opsun Systems also assist their clients at every step of the project design process, from energy yield assessment to quality engineering drawings for the building permit process.

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



### Futura Industries

Futura's flexible, custom solutions produce the complex anodized aluminum extrusions and precision-dimensioned products needed for today's solar panels and mounting systems. Futura helps renewable energy customers increase manufacturing efficiency, while decreasing production costs.

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



### PanelClaw

PanelClaw provides roof-mount and ground-mount solar racking systems. Their roof-mount racking boasts a three-component design and smart ballasting methodology to deliver exceptional value in the commercial, flat-roof market. PanelClaw ground-mount systems include ballasted and penetrating solutions to accommodate a wide range of soils and terrain. Each system is engineered with pre-assembled components, as well as in-field adjustability for a combination of simplicity and flexibility.

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



### Genmounts

Genmounts Genesis Series Ballasted Solar Racking System is an easy-to-install solar mounting solution for non-penetrating rooftop and ground-mount PV installations. The system features integrated electrical bonding, requiring only a single ground point for up to a 419-amp array. The racking system is 100% made in the USA, built from marine-grade, rust-proof aluminum, and can accommodate custom tilt angles from 0° to 20°. The system comes with wind load calculations based on actual wind tunnel testing, and is listed to UL Standard 467.

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

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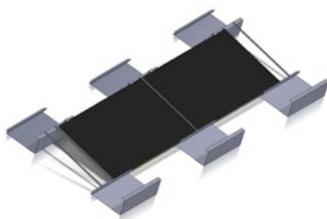
Advanced Power Products | 955 Todd Av., Azusa, CA 91702 | 626-969-7227 | Fax 626-969-8566



### Patriot Solar

Patriot Solar's Spider ST is a lightweight, ballasted roof-mount system. It's specifically designed for quick assembly, minimizing labor costs, and is ideal for large commercial or utility-scale projects. Made of injection-molded, high-density polyethylene (HDPE), the three-piece system simply snaps together for easy installation.

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



### Rack10 Solar

The Rack10 offers a new look for solar racking, with a patent-pending design that uses only three components to make the lightest ballasted solar racking system on the market. Its design allows rapid installation, leading to low labor costs. The American-made system also features integrated electrical bonding and wire management.

[www.rack10solar.com](http://www.rack10solar.com)



### Sedona Solar Technology

Sedona Solar Technology Releases the IntelliTrack RF5000 with a new approach to lowering the cost of dual-axis tracking. Sedona Solar Technology will also debut the IntelliTrack RF5000, its new dual-axis solar tracking frames in the first quarter of 2014. Based on patent-pending Balanced Frame technology, The IntelliTrack enables solar arrays to generate a 40% or greater increase in power produced, compared to fixed solar frames.

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



### SunLink Corporation

With two load-optimizing options that either adjust feet to align loads with roof structure or distribute loads along the length of the long beam, Precision RMS from SunLink is ideal for roofs with limited deck capacity. Core RMS features a rapid-installing, durable-grid assembly. Additionally, the company's Large-scale GMS offers high-quality structural engineering and product design that yield the lowest cost for 500 kW+ projects. And, their non-penetrating Ballasted GMS is ideal for landfills and environments where driving pile is not possible.

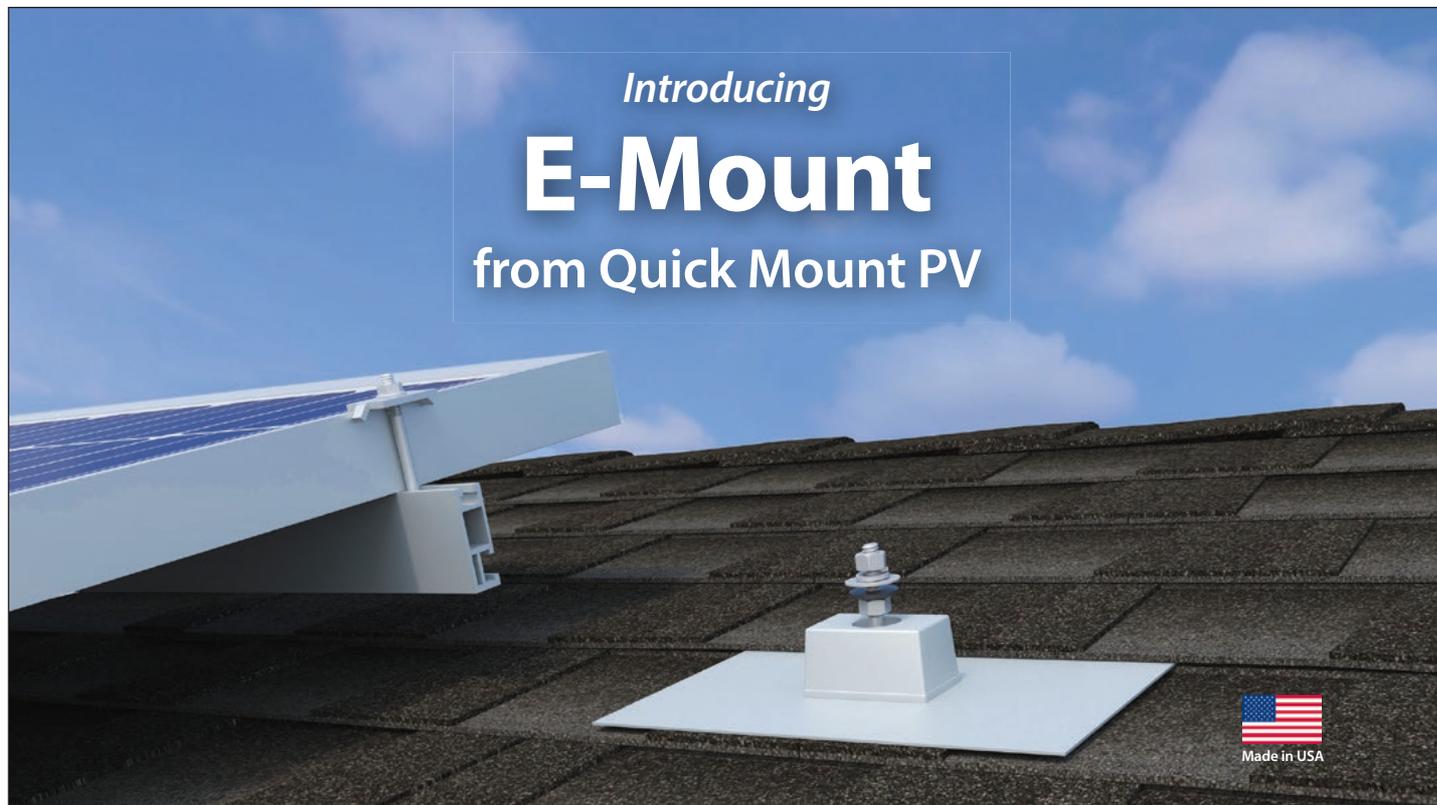
[www.sunlink.com](http://www.sunlink.com)



### TRA Snow and Sun

There are many standing seam profiles, which means it's impossible to have a one-size-fits-all approach. TRA Snow and Sun's Solar Mount Clamp-On's fit many standing seam metal roofs using a safe, reliable design that's customized for a secure fit. The exclusive attachment system, using under-the-hem clamping and bolting, provides superior strength while maintaining a manufacturer's roof warranty.

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



Introducing  
**E-Mount**  
from Quick Mount PV



## Quick Mount PV Quality, Affordably Priced

### Easy

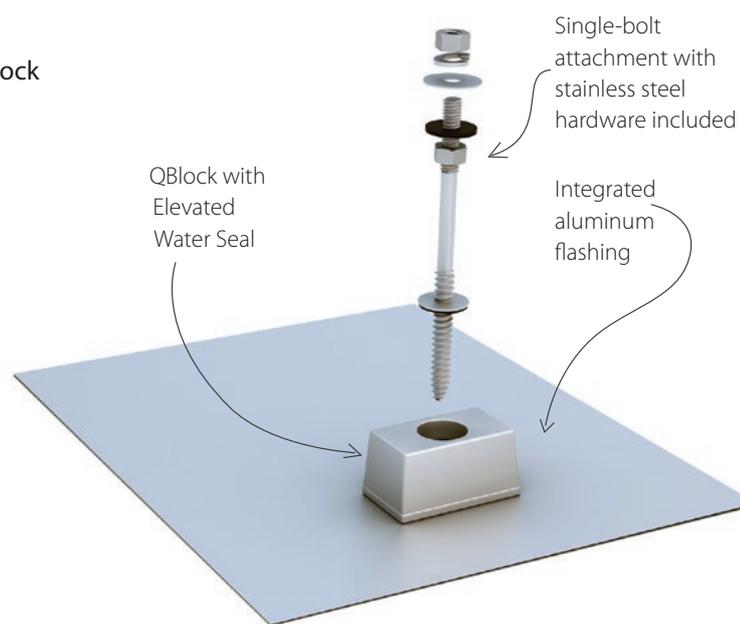
- Integrated flashing and mounting block with fast, single-bolt installation
- Lighter 9 x 12-inch flashing

### Economical

- Competitively priced
- 10-year limited product warranty

### Elevated

- Patented Elevated Water Seal raises the waterproofing barrier off the roof
- Seal protected from the elements in all-aluminum QBlock



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PERFORMANCE MONITORING



**Draker**

Draker has provided innovative monitoring, management, and control solutions for commercial and utility-scale PV systems since 1999. Draker's products and services allow PV developers, owners, and operators to predict, measure, monitor, manage, and control their solar assets to increase yield and maximize profitability. Draker's complete panel-to-grid solutions include data acquisition and control hardware, Clarity DC analytics, Intelligent Array software, and a wide range of project and field-based services.

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



**eGauge Systems**

Combining revenue-grade accuracy with a real-time meter, datalogger, and web server, eGauge offers a unique approach to renewable energy monitoring. They provide customers a tool that measures both energy production and consumption. eGauge makes it possible to utilize a manager portal to actively monitor installations and prevent failures, profit-loss, and customer dissatisfaction—all with no on-going service or support fees. The eGauge monitoring system is capable of measuring up to 12 conductors and three voltage phases, up to 277 V to 480 V and 4800A.

<http://egauge.net>



**Kipp & Zonen USA**

The CMP10 is a secondary standard pyranometer that reduces maintenance and has the best price and quality performance ratio currently on the market. The secret of this new development lies with the internal desiccant that doesn't require inspection or replacement for at least 10 years. Kipp & Zonen provides every CMP10 with a unique, five-year warranty as standard.

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



**Apogee Instruments, Inc.**

Apogee Instruments manufactures high-quality, silicon-cell pyranometers that are low-cost, durable, accurate, and have excellent cosine response. Other products offered include sensors for measuring UV and PAR, spectroradiometers, infrared radiometers, oxygen sensors, aspirated radiation shields, and more.

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



**Carlo Gavazzi**

Carlo Gavazzi offers two Eos-Array Web modules: VMU-C Web Server and VMU-W Cellular Wireless Modem. They complement Eos-Array, which is dedicated to the management, monitoring, and control of systems for PV plants. Full monitoring of solar plants is accomplished by the combination of Carlo Gavazzi's existing Eos-Array modules, along with the EOS-Web modules: VMU-C and VMU-W. VMU-S string-level monitoring module, VMU-P the environmental measurement module, and VMU-O the input/output module, handle measurements and control function split into independent modules. The VMU-C Web module, acting as a compact web server, gathers data from EOS-Array modules, inverters, and AC energy meters. VMU-C EOS-Web module, in combination with Eos-Array, is capable of showing efficiency yield graphs and handling information, accessible to users through a web browser.

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



**Moxa Americas Inc.**

Moxa's UC-8100 Series computer makes it easier for systems providers to offer a complete monitoring service for any and all of their remote field devices. It acts as a compact, highly flexible, vendor-agnostic datalogger that connects inverters, string combiners, smart meters, and other devices—transmitting data over Ethernet, Wi-Fi, or cellular. Moxa's easy-to-deploy software platform can collect this data from multiple locations, enabling management of the attached devices themselves.

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



**Yokogawa Corporation**

Yokogawa Corporation of America provides complete control, communication, and instrumentation systems for utility-scale solar applications. Yokogawa's HXS10 controller is specifically designed for controlling solar trackers with embedded NREL Solar Positioning Algorithm, robust operating temperature (-20° C to +70° C), and extensive field communication support. Since the HXS10 was designed for solar tracking applications, it has a variety specialty inputs for inclinometers and position feedback sensors, including RS232, RS485, and high-speed pulse encoders, as well as full trigonometric functions for calculating positions. A single HXS10 is capable of controlling up to 20 axes for cost-effective tracker deployments. Yokogawa's turnkey control systems include tracker control panels (LOCs), Supervisory Control Systems (SCS), Distributed Control Systems (DCS), communication networks, and field instrumentation.

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



**Tomak Solar Energy**

Tomak Solar Energy offers a unique tracker invention. The Heliotrope is a rotation system for modules, which combines innovative solar tracking technology with an installation equipped with just one engine. This solution significantly reduces the load on the main components of the system, mitigating the risk of failures, which would entail additional technical maintenance and repairs. The Heliotrope has achieved an optimal cost/performance ratio due to its highly intelligent software.

[www.tokmaksolar.com.ua](http://www.tokmaksolar.com.ua)

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

## PV INSTALLERS



### EKO Instruments USA

EKO Instruments USA offers the Solamente PV Checker. The instrument can be used by technicians to quickly and cost-effectively locate solar cell damage, while identifying modules needing repair or replacement, either in the field or the factory. The device allows detection of PV cells that are starting to fail, so corrective action can be taken to maintain and optimize power output and allow for preventative maintenance. The instrument can be used in the production environment as a pass/fail QA/QC tool.

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



### Eoply USA Inc.

Eoply USA Inc. offers reliable mono-silicon PV modules for off-grid applications (24-volt systems). Modules come in power ratings from 185 W to 200 W, and are shipped locally from Eoply warehouses and distributors. Modules also come listed with UL1703 certifications, CEC compliance, as well as a 25-year power warranty and a 10-year product warranty.

[www.eoply.com](http://www.eoply.com) | [www.eoply.us](http://www.eoply.us)



### Lighthouse Solar

Lighthouse Solar is a total solar solution provider for residential and commercial customers. Services include system design, financing, installation, and data/system monitoring. Each job is unique, so the in-house design team creates custom system designs that best suit the needs of each customer. Installation teams are professionally trained and experienced, focusing on the needs of customers. With multiple US locations, Lighthouse is able to meet the needs of customer's countrywide.

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

### Sader Power

Sader Power is an efficient, US solar installation company. With an average installation time of 10 minutes per kilowatt utilizing their revolutionary RAQ, Sader provides an opportunity to quickly and efficiently deploy solar and the underlying funds at a rate typically only seen in utility-scale deployments. Over the last three years, Sader Power has installed over 3,000 solar arrays, with over 12 MW of generating capacity.

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

# WE'RE WITH YOU FROM CONCEPT TO CONSTRUCTION

Solar developers and EPC contractors face complex challenges: completing projects in a dynamic political and regulatory environment while adapting to compressed schedules and incorporating efficiencies to remain cost-competitive.

At Ecology and Environment, Inc., our renewable energy experts provide smart, practical solutions that help solar clients move projects from concept to reality through careful planning and a proactive approach. From initial siting studies through construction and mitigation monitoring, we draw from our extensive experience to anticipate potential project delays and resolve issues early to reduce risk and keep solar projects on track.



For help with your project, contact:

**Nick Figone • (415) 398-5326 • [nfigone@ene.com](mailto:nfigone@ene.com)**



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Global Environmental Specialists

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



**Solar Liberty**

Solar Liberty installs grid-tied photovoltaic solar energy systems for government, non-profit, education, commercial, and residential customers. As a wholesale provider, Solar Liberty is a value-driven solar electric provider in New York State, with the ability to offer wholesale pricing on solar panels, inverters, racking, and other equipment.  
[www.solarliberty.com](http://www.solarliberty.com)

**PV MANUFACTURERS & EQUIPMENT**



**JinkoSolar**

JinkoSolar provides a selection of high-quality monocrystalline and multicrystalline modules. Designed specifically for the US market, the JKM305P-72 285-305 watt polycrystalline module and the JKM255P-60 235-255 watt polycrystalline module offer new high-performance options for American installers. Both modules provide excellent conversion efficiency due to the manufacturing technology JinkoSolar is internationally recognized for.  
[www.jinkosolar.com](http://www.jinkosolar.com)



**Smartech International**

Smartech is the North American source for Steinbach diaphragms and PTFE sheet materials for PV laminators. Steinbach's EVA-resistant Lamibrán diaphragm is used by leading module manufacturers worldwide. The wide variety of available PTFE materials are used for transport belts and release sheets in the lamination process, as well as for other applications.  
[www.smartechonline.com](http://www.smartechonline.com)



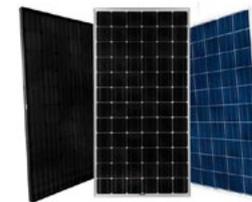
**Upsolar**

Upsolar's smart modules boost system output through maximum power-point tracking (MPPT). Smart modules enable string lengths of up to 30% longer than average, as well as different types of modules on the same string, to facilitate more flexible system designs. Additionally, smart module systems are equipped with real-time monitoring capabilities, offering greater transparency into a system's performance through module-level analysis.  
[www.upsolar.com](http://www.upsolar.com)



**centrotherm photovoltaics AG**

centrotherm offers integrated production solutions for the manufacturing of high-performance solar cells with appropriate process, technology, and service packages. centrotherm's main products are standard production systems for diffusion, oxidation, and batch-type systems for passivation and nitride coating in c-Si solar cell processing, as well as fast firing furnaces.  
[www.centrotherm.de](http://www.centrotherm.de)



**ecoSolargy**

ecoSolargy provides a full line of monocrystalline and polycrystalline products, as well as inverter and racking solutions. ecoSolargy also fully assists customers throughout their solar project. With their new HDPV Solution kits, they offer PV kits that reduce costs up to 20%, and increase production up to 8% through pre-engineered, optimized systems.  
[www.ecosolargy.com](http://www.ecosolargy.com)



**ANNEALSYS**

ANNEALSYS provides equipment for the research and development of PV and solar energy. For example, they offer rapid thermal annealsys furnaces, selenization systems, as well as thin-film deposition by MOCVD, ALD, and Spray CVD.  
[www.annealsys.com](http://www.annealsys.com)



**GPTech**

GPTech develops power electronic devices, which use quality technology to provide new solutions to the renewable energy sector. Present in four continents, solutions are focused on the grid integration of solar and renewable energy, as well as on grid stability and energy transport. They are based on four top product lines: Advanced Power Integration, Multi-level Inverters, Energy Management Systems, and Plug & Play Solutions for energy storage.  
[www.greenpower.es](http://www.greenpower.es)



**Inventec Energy**

Inventec Energy produces high-quality PV modules, including Standard PV up to 320 W (for 72-cell modules) and 260 W (for 60-cell modules). Inventec also produces black-on-black modules and building-integrated photovoltaics (BIPV). BIPV can be customized to any projects' specifications. All modules are made in Taiwan and use no Chinese materials.  
[www.inventecenergy.com](http://www.inventecenergy.com)

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### MAGE SOLAR

To match their MAGE POWERTEC PLUS Modules, the frame-attached SolarBridge Pantheon II micro-inverter features a 30-year product warranty that is unique in the industry. It offers the same quality and reliability from any of the MAGE POWERTEC PLUS Modules, but now as an AC PV Module, equipped with convenient plug-and-play technology.

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

### Muhlbauer, Inc.

Muhlbauer offers reel-to-reel (R2R) manufacturing equipment for flexible solar cells and modules, including sheet-based solutions. Process steps include, but are not limited to: individual cell scribing (mechanical and/or laser); screen printing; performance testing and binning; pick and place of cells into modules; bus bar application and electrical connecting; lamination and encapsulation; and final module testing; etc.

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



### Morningstar Corporation

Morningstar's maximum power point tracking (MPPT) and pulse-width modular (PWM) controllers, as well as their pure sine wave inverters, have been delivering some of the solar industry's highest overall customer value for over 20 years. They are marketed through 230-plus, highly qualified distributors in over 90 countries. Morningstar's brands include: TriStar MPPT; SunSaver MPPT; TriStar; SunSaver; ProStar; SunLight; SunGuard; SHS SunKeeper; SHS Night Light; and SureSine.

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



### Process Technology

The TIH inline fluoropolymer heater is designed for the most demanding re-circulation or single-pass chemical processing applications, including heating chemistries for the production of solar cells on silicon wafers. Compatible with almost any chemistry, it utilizes all fluoropolymer wetted parts and operates at 99% heating efficiency. Thick fluoropolymer sheath offers ultra-clean performance, and a patented heater gas purge system continuously removes any chemical permeation, resulting in a long life and reduced COO. Assembled in Class 100 cleanroom to the highest manufacturing standards.

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



### PV Racking

PV Racking offers clamp-free mounting equipment for ground, roof, and carport applications. They have an innovative solar racking system that eliminates the need for clamps, and is easier to install, more secure, and superior in appearance. They can provide everything from the helical piers and modules to the inverters, and offer full installation services.

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



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Bonfiglioli USA offers one of the most unique solutions to the North American PV market with its 1000V DC, UL-certified, modular, multi-MPPT inverters for floating arrays. The modularity of the multi-MPPT architecture ensures maximum energy harvest by increasing availability and lowering failure sensitivity, decreasing overall costs while increasing revenue with very high overall system efficiency.

With over 1.8 GW of Bonfiglioli inverter technologies installed worldwide, Bonfiglioli has repeatedly proven it has the technical know-how and long-term staying power to support large-scale PV projects.

For details please contact:

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

The Bonfiglioli RPS Station:

- Power ratings from 1.4MWac to 2.8MWac
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- Complete commissioning and service support
- Ease of maintenance and serviceability
- Reduces BOS costs with higher power density in a smaller footprint
- Longer lifetime of components, resulting in lower O&M costs

 **Bonfiglioli**  
power, control and green solutions



### Talesun Solar USA

Talesun Solar USA offers quality poly and mono modules in 60- and 72-cell formats. Talesun modules are constructed in a fully automated manufacturing facility, certified with the highest standard of production excellence for module quality and reliability. This production model delivers notable price-to-performance ratios. Modules meet international standards and certifications. They come with a 10-year product warranty, a 25-year linear power performance warranty, as well as SolarSafe third-party warranty insurance.

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

### PV MODULE INSPECTION



### FSI Technologies Inc.

FSI Technologies (FSI) has been a trusted manufacturer of factory automation systems and products since 1959. They can provide a full range of factory automation systems, engineering, and training for all solar manufacturing applications. They are partnered with NeuroCheck vision software, EyeSpector Smart Cameras, and Eye Vision Software. FSI's Assured Path to Success TM program has a 100% success rate on even the toughest applications.

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

### RESEARCH & DEVELOPMENT | TESTING



### tec5usa

The MultiSpec series from tec5usa is a family of reliable, low-maintenance, fast measuring spectrometer systems (detector-array technology). A wide spectral range from 190 nm to 2200 nm can be covered with high sensitivity and high signal-to-noise ratio. Systems are used for a multitude of applications, including: solar irradiance; monitoring of sunlight simulators; concentration determination in wet chemistry; plasma detection in dry-edge processes; and thin-film analysis of all kinds of coatings.

[www.tec5usa.com](http://www.tec5usa.com)

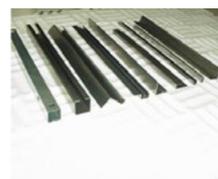


### Stratasense

Stratasense provides a hardware and software solutions for acquiring the current versus voltage (IV) curves of operating solar modules. With successful deployments around the world, they perform valuable research and analytics to measure the quality of PV modules. The Stratasense IV curve tracer is the only instrument specifically designed to perform continuous, real-time, and in-situ monitoring of the IV curve of PV modules.

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

### ROLL FORMING



### Johnson Bros Metal Forming Co.

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

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



A voestalpine company

### Roll Forming Corporation

Roll Forming Corporation offers comprehensive partnerships with services that extend from initial engineering concepts and raw material sourcing, to product development, full-scale production, and beyond. Their in-house tooling department provides tooling and maintenance support, and can even utilize finite element analysis to improve new product launches. And, to complete the supply chain, Roll Forming Corporation provides parts' ordering, inventory, secondary processing, and logistical support for lean manufacturing and assembly operations.

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



### American Roll Form Products

American Roll Form Products is a full-service custom fabricator, providing roll forming, turret punching, press braking, powder coating, robotic welding, stamping, and assembly. Ground pile roll tooling is available as a lightweight and low-cost alternative to wide flange beams, as well as for north-south rails, east-west rails, diagonal bracing, module attachment rails, and more. American Roll Form Products also offer engineering, prototyping, inventory management, tooling cost amortization, packaging, and shipping.

<http://arfpcorp.com>

### SAFETY



### Garlock Safety Systems

Garlock manufactures a variety of roof-edge fall prevention systems, ideal for rooftop solar projects. Products include warning lines, portable rail systems, as well as leading-edge rail and cable fall prevention systems.

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

### SECURITY EQUIPMENT



### Southwest Microwave, Inc.

Southwest Microwave is a producer of high-performance outdoor perimeter security systems, with over 40 years of experience. The company offers precise, intrusion detection for security-sensitive applications and harsh environments. Southwest Microwave's INTREPID sensor technologies deliver the industry's broadest feature set and highest detection performance, effectively protecting solar energy facilities worldwide.

[www.southwestmicrowave.com/ssd/](http://www.southwestmicrowave.com/ssd/)

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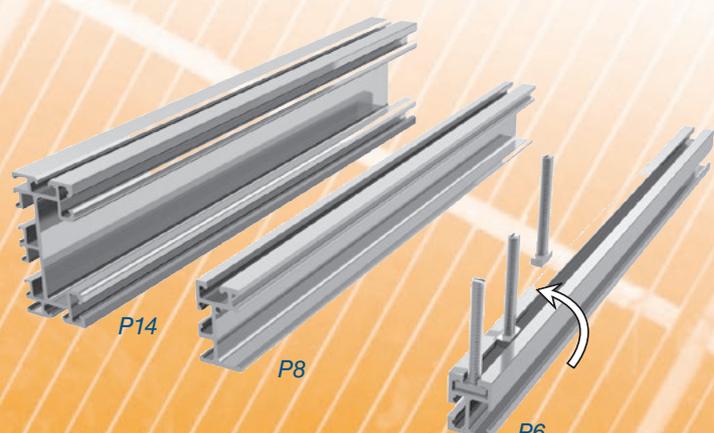
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## SEMICONDUCTORS



### Microsemi Corporation

Microsemi Corporation's non-volatile, flash-based IGL002 FPGAs offer a low system cost and low power, with best-in-class integration, reliability, and security. They have the highest number of main-stream FPGA features, including GPIOs, 5G SERDES interfaces, and PCI Express endpoints, when compared to similar devices on the market today. They also feature what's currently the industry's only high-performance memory subsystem.

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

## SOFTWARE



### EasySolar

A new experience of photovoltaic design will be introduced by the new EasySolar app. It's the first software that will use Cloud-based technology, so that solar projects can be easily managed, shared, and modified on any device (laptop, tablet, or smart phone). Apart from maps of irradiation and equipment database, some functionalities of the app are appearing for the first time in the field of photovoltaics, such as inclination or azimuth verification in-situ.

<http://easysolar.co>



### Valentin Software, Inc.

Valentin Software offers a range of professional tools for the design, planning, dynamic simulation, and yield calculation of solar power systems. Their software includes: PV\*SOL for solar electric systems; PV\*SOL Expert with 3D visualization and detailed shade analysis; PV\*SOL advanced with battery storage systems; and PV\*SOL basic for quick and easy calculation of residential systems. They also offer T\*SOL and GeoT\*SOL for solar thermal and heat pump systems, with online trial versions, webinars, and tutorials available.

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

## SOLAR ASSESSMENT & FORECASTING



### Campbell Scientific, Inc.

The Solar800 is a turnkey, solar-measurement data-acquisition system from Campbell Scientific, specifically designed for solar-resource assessment. The Solar800 provides the onsite data essential for a thorough understanding of a project site's solar resources and variability. The system is designed with fast-to-field features that simplify and expedite installation. No system coding is required, and quick-deploy installation components are included with a guide and simple-to-configure software. Data retrieval is easy and flexible. Options include: FTP; e-mail; Modbus; DNP 3; and LoggerNet capability.

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

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# The Wiley WEEB: It's What's In Store

When it comes to harnessing renewable energy, more businesses are finding that the answer is right in front of them. *Well, right above them.*

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has been revolutionizing the installation of PV systems—making solar projects more viable.

For example, BURNDY has supplied the WEEB solution to help IKEA reach its goal of producing 100% of the energy consumed by its stores from renewable sources by 2020. Through the Wiley WEEB's simple, reliable and low-cost method of bonding PV module frames and racking systems together, **installers save up to at least two minutes of installation time on each PV module.** And when you're talking about dozens of projects (IKEA just finished its 39<sup>th</sup> nationwide), that time adds up.

That's just one more way BURNDY and the Wiley WEEB are on the top of the retail world—or at least the buildings.

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**3TIER**

3TIER delivers renewable energy assessment and forecasting services to many of the largest utilities, energy traders, financiers, and project developers around the world. With over 10 years of experience, they help clients make profitable energy decisions throughout the development and operational process with energy estimates—for the next five minutes or next 30 years. 3TIER's expertise in weather, climate, and risk brings the latest science to the industry through services customized to each client. [www.3tier.com](http://www.3tier.com)

**SOLAR BACKSHEETS**



**FLEXcon**

Due to a long-standing relationship with proven raw material suppliers, FLEXcon is a continuous, reliable resource for solar backsheets. They offer a variety of backsheets, which are ideal for solar farms, as well as commercial and residential installations, including the following series: FLEXcon multiGUARD KPE 12; FLEXcon multiGUARD KPE 156; FLEXcon multiGUARD KPK 12; FLEXcon multiGUARD PPE 11; FLEXcon multiGUARD TPE 12; FLEXcon multiGUARD TPT 12; and FLEXcon multiGUARD EPE 10. [www.flexcon.com](http://www.flexcon.com)

**SOLAR COATINGS**



**PPG Industries, Inc.**

A supplier of coatings and glass to the solar industry, PPG Industries (PPG) offers a complete range of pre-treatment products, primers, and topcoats, including: Duranar liquid and powder coatings, which provide durable, colorful alternatives for anodized aluminum frames; Chemfos zinc-phosphate-based and Zircobond zirconium-based pre-treatments; Powercron electrocoat and Spectracron ZRC zinc-rich primers; and Solarcron durable, ultra-durable (powder) and premium-durable topcoats. PPG has the ability to manufacture heat-strengthened glass as thin as two millimeters. PPG solar products are available uncoated as Solarphire PV glass or with advanced performance coatings, such as Solarphire AR/2XAR (anti-reflective) and Solarphire NaB (sodium barrier) glasses. PPG coatings make solar components more attractive and durable, while maximizing the efficiency of today's solar technologies. [www.ppgindustrialcoatings.com](http://www.ppgindustrialcoatings.com)  
[www.ppgsolarphire.com](http://www.ppgsolarphire.com)



**DURA-CON Corrosion Resistant Fasteners**

DURA-CON Corrosion Resistant Fasteners are steel fasteners with a proprietary coating, specifically tested for outdoor applications that are up to 40% more affordable than industry standard stainless steel. They were created for the solar industry as an alternative to stainless steel and hot-dip galvanized fasteners. DURA-CON fasteners have the ability to resist environmental corrosion, and are proven to prevent galvanic corrosion. They've been tested at 1500 salt spray hours with no corrosion (ASTM B117). Additional benefits of DURA-CON fasteners include the elimination of galling, reliable clamp force, and a greater tensile strength than stainless steel. [www.duracon.info](http://www.duracon.info)

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**SOLAR FASTENERS**



**AceClamp/PMC Industries, Inc.**

AceClamp/PMC Industries' time-saving solar kits for standing seam metal roofs (SSMR) install easily and reliably. PMC's patented AceClamp Solar-Kit reduces installation time by as much as 25%. The AceClamp ML model received FM Approval as a non-penetrating fastening clip for SSMRs for high wind loads. The new A2 AceClamp Solar-Kit is one of the strongest clamp systems in the industry for attaching solar panels, compared with single set-screw clamps. The A2 AceClamp's distinctive push-pin design prevents damage to the roof panel and torque back-out, and is made with a grounding cable groove in the clamp—saving time and costs. [www.aceclamp.com](http://www.aceclamp.com)



**Mudge Fasteners**

From utility-scale projects to residential installations, Mudge Fasteners provides expertise in solar fasteners, including custom packaging and kitting, performance mock-ups, jobsite delivery, documentation support, and production consulting. As a distributor, Mudge supplies everything from the fasteners, mounting hardware, and wire and cable management products, to adhesives and sealants, grounding lugs, tools and bits, as well as fall protection products to a wide variety of customers in the solar power industry. [www.mudgefasteners.com](http://www.mudgefasteners.com)



**SolarFastenerExpert.com**

SolarFastenerExpert.com is a one-stop shop for solar installers looking for quality solar fasteners and related products at affordable prices. Featuring many of the industry's top brands, find everything from fasteners, mounting hardware, grounding lugs, and cable ties, to tools, bits, adhesives, sealants, fall protection, and more. Save time and money by purchasing directly from a computer or smartphone, 24/7. [www.solarfastenerexpert.com](http://www.solarfastenerexpert.com)

## SOLAR HOT WATER | INSTALLERS



**sunbandit**  
Solar Hybrid Energy Systems • Patent(s) Pending

### Sun Bandit

Sun Bandit Solar Hybrid Energy Systems make the benefits of owning a solar hot water heater easier to enjoy and more affordable than ever. Sun Bandit is one of the most practical solar hot water solution on the market, employing patent-pending PV technology in an innovative way to capture, store, and use the energy of the sun in one simple to install solar appliance. Sun Bandit has redefined the way in which solar is used to heat water by eliminating the need for net metering, complicated engineering, fluids, pumps, or heat exchangers—resulting in a system that's clean, quiet, and dependable.

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



### Solar-Trac by OmegaFlex

Solar-Trac is flexible 316L stainless steel tubing for residential and commercial solar hot water systems. Solar-Trac comes in 3/8" up to 2" insulated or un-insulated supply and return lines. Coupled with Solar-Flare self-flaring fittings, Solar-Trac offers installers the highest levels of quality and ease-of-installation for tomorrow's energy needs. Since 1975, OmegaFlex is the pre-eminent international producer of flexible metallic piping products.

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

## SOLAR INTEGRATION



### CarrierClass Green Infrastructure

A division of CarrierClass Group, CarrierClass Green Infrastructure (CCGI) designs, sells, and installs solar electric, solar thermal, and custom off-grid solar power products for commercial and residential customers. CCGI's primary focus and strength is the integration of proven solar technologies into product lines that harness solar energy to provide power in nearly any situation. The hallmarks of all CCGI green power products and projects are high-quality solar design, engineering, and architectural and aesthetic standards.

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



### Stiebel Eltron

Solar thermal will always remain a viable solution, but now there's another renewable energy option with Stiebel Eltron's 300 Heat Pump Water Heater. The heat pump portion of the Stiebel Eltron Accelera 300 draws only 550 watts—that's low enough that it can be tied into a solar photovoltaic system. With use of the electric back-up element (+1700 watts), grid-tie is likely. But with a full tank of 140° F (60° C) water, and a 78.6 gallon first-hour rating, daily hot water needs may be satisfied without the back-up element.

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

## SOLAR MODULES



### SolarWorld

SolarWorld's Sunmodule solar panels are produced to the highest standards of quality, performance, and durability. SolarWorld makes three panel varieties to meet customers' needs. Sunmodule Pro, high-performance poly, is available in both 60- and 72-cell formats. Sunmodule Plus, high-density 60-cell mono, is available up to 275 watts. And the Sunmodule Protect, SolarWorld's premium product, offers the power density of Sunmodule Plus with a 30-year warranty.

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

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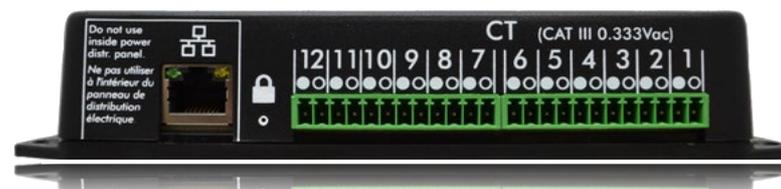
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### Centennial Global Technology

Established in 2003, Centennial Global Technology provides international manufacturing of high-quality, low-cost, and innovative solar energy solutions. Centennial Global offers custom solutions from four-cell technologies, including: CIGS; crystalline; spherical and amorphous; as well as thin-film. Their quality control standard is supported and validated by UL, ETL, TUV, and IEC certifications, as well as from third-party verification in various public institutions.

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



### LG Electronics USA, Inc.

With its 60-cell panel design, the LG MonoX NeON premium series delivers a high-efficiency output of up to 300 watts with 18.3% module efficiency. It combines LG's N-Type cell manufacturing technology into one advanced unit. Among the lightest on the market at only 37 pounds (16.8 kilograms), the LG MonoX NeON is over 11% lighter than previous models, allowing installation by one technician rather than two.

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



### Lumos Solar

Lumos SolarScapes' modular and customizable solar canopy structures provide function and design. Ideal for patio covers, pool awnings, carports, walkways, bus stops, and commercial overhead applications, there are unlimited design possibilities. Featuring the LSX Frameless Module System, Lumos SolarScapes provide an aesthetic and architectural solution for shade and renewable energy.

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

## SOLAR SUPPORT STRUCTURES



### Baja Construction Co., Inc.

With its own engineering and design department and construction crews, Baja is able to design and build cost-effective shade structures and solar support systems. Some of the specific product characteristics of Baja's structures include cold-rolled, light-gauge, high tensile-steel, and galvanized structural members. Their systems are pre-fabricated, pre-engineered, and assembled onsite with no field engineering and/or soldering. For solar projects, direct attachment from modules to purlins is simple, with no racking or decking required.

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

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### Motech Americas

Motech Americas draws on more than 20 years of module manufacturing experience to produce high-quality photovoltaic modules. Their module qualification process conforms to IEC61215, IEC61730, and UL1703 international standards, so that quality is guaranteed. All PV modules manufactured at Motech Americas use 100% Motech cells, have a wide power output range, and qualify under the "Buy American" clause of the American Recovery and Reinvestment Act (ARRA).

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



### Brittmore Group

Brittmore Group supplies engineering, procurement, and construction (EPC) providers with a turnkey, structural balance-of-systems (SBOS) solution for large-scale, fixed-tilt, ground-mount PV projects. Through the smart use of automation, the Brittmore System delivers robust racking at better than Best-of-Breed pricing and install rates. Once provided with the PV modules of choice and a site ready for installation, Brittmore returns a fully populated racking system that's ready for final DC-interconnect, with up to a 10% total BOS cost savings.

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



### Trina Solar

Trina Solar's PDG5 frameless, dual-glass module is UL/IEC certified to 1000 V and requires no grounding. The module has two layers of 2.5 mm heat-strengthened glass. By replacing the plastic backsheet with heat-strengthened glass, dual-glass provides a UL Fire Class A safety rating and reduces micro-cracking, PID, module warping, UV aging, and corrosion. The module's robust package protects cells during mechanical loading, and shocks to minimize micro-cracks that could diminish module efficiency.

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

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### Cooke & Associates Inc. (True North Power)

Cooke & Associates Inc. provide the licensing of solar mounting and tracking systems designs for international manufacturing. They offer CAD and solid works designs, technology, software manufacturing, installation training, as well as technical services and field support services worldwide. Their latest design of the Sunpoint2GPS tracker is now available, and is a fully autonomous, self-aware, self-contained azimuth tracker. It's capable of handling up to twenty 200 W to 250 W solar PV panels, and is seasonally adjustable. When powered up, this tracker immediately senses where it is on the planet, calculating the appropriate sun angle and pointing to within one degree in Azimuth.

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



### Arning Companies, Inc.

Arning Companies, Inc. has more than 30 years experience in the canopy industry, and is quickly becoming recognized nationwide in the design, engineering, manufacturing, and installation of solar canopy and carport structures. In addition to their custom design, custom fabrication, and complete installation capabilities, Arning Companies, Inc. is an AISC-certified steel fabricator with in-house, AWS-certified welders.

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

## SOLAR THERMAL MANUFACTURING & EQUIPMENT



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### RESOL GmbH

The RESOL WMZ energy metering module is now available in a new version with a commissioning menu for easy configuration and imperial temperature, as well as with volume units especially for the North American market. The commissioning menu helps users configure the module by leading them through the most important adjustments on a step-by-step basis. Plus, the new WMZ energy metering module is available in different versions, for voltages from 12 VDC to 230 VAC.

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



### Solar Usage Now

The SUN Equinox commercial packages are effective solar thermal solutions for any size hot water job. The adaptable sizing design from Solar Usage Now is based on their non-corrosive, atmospheric tanks that are manifolded together, along with their circulation pumps, tankless water heaters, solar collectors, and a differential controller. The system is pre-fabricated in-house to cut down on installation time and installer error. These systems provide some one of the most efficient hot water solutions currently on the market.

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



### Accuratus Corporation

Accuflect light reflecting ceramic is an ideal reflector material for utility-scale solar thermal installations. With high reflectance over the visible through short-wave infrared, it's optimized for the peak wavelengths of the terrestrial solar spectrum. Accuflect has a use temperature of up to 1100° C (2012° F) and is a good emitter in the medium- and long-wave infrared, simplifying the cooling requirements for the reflectors.

<http://accuratus.com>



### Aquatherm Industries, Inc.

Aquatherm Industries is currently the largest US manufacturer of unglazed, polymer solar thermal, which is primarily used in residential and commercial swimming pool heating. Solar thermal provides residential pool owners with a longer and more comfortable season, and dramatically reduces or eliminates fossil-fuel consumption at commercial properties. Made in the USA, solar thermal products are manufactured at their 50,000 square-foot, ISO 9001:2008 registered facility.

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



### Bent River Machine, Inc.

Bent River Machine specializes in solar photovoltaic laminators, flat-panel laminators, prototyping, and custom automation. Bent River Machine also offers: tooling and fixturing; PLC controls engineering; mechanical and electrical engineering; OEM systems manufacturing; conveyers; robotics; and more.

[www.bent-river.com](http://www.bent-river.com)



### FREE HOT WATER

FREE HOT WATER offers heavy-duty commercial solar pump stations, integrating functionality and safety components into one compact, pre-assembled, pre-engineered, and high-quality unit. The three-inch pump skid features two 3.5 hp vertical multi-stage centrifugal pumps and a 50-plate external HX, providing over 100 GPM flow on both circuits and a solar differential controller, with a graphical LED control interface. It adjusts to the speed to achieve the highest temperature between the collector and the storage tank. The light, commercial 1-1/2" pump station is good for up to 1000 square-feet of solar thermal flat-plate collectors, and includes a Grundfos UPS26-150 pump, NPT connections, temperature and pressure gauges, a six-gallon expansion tank, a glycol fill station, Grundfos VFS20-400 Temperature Vortex Flow Sensor, and a Sun Reports Web Monitoring System.

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



### HUCU Solar

HUCU Solar manufactures solar thermal flat-plate collectors for all hot water applications, including sanitary hot water and heating, as well as process heat and swimming pool heating. Their collectors feature a deep-drawn body, which ensures the collector is watertight. The absorber sheet is made with a highly selective surface for maximum energy gain. And, the absorber is laser welded to the copper tubes, using the latest technology. HUCU Solar has the necessary accessories for a complete solar installation.

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



### MC2 Energy Inc.

MC2 Energy's the ESOLAIR is currently rated with the best efficiency of all certified glazed-air heating solar collectors, as listed by the Solar Rating and Certification Corporation (SRCC). The ESOLAIR can either operate on a stand-alone basis or can be integrated to the main heating system—with or without external air pre-heating. The maximum power is 6820 Btu/h (2000 W). Dimensions are 92" x 44" x 4".

[www.mc2energy.net](http://www.mc2energy.net)

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**Steca Elektronik**

Steca Elektronik is a supplier of products for the solar electronics industry, including the following markets: PV grid connected, PV off-grid, and solar thermal. Steca's solar thermal products ensure the safe, effective operation of solar energy systems for domestic water heating and backup heating. Committed to the highest quality standards from conception to development, the wide range of solar thermal products from Steca stand out in terms of efficiency and ease of operation. Based in Germany, Steca sets the international standard for the regulation and control of solar energy systems.

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



**UMA Solar**

UMA Solar offers a variety of solar and eco-friendly products, providing one-stop shopping and turnkey solutions. Products include: solar pool heating; solar hot water heating systems; solar electric (PV); heat pumps; salt-water chlorinators; and solar attic fans. Each product is backed an unprecedented industry warranty.

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

**SOLAR THERMAL SYSTEMS**



**Viessmann Manufacturing Company (US) Inc.**

Viessmann Manufacturing Company manufactures high-quality solar thermal components and systems that achieve high standards of performance and quality for every application—from domestic hot water to commercial pool heating. Manufactured with quality, corrosion-resistant and UV-stabilized materials, Viessmann solar thermal collectors are SRCC Certified to the OG 100 standard, providing superior performance over a lifespan of 20-plus years. Designed to the last detail, Viessmann solar systems are based on time-tested, fine-tuned technology that's backed by an extensive support network to ensure that every solar thermal project is designed, installed, and commissioned properly.

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



**Caleffi North America**

Caleffi offers the StarMax Solar Water Heating Collector for pumped glycol and drainback systems. The patented design is shaped similar to a standard four-outlet collector, but features a fifth outlet located at the bottom center. The internal upper and lower headers are sloped. When used for drainback, all the fluid drains without the need to pitch the collectors. The collector is housed in a solid, powder-coated frame with welded corners, providing long life under the harshest of climate conditions

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



**Chromagen Solar Water Solutions**

Chromagen has been manufacturing solar water solutions since 1962. They have fine-tuned the design and manufacture of solar water systems, including solar tanks, solar collectors, kits, and accessories. Chromagen systems use quality materials and advanced techniques, which result in highly efficient, durable products. Offering a wide range of systems enables Chromagen to provide solutions for the residential and commercial sectors, which comply with international standards, including SRCC.

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



**Pfister Energy**

Pfister Energy specializes in the complete engineering, procurement, and construction (EPC) of renewable energy systems designed for commercial, industrial, utility, and government entities. Pfister Energy's building-integrated and modular solar thermal energy systems combine solar thermal and solar electric to maximize energy production on a per-square-foot basis. Their PV thermal collection systems can be installed below many varieties of conventional roofing and siding materials; plus, PV panels can be added and integrated into the building envelope, creating a hybrid solar energy system. Pfister Energy works with building owners, roofers, integrators, and investors, as a total solutions provider for solar PV and solar thermal.

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



**Solar Wave Energy Inc.**

Thermal-grid monitoring is a web-based management tool for solar thermal systems, providing operational information for building owners and installers. The service includes a secure log-in, allowing users to see current conditions, production, history, and receive monthly status reports. Technician log-in allows for remote adjustment of controller settings and portfolio views.

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



**Taco, Inc.**

Taco's new family of solar pumping products meets a wide variety of solar thermal applications. For instance, their Pumping Station combines all the features needed for a closed-loop water heating system, while X-Pump Block combines a stainless steel flat plate heat exchanger with two bronze circulators and a solar differential temperature control. Their Variable Speed Pumps include solar differential temperature controls. These pumps continually adjust speed so as to reduce short-cycling, and maximize solar collector output.

[www.taco-hvac.com](http://www.taco-hvac.com)

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**Q-Lab Corporation**

Q-Lab Corporation is a global provider of material durability testing products, and has been since 1956. They design and manufacture standard test substrates, as well as weathering, light stability, and corrosion testers. In addition, contract test services, which include accelerated laboratory testing, are available at various Q-Lab locations. Outdoor exposure testing for weathering, light-fastness, and corrosion are also available in the US.

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



### UL LLC

UL's comprehensive suite of PV plant services aims to assist in understanding and managing the risks associated with the procurement, construction, and operation of commercial and utility-scale PV systems. Built on broad and profound knowledge of relevant codes, standards, and technologies, these services are designed to help keep a project on track and increase assurance that a project meets the development schedule, while maintaining expected performance once in service.

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



### Cincinnati Sub Zero, Inc.

Cincinnati Sub Zero, Inc. (CSZ) designs and manufactures solar panel testing chambers for testing various size PV modules and solar panels. These chambers are designed to meet common solar panel test specifications for IEC, UL, and ASTM for temperature cycling test, damp heat test, and humidity freeze tests. CSZ's solar panel testing chambers aid in qualifying that modules can withstand the thermal stress caused by repeated changes in high and low temperatures, along with exposure to high humidity.

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



### CSZ Testing Services

CSZ Testing Laboratory provides a full range of environmental testing services for photovoltaic modules and panels. Their laboratory is equipped to handle all module and panel sizes for the following tests: temperature cycling; damp heat; and humidity freeze tests.

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



### LayTec in-line GmbH

LayTec's X Link provides solutions for the in-line and off-line monitoring of the solar module lamination process. LayTec X Link measurement systems rate the long-term stability of solar modules by evaluating the level of cross-linking in EVA solar module encapsulation—within seconds, non-destructively, and accurately. Customized systems are also available.

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

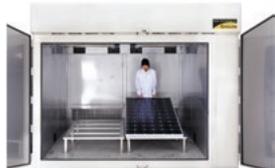
### THEFT PROTECTION



### Bryce Fastener Inc.

Bryce Fastener offers Zero-theft Fasteners, specially designed for solar applications. Each customer receives their own unique security bolt, along with a matching tamper-proof screw bit that's manufactured specifically for them. Designed to hold, Bryce's fasteners eliminate the need for other theft prevention measures.

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



### Atlas Material Testing Technology LLC

With over 30 years of testing and measurement experience supporting the solar industry, Atlas offers a wide range of product and service solutions that help companies answer important solar durability questions, while meeting their product warranty and efficiency claims. Atlas provides weathering instruments, solar simulation chambers, testing services, and consulting solutions for the PV, CSP, solar thermal, and BIPV markets.

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



### CFV Solar Test Laboratory

CFV Solar Test Laboratory provides quality test services for all photovoltaic technologies, including c-Si, thin-film, CPV, and BiPV. They also offer certification and non-certification testing of PV modules. CFV's team ensures fast testing and open communication, resulting in accurate results and high customer satisfaction.

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

### THERMAL MANAGEMENT



### STEGO, Inc.

Since 1980, STEGO has been developing and manufacturing innovative products that heat, cool, ventilate, illuminate, and control temperature and humidity of enclosed electrical and electronic control systems. These products are renowned for reliability, longevity, simplicity of use, and high quality. STEGO strives to solve electrical and electronic control packaging problems for their customers.

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



### Rennsteig Tools, Inc.

The eForce Battery Powered Crimping Tool is specially designed for a variety of industries, including the solar sector. It comes with one or two Li-Ion batteries in a heavy-duty portable plastic case. With this tool, it's possible to use all existing Rennsteig die sets and locators. It's currently the world's first electromechanical-driven tool, with the following features: process monitoring via a LED-display; an illuminated work area; a quickstop function; and an energy saving function. It further offers low noise and low maintenance, and provides increased safety.

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

### TOOLS



### Seaward Solar

Seaward Solar is a manufacturer of electric test tools made with PV installers in mind. Their complete range of instruments enables installers to safely test and commission new and existing photovoltaic installations, in conjunction with the latest international standard IEC62446. The unit will ensure any solar system is electrically safe, complying with the test methodology defined in most national and state guidelines.

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

### TRACKING SYSTEMS



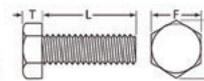
### AllEarth Renewables

The AllSun Tracker is a complete grid-tied, dual-axis solar electric system that uses GPS technology to follow the sun, producing up to 45% more energy than fixed rooftop systems. Made in the US, this ground-mounted solar tracker is designed for residential and commercial scale installations. The tracker has an industry-leading, 10-year warranty and 120-mph wind rating. Its simple, durable design and complete system pallet simplifies costly procurement and installation time.

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



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**Array Technologies, Inc.**

Array Tech's DuraTrack HZ single-axis tracking system has fewer motors, structural material, and parts per megawatt than any other utility-scale tracking system currently on the market. The adaptable DuraTrack HZ has undergone independent engineering review and rigorous testing, including full-scale wind tunnel testing. Pre-assembled components and a reliable design, coupled with engineering and project management support, provide one of the most comprehensive product experiences in the solar industry.

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



**POSITAL-FRABA**

POSITAL-FRABA is an international supplier of position sensors with applications in the solar power industry. IXARC absolute/incremental rotary encoders and TILTIX inclinometers are ideal for use in single and dual-axis solar trackers for all kinds of PV, CSP, or CPV systems. Reliability, especially under harsh conditions, is assured by highly effective environmental sealing (IP69K) and robust, damage-resistant packaging. Electronic interfaces are available for most control system hardware.

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



**Solar and Renewable Power Systems LLC**

Solar and Renewable Power Systems offers the Sonnen System Dual-Axis PV tracking systems, which align solar panels at the optimum angle to the sun for optimum power generation. This process allows the energy usually generated using static PV panels to be increased by as much as 45%. Some of the main features of Sonnen System Dual-Axis Tracking Systems are: biaxial tracking for PV installations; centralized monitoring via the Internet; a comprehensive safety concept; a building-integration option; and a track-back function that prevents cross-shading. The systems offers an additional yield up to 45% compared to fixed-mount installations, with a 20-year warranty depending on the service agreement. Suitable for all panel brands.

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



**LINAK U.S.**

LINAK provides solar tracking actuators. The LA37 electric actuator was designed specifically for solar applications in harsh, outdoor environments. It has been proven through extensive, lifetime environmental and climatic tests. LA37 actuator features a static holding force of up to 45 kN, as well as embedded electronics and feedback such as Hall pulses and Modbus RTU.

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



**P4Q Solar Tracking Controllers**

P4Q Suntrack brand of solar tracking controllers provide DC, AC, and hydraulic solutions, and offer up to 800 MW of solar energy daily. The controllers offer features, such as backtracking, sun sensor, temperature sensors, absolute inclinometer, and more. They are also UL and CE listed. P4Q Suntrack offers their own network management system to monitor system health, upgrades, and remote monitoring.

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

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SubDrive SolarPAK System is ideal for providing water anywhere the sun shines. Powered by a renewable energy source, it is capable of tackling the challenges of the harshest environments.

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



**Exosun**

Exosun designs, develops, and supplies solar tracking systems, delivered with associated engineering services. Exosun's flagship product is the ExotrackHZ horizontal single-axis tracker. Its robust, grease-free structure and centralized control unit make it one of the most innovative and lowest maintenance solar trackers on the market. Highly efficient and UL certified, ExotrackHZ improves the return-on-investment for utility-scale solar plants.

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

**UTILITY-SCALE | PV**



**Bonfiglioli**

Bonfiglioli's unique solution for the North American PV market is a fully, pre-integrated skid enclosure, which houses 1000 V DC multi-MPPT inverters for floating arrays. With power ratings from 1.4 MWac to 2.8 MWac, the Bonfiglioli RPS Station reduces BOS costs with higher power density in a smaller footprint; the modular architecture ensures maximum energy harvest and increases availability. Over 1.8 GW of Bonfiglioli inverter technologies are installed worldwide in large, utility-scale applications.

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

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### Danfoss Solar Inverters

Danfoss' QLX Series PV inverters come in 1 MW to 1.5 MW. Operating without de-rating, the US outdoor version is available for harsh weather operation at up to 50° C, and is completely sealed to withstand even the harshest environmental conditions. Further benefits of the QLX Series include: a painted aluminum enclosure, built-in communication via Danfoss' Etherlynx protocol; configurable grid interface; skid solution with one or two QLX Series units; ride-through capability to meet FERC 661A requirements; and NEMA 4/ NEMA 3R.

[www.danfoss.us/solar](http://www.danfoss.us/solar)



### TMEIC

TMEIC's PV inverter product line includes high-efficiency Solar Ware inverters, rated from 100 kW up to 1667 kW. The Solar Ware Samurai 1.667 MW inverter will be UL listed at 1000 VDC, offering an advanced hybrid cooling system that's optimized for outdoor installations. TMEIC's Solar Ware Main Site Control provides overall coordination and control of utility-scale PV plants, providing access to complete information about an entire plant's power production.

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



### ABB

ABB's portfolio of products, systems, and solutions for the solar industry is extensive, ranging from rooftop commercial installations to utility-scale power plants. Their turnkey solutions cover the entire scope of supply, including PV solar power plants and integration of renewables into isolated and microgrids, to feasibility studies and site analysis, as well as site clearance, plant design, engineering, manufacturing, procurement, erection, commissioning, and grid connection.

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



### groSolar

groSolar provides engineering, procurement, and construction (EPC) services for the 1 MW to 30 MW commercial- and utility-scale solar markets. These include design and build applications on brown-fields, landfills, water/wastewater treatment plants, organic farms, agriculture, manufacturing facilities, and commercial roofs. groSolar provides a one-stop source for all solar project needs, including on-going operations and maintenance.

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



### Signal Energy Constructors

Signal Energy Constructors is a full-service design/build general contractor providing engineering, procurement, and construction (EPC) services for utility-scale solar/PV projects throughout North America. Their ability to self-perform the key components of any solar project—including the structural foundations, mechanical completion, and installation of fixed and tracking systems, as well as the HV electrical design of substations, collection systems, interconnection facilities, and transmission lines—gives clients assurance that their construction projects will be completed on time and within budget.

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



### USA Wire & Cable, Inc.

USA Wire & Cable's Solar Solutions supply the cables needed for all solar projects, including PV, CPV, tower, and parabolic trough. Their PV wire includes: Type USE-2, RHH/RHW-2, 600V/RW90, 1 kV, XLP insulation, and 60 mils; Type USE-2, RHH/RHW-2 2 kV, and XLP insulation 75 mils; 2kV, EPR/CPE, direct burial; 2 kV aluminum feeder; as well as MV 5 kV to 35 kV, armored, control, tray, and instrumentation cable. USA Wire & Cable also offers H4 solar connectors, MC4 and MC4 equals, and custom-made string harnesses.

[www.usawire-cable.com](http://www.usawire-cable.com)

### OTHER Cathodic protection



### LP Hoying, LLC

LP Hoying Solpro systems are ready-to-install solar power supplies, with 12/24-volt 0-amp to 10-amp output ratings, that are shipped complete with temperature compensated charge regulator, solar panel(s), lead acid battery (with a minimum of 100 hours autonomy), heavy-duty battery box, switching output controller (with load drop for battery protection), heavy-duty steel pole with panel support, and wiring harness. Installation is easy and all required materials are provided. Other ratings are available.

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

### Electrical products & solutions



### CG

CG provides electrical products and solutions for grid interconnection of renewable energy projects, including for solar power. CG's products and solutions include: HV, MV, and LV transformers; MV switchgear; HV substation engineering and turnkey systems; SCADA and smart grid protection; as well as control and automation systems interconnecting renewable energy projects to utility grid systems. CG's manufacturing, engineering, and systems offices are located throughout North America, as well as globally.

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

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

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

Project development/investment



**SunPin Solar, LLC**

SunPin Solar, LLC is a photovoltaic solar investment and development firm that's committed to the successful implementation of commercial and utility-scale projects throughout North America. SunPin Solar has the ability to execute a project from early stages of development through commercial operation.  
[www.sunpinsolar.us](http://www.sunpinsolar.us)

## Solar cell metallization



### DEK Solar

DEK Solar is an innovator of solutions for commercial PV cell manufacture. The company's Eclipse cell metallization line delivers scalable throughput, from 1200 wph to 3600 wph. Their PV1200 system offers 1200 wph, Six Sigma performance in a compact footprint. And, DEK's new Apollo platform provides extreme accuracy, 1450 wph capability, and optimized features for technologies such as Print-on-Print (PoP) and Selective Emitter (SE) in a small, single-lane footprint.

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

## Solar commerce

### Solar Exchange

Solar Exchange is a global solar marketplace facilitating B2B online auctions for direct materials and finished goods. Solar Exchange is building a global community that promotes an organized way of doing business, where companies can collaborate with buyers and sellers, large and small, from anywhere in the world. Members can buy direct from manufacturers and suppliers, and sell products to reach new customers anywhere in the world.

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

## Solar inverter stations



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### Lectrus

Lectrus designs, builds, and integrates solar inverter stations for utility-scale parks at its three US manufacturing locations. The company has supplied over 700 MW of stations—both skid and enclosed—in over 20 North America solar parks.

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

## Solar simulation chambers



### Honle UV America

Solar simulation that's carried out with Honle SOL units deliver reproducible results, which are an effective comparison to tests in natural sunlight. Honle's newly developed bulbs enable SOL units to produce light that's, again, extremely close to natural sunlight.

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

## Solar water pumping



**Franklin Electric**

### Franklin Electric

SubDrive SolarPAK from Franklin Electric combines solar technology with proven groundwater pumping equipment to offer a rugged, high-output system that tackles the challenges of off-grid pumping. SolarPAK, featuring a standard, four-inch Franklin Electric pump and motor packaged with a solar controller, will couple with a new or existing array to offer electric pumping options where electrical power may not be accessible or cost effective. SolarPAK is available in 45 gpm and 90 gpm ratings.

<http://solar.franklin-electric.com>

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# Keeping PACE with Texas

## Financing opens commercial & industrial renewable markets

Ann Drumm & Matthew A Thompson, PhD

**AS A RENEWABLE ENERGY PROVIDER,** Texas is currently a really good state to be working in. Those based in the area can expect to expand their business starting in 2014, with the state's authorization of an innovative financing mechanism for projects on commercial and industrial buildings.

In June of 2013, Governor Rick Perry signed S.B. 385, the revision to the Property Assessed Clean Energy (PACE) Act, immediately authorizing the establishment of PACE programs in communities throughout Texas. PACE gives commercial and industrial building owners low-interest, long-term financing for renewable energy installations, as well as energy and water efficiency projects on existing structures. Overall, this government/community initiative helps create permanent private sector jobs, strengthening national and local economies, while promoting renewable energy.

And, the potential market in Texas is massive. The state currently leads the nation in energy consumption, accounting for 12% of the country's energy use, with industrial and commercial sectors constituting 62.6% of that consumption (source: [www.eia.gov](http://www.eia.gov)).

PACENow, a non-profit organization that tracks the progress of PACE legislation and projects around the United States, reports that renewable energy projects constituted 46% of commercial PACE investments nationwide since 2008, and mixed projects that combine renewable energy and efficiency have constituted an additional 23%. Another non-profit, Keeping PACE in Texas (KPT), is a non-partisan association that has organized businesses, commercial trade associations, non-governmental agencies, and other stakeholders to advocate for the Act.

"It's a win-win-win-win solution for renewable energy providers, property owners, lenders, and communities," explains Tim Arndt, a KPT volunteer. "PACE is a market-based financing tool that eliminates the typical barriers for stakeholders, so that renewable energy and efficiency projects can get done."

### Removing risks & barriers

PACE eliminates the barrier of access to capital by allowing 100% of the project costs (including materials, labor, and fees) to be financed for up to 20 years. The property owner enters the property into a voluntary contractual arrangement with the local taxing authority, which services the debt through a property assessment. The debt is, then, secured by a special assessment lien that runs with the land, which eliminates concerns for property owners who purchase property as a short-term investment.

Additionally, the benefits of the project are passed along to subsequent property owners. Although the consent of existing lien holders is required, projects are designed to create net positive cash flow from energy/water savings, which minimizes the repayment risks.

PACE eliminates other major barriers for property owners, as well. The owner/tenant split incentive is solved by qualifying the PACE assessment as a pass-through cost to tenants. Any concern about return-on-investment is addressed by requiring a third-party engineer review to verify that the energy and water savings will be achieved as projected.

The legislation authorizes municipalities and counties to create local PACE regions, and begin implementing financing programs for commercial and industrial properties, as well as residential properties with five or more dwelling units. KPT is even preparing a PACE in a Box toolkit, which will be available to local governments in early 2014, to enable quick implementation and consistency across jurisdictions.

KPT's goal is to provide turnkey recommendations that include the best of existing programs, while learning the lessons from implementation in other states. Standardizing the rules and procedures that govern applications will facilitate rapid approval of applications so that owners, contractors, and communities can quickly realize the benefits of renewable energy projects.

Programs created with the PACE in a Box toolkit will be easy for governments to administer and user-friendly for property owners and contractors. Critical elements will be standardized, including:

- Underwriting standards;
- Minimum project qualifications;
- Energy audit documentation standards;
- Energy and water savings measurement, as well as verification;
- Third-party review of engineering; and
- Requirements for PACE contracting/bonding.

### Why Texas

The PACE Act passed the Texas Legislature with bipartisan support due to concern about the limited supply of energy and water resources in a time of rapid population growth. Contractors, who typically generate interest and drive PACE applications, are finding allies in property owners as they become aware of the potential savings in efficiency and the security of distributed generation.

Contractors who stay informed about PACE will be best positioned to help their customers apply for the program as soon as it is implemented in the communities where they operate.

To stay on top of developments through the Keeping PACE in Texas website, visit [www.keepingpaceintexas.org](http://www.keepingpaceintexas.org)

Ann Drumm is a Keeping PACE in Texas Volunteer; Matthew A Thompson, PhD, is the executive director of Principal Solar Institute.

Principal Solar | [www.principalsolar.com](http://www.principalsolar.com)

### Beyond Texas

Although the Property Assessed Clean Energy (PACE) Act is currently making a big difference in Texas, PACE programs have been used to finance significant renewable energy projects in other states, too.

Introduced in pilot programs back in 2008, PACE made immediate sense to energy efficiency advocates across the country, and today, 31 states and the District of Columbia have adopted (or already had) legislation that enables local governments to offer PACE benefits to building owners.

Some recent examples of where PACE is making a difference include:

- A 200-kilowatt (kW) rooftop solar array on the Pier 1 building in San Francisco, with a projected annual PV production of 245,520 kilowatt-hours (kWh);
- A 37 kW solar array on a Washington, DC, multi-family property; and
- A 35.5 kW solar array on a union building in Los Angeles County, which produces 80% of the building's electricity use—reducing the monthly electric bill from \$2,500 to \$10.

Visit [www.pacenow.com](http://www.pacenow.com) to track PACE legislation.

# Service Spotlight: Legal services

Legal services provide invaluable experience, knowledge, and representation to the various renewable energy sectors. Here's a guide to some of the representation available in the industry.

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## Bond, Schoeneck & King, PLLC

**Sectors covered:** Solar, wind, waste-to-energy, and combined cycle

**Services provided:** Expertise in assisting and counseling clients in all aspects related to the siting and construction of energy and transmission facilities, as well as issues related to interconnection, and the purchase, sale, production, and distribution of energy—successfully resolving state and federal regulatory permitting, compliance, and enforcement concerns. Bond also has considerable experience in siting power generation, and electric and gas transmission projects, under the State Environmental Quality Review Act (“SEQRA”) and Articles VII and X of the Public Service Law.

**Locations:** New York and Florida

**Recognition/Awards:** Ranked #1 in “Best Lawyers New York” in Environmental Law; Ranked #1 in “Best Lawyers” in Syracuse, New York in Energy Law

**Website:** [www.bsk.com](http://www.bsk.com)

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## Cleantech Law Partners, PC

**Sectors covered:** Solar, wind, geothermal, and biogas

**Services provided:** Everything from permitting, contracts, and structuring to finance, policy, lobbying, and corporate management.

**Locations:** National presence in the US, as well as Germany, Israel, and India

**Recognition/Awards:** Lawyer from Cleantech Law Partners named one of top “Cleantech Lawyers” in the United States

**Website:** [www.cleantechlaw.com](http://www.cleantechlaw.com)

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## Dentons

**Sectors covered:** Solar, wind, biomass, biofuels, hydro power, and waste to energy

**Services provided:** Guides clean energy clients in all facets of law, including: energy trading; environmental; market rules; M&A transactions; PPA's; policy; project development; project finance; regulatory; tax; and tendering.

**Locations:** Offices in more than 75 locations, spanning 50-plus countries. In North America, Dentons has six offices in Canada and 16 offices in the US serving clean energy clients

**Recognition/Awards:** Dentons energy lawyers are consistently highly ranked in domestic and global legal directories, such as Chambers, Lexpert, Best Lawyers, Euromoney, and Legal 500

**Website:** [www.dentons.com](http://www.dentons.com)

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## Estriatus Law PC

**Sectors covered:** Solar, and the clean tech sector

**Services provided:** A boutique law practice, counseling clients on the development of solar PV facilities and transactional matters, such as: licensing; supply; manufacturing; distribution agreements; PPA project documents; dispute resolution; M&A transactions; corporate governance; and policy matters. Retainer arrangements are often established as a cost- and time-effective approach, versus hiring in-house counsel or utilizing a multi-national law firm.

**Locations:** Throughout the United States

**Recognition/Awards:** N/A

**Website:** [www.estriatuslaw.com](http://www.estriatuslaw.com)

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## Troutman Sanders LLP

**Sectors covered:** Solar, wind, geothermal, ocean, river and hydropower projects, as well as alternative “clean coal,” ethanol, biodiesel/biogas, and biomass-related transactions

**Services provided:** Representing investors, developers, and utilities in all aspects of renewable energy project development, finance, corporate, and M&A transactions.

**Locations:** Work is done across the United States, as well as internationally from offices in the US (Georgia; Virginia; New York; Illinois; Oregon; California; and DC) and in China.

**Recognition/Awards:** Troutman Sanders' Energy practice received a “Tier One” ranking in the 2014 US News – Best Lawyers “Best Law Firms”—nationally and in the metropolitan areas of Atlanta, Georgia; Washington, DC; and Richmond, Virginia.

**Website:** [www.troutmansanders.com](http://www.troutmansanders.com)



**Left:** Industrial wood pellets  
**Below:** Overview of the number of US jobs currently in the forestry industry



# Seeing the Forest Through the Trees

## The power of wood pellets

By Seth Ginther

**FOR DECADES**, we've been seeking alternatives to fossil fuels because of the negative effects of burning coal and oil on the environment. Yet, concerns about cost, reliability, and capacity needs have slowed the adoption of renewable energy on either a national or global utility-scale level.

Nevertheless, ongoing projects and efforts are continuous—and for good reason. Fossil fuels are the largest greenhouse gas emitters in the world, contributing to three-quarters of all carbon, methane, and other greenhouse gas emissions. Ongoing research and new, alternative sources of energy provide hope for power that one day won't harm the earth.

One recent alternative: industrial wood pellets. Currently, the United States stands as a world leader in forestry management production, so it seems only fitting that related wood waste and unused forestry debris could provide a usable energy source, rather than just being discarded. As utilities in other parts of the world are also discovering, industrial wood pellets address today's pressing energy concerns, from reducing carbon emissions and controlling power costs, to increasing capacity and maintaining reliability.

Utilities in Europe, for example, are already on the path to creating a brighter energy future for EU citizens by increasing use of pellets as a renewable energy source. Research there has demonstrated clear advantages of using industrial wood pellets as an alternative to traditional, coal-fired utility plants.

### The science

Pellets are a form of woody biomass (although other sources of biomass, from crops for instance, can also be made into pellets) that's dried and processed into an easily combustible form. Wood pellets are clean to handle and ideal for use in automatic heating systems. They serve as a particularly efficient source of heat because they contain very low levels of moisture and ash, so when burned, virtually all of the material is used up and converted to heat or energy.

Industrial wood pellets are produced primarily in the Southeastern US from low-quality wood fiber, including forestry byproducts that would otherwise go to waste. Along with saving the costs of waste, the product of wood pellets actually release up to 90% less carbon than coal. In addition, burning wood pellets, instead of coal, emits fewer heavy metals and other pollutants into the air we breathe. In fact, trees are generally considered carbon neutral—meaning any wood technically absorbs as much carbon during its lifetime as it gives off while being burned.

### The appeal

Dozens of respected scientists wrote a letter to Congress in 2010, to voice support for a growing US industrial wood pellet industry based on the cost and environmental benefits. Their letter maintained that: "Carbon dioxide released from the combustion or decay of woody biomass is part of the global cycle of biogenic carbon, and does not increase the amount of carbon in circulation. In contrast, carbon dioxide released from fossil fuels increases the amount of carbon in the cycle."

The scientists' letter also warned policymakers that claims to the contrary were based on misinformation that could wind up encouraging US utilities to stick with more damaging fossil fuels. Nearly three years on, it appears these benefits (and concerns) are well founded.

Today, the US industrial wood pellet industry is still growing, but its benefits are largely being exported.

### The forests

Concern over the depletion of trees and forests is an important issue raised in relation to the wood pellet industry. However, the US Forest Service has recorded steady increases in the number of trees per acre in all regions of the country for more than 50 years. The United States not only leads the world in forestry, but also in sustainable forest practices. A comprehensive framework of laws, regulations, programs, and practices has been developed over decades, and are continuously adapted to local conditions.

Fossil fuel production and consumption has hundreds of years of history and, in comparison, the use of renewable energy is still in its infancy. Here are some reasons for change, according to the Energy Information Administration ([www.eia.gov](http://www.eia.gov)):

- 98% of energy production in the United States still comes from non-renewable sources;
- More than 2.5 million metric tons of carbon is produced by power plants; and
- The US consumes more than 20 million barrels of oil per day, with more than one million tons of coal consumed annually.

Pellets also aren't the primary purpose of forestry. In fact, wood pellets are merely an afterthought. The economics of US forestry practice favors the growth of large trees to produce high-value products, including lumber for homes or furniture—and not the low-value wood fiber that can be pressed into pellets. The fiber used for bioenergy is simply a byproduct of those higher value product industries.

American pellet producers rely on low-cost, low-quality fiber, using parts of trees left behind or unsuitable for the pulp, paper, or lumber markets.

Any argument that more US forestland is being depleted for wood pellet production is simply unfounded. What is correct is that demand for wood pellets is growing, along with managed US forests. In a recent letter to UK regulators, Georgia Governor Nathan Deal wrote, "Less than one-tenth of one percent of southern US forest inventory would be affected," assuming European demand meets projections through to 2020.

Moreover, research shows that young trees absorb carbon at a faster rate than older trees. The practice of rotational harvesting means there's a continual cycle of new growth. And, interestingly, trees tend to grow faster in the southeastern United States, meaning the benefits from these carbon powerhouses are realized much faster.

### The economy

As the wood pellet industry grows, so does it impact on local job markets and state economies. Overall, the forestry industry is responsible for adding billions of dollars and hundreds of thousands of jobs to the US economy, including in many states hit hard by the recession—and, particularly, in the southeast where trees tend to grow the quickest. The developing pellet industry is, therefore, also responsible for creating new and much-needed jobs in forestry, production, and shipping.

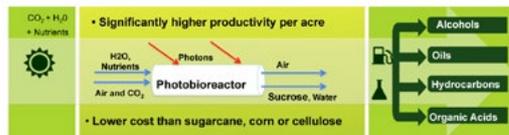
As European utilities have learned, it's relatively inexpensive to convert existing coal furnaces to use industrial wood pellets. This innovation enables electricity producers to decrease reliance on coal and reduce carbon emissions without incurring the massive capital costs that come with the construction of new plants.

The benefits of wood pellet production seem clear: less waste, fewer emissions, more jobs, and stronger forests. Not to mention, less dependence on fossil fuels and a cleaner source of heat and energy production. It's time to see the forest for the trees.

*Seth Ginther is the executive director for the United States Industrial Pellet Association.*

**United States Industrial Pellet Association**

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



### Biosynthetic sugar process

Proterro, currently the only biofeedstock company that makes sugar instead of extracting it from crops or deconstructing cellulosic materials, has been issued a United States method patent, protecting its unique biosynthetic sugar-producing process that combines transgenic cyanobacteria with a robust photobioreactor. It's the latest step toward commercialization of a process that unleashes the economic value of biofuels and biobased chemicals for industry partners.

Using only CO<sub>2</sub>, sunlight and water, Proterro's process dramatically lowers the cost of sugar production, yields a fermentation-ready sucrose stream, and has proven to be 30 times more productive on an acreage basis than sugar cane. Proterro is currently commissioning a pilot plant in Florida, and has completed a preliminary design, layout, and associated cost estimate for a demonstration-scale plant.

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



### Vertical turbine pumps

KSB offers a wide selection of vertical turbine pumps, including the large capacity SEZ series of turbine casing pumps. Vertical turbine pumps, also known as borehole or well pumps, typically are cylindrical in shape, with their intake nozzle and impellers located at the lower end of a long tubular casing with a discharge nozzle located near the top. They are easy to install in a crowded plant or a deep well because of their simple, compact shape. The SEZ tubular casing pumps are KSB's largest vertical turbine pumps. They're used in power plant condenser systems and large-scale desalination facilities where the requirement is to lift very large volumes of water (up to 18 m<sup>3</sup>/sec or 285,300 gpm) moderate distances.

**KSB Pumps Inc** | [www.ksb.ca](http://www.ksb.ca)



### Biomass receiving systems

Robert White Industries, Inc. (RWI) announces the development of new biomass receiving systems, designed for receiving biomass discharged from standard or live-floor semi trailers. The systems are created to properly deal with the environmental, safety, and the material-handling challenges presented by biomass unloading, processing, and storage. They better prepare biomass for storage by smoothing biomass surges at the trailer discharge, metering product into the handling system, sizing product to specification, and removing tramp metal prior to storage. RWI's systems are designed to work with green or dry wood products, corncobs, corn stover, and other types of biomass material.

**Robert White Industries, Inc.**  
[www.rwii.net](http://www.rwii.net)

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*The Huckabay Ridge Anaerobic Digestion Project in Stephenville, Texas, is currently the largest anaerobic digestion plant in North America*

## From By-product to Power

The business of turning manure into renewable energy

By Michelle M Lantz

When thinking of horses, renewable energy likely isn't the first thing that comes to mind. But, over time, the potential connection between animals and energy has become obvious.

Back in the late 1800s, the horse population skyrocketed in America and around the world due to the explosion of trade and industrial freight, personal and public transportation, and increased farming acreage.

All of this "horse power" created mounds...and mounds...of horse manure. Beyond the obvious issue of odor, additional environmental concerns stemmed from the unwanted byproduct, including flies and disease, public sanitation issues, and even increased fatalities.

To solve the horse byproduct problem, urban planners and entrepreneurs of the day began to invest in new technologies and new modes of transportation. Slowly, over time, people relied less and less on the horses themselves, and more and more on automated "horsepower."

What those pioneers didn't predict, however, was the impact vehicles would have on our energy consumption and environment in other ways. Moreover, as the population increased, so did the need for dairy and meat. So, despite any decreases in horse manure throughout the city streets, mounds of manure were (and still are) an unsightly issue at dairy and meat farms.

As the saying goes, "What comes around goes

around." Entrepreneurs are again discussing manure, only this time they are using new technologies to turn the animal byproduct into energy—renewable energy.

### The power of anaerobic digestion

Anaerobic digestion (AD) is the process by which organic materials (such as manure) are broken down by microorganisms, in the absence of oxygen. Used to manage waste, anaerobic digestion can also be used to produce fuels. The usage of animal waste for AD solves two environmental issues: disposing of billions of pounds of manure, and creating a high-quality renewable source of energy.

Currently, the largest AD facility in North America is at the Huckabay Ridge Anaerobic Digestion Project in Stephenville, Texas. Located in a major dairy community where manure is plentiful, the Huckabay Ridge facility turns manure and substrate (including glycerin, grease trap, and other organic waste) into biomethane gas (methane, carbon dioxide, and hydrogen sulfide), as well as fertilizer through microbial co-digestion.

During a multi-stage digestion process, the substrate provides most of the carbon needed for biomethane production, while the manure provides pH, alkalinity,



### Fast facts

According to the United States Environmental Protection Agency ([www.epa.gov](http://www.epa.gov)), some benefits of anaerobic digestion (AD) include:

- The creation of biogas, a renewable source of energy that can be used similar to natural gas.
- A reduction in methane emissions—when left to waste, food and other organic materials (such as manure) decompose to create methane, a greenhouse gas with a global warming potential 21 times higher than carbon dioxide.
- Animal byproduct management. Dairy digesters, for example, provide a management method for manure that improves water quality, reduces methane emissions from manure lagoons and storage ponds, and minimizes odor.
- A reduction in chemical usage. Using the solid residual as a soil amendment can reduce the need for chemical fertilizers, improve plant growth, reduce soil erosion and nutrient run-off, alleviate soil compaction, and even help the soil retain water.



### Bin monitoring software

BinMaster introduces a new version of the eBob software, designed to help users gather real-time inventory data from storage bins. The eBob program works in conjunction with BinMaster SmartBob remote level sensors to provide measurement data to personal computers. The new release of eBob version 5.2 includes the ability for customers with a LAN, WAN, or VPN to access the bin level measurement from one or multiple eBob Server (remote) locations on the network.

eBob software helps customers more effectively manage bin levels without having to manually inspect and measure each bin, saving valuable time, while optimizing bin levels and storage capacity. It provides for highly affordable inventory tracking for any size of operation by using computer-based technology to provide detailed information. The software is easy to use and requires no special training or support.

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



### Mid-stream processing granulator

The Saturn Grizzly M-80 industrial rubber granulator, from Granutech-Saturn Systems, is a size-reduction system that utilizes a single rotor design for mid-stream processing. The Grizzly M-80's unique rotor construction and proprietary blade material allow the greatest size reduction for tires recycled into bio-energy—while minimizing blade wear and providing clean rubber and separated steel.

The Saturn Grizzly M-80 can be configured, through adjustment in screen size, to create products in 1/2" minus, 3/4" minus, one-inch minus or larger sizes. The M-80's rotor is 34" in diameter, supported by double-row spherical roller bearings. Available with either a 300 hp or 400 hp drive motor, and an 80" (model 80) or 96" (model 96) wide cutting chamber, both models utilize rotary and stationary cutting knives with the rotor incorporating a proprietary staggered-knife design. The Saturn Grizzly is powered by a TEFC electric motor and a heavy-duty gear reducer.

**Granutech-Saturn Systems**

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



### Abrasion-resistant pump

Almatec announces the launch of the E80 model in its family of E-Series AODD Pumps. With the addition of the E80, Almatec's E-Series pumps are now available in seven optional sizes, achieving maximum capacities that range from 4 gpm (0.9 m<sup>3</sup>/h) to 210 gpm (48 m<sup>3</sup>/h). The E80 is equipped with a nominal connection diameter of DN80 (3") and a maximum capacity of 210 gpm (48 m<sup>3</sup>/h). The E80 is currently the largest model in the E-Series family of solid-body plastic AODD pumps from Almatec, ideal for use in the biofuel industry.

The E80 is constructed with abrasion-resistant polyethylene, and is ideal for use in abrasive and difficult-to-handle applications. The E80 is designed with integrated flanged connections to ensure high stability and leakage protection. Level sensors monitor complete filling of the chambers.

**Almatec** | [www.almatec.de](http://www.almatec.de)

and buffer capacity to maintain biological stability. The facility has eight massive, continuously stirred tank reactors, referred to as digesters, with a total working volume of 6.8 million gallons.

Once digestion is complete, the resulting biomethane is piped to an onsite processing plant where carbon dioxide, hydrogen sulfide, and water are removed. The end product is clean, high-quality renewable natural gas, which is piped to an intrastate pipeline, sold, and delivered to a large California utility.

Huckabay Ridge currently processes about 12,500 tons of manure and 14.6 million gallons of substrate per year—waste that would otherwise be dumped in unsustainable destinations, such as in landfills.

Through sustainable use of the waste, this facility has taken upon itself to help reduce greenhouse gas emissions, minimizes adverse impacts on local watersheds, and produces liquid and solid fertilizer to promote crop growth.

### Changes for the future

Although today's urban planners and investors are still dealing with many of the same issues as their predecessors 100 years ago, the results are different, offering promise for the future. Innovative technologies, such as anaerobic digestion, have created more environmentally friendly opportunities to dispose of the mounting collection of waste and animal byproducts.

The Huckabay Ridge Anaerobic Digestion Project is merely one example of the positive impact AD technology can offer, but there are various, similar waste-to-energy plants popping up throughout the US as a means of turning waste into power.

From horses to dairy cows, it's pretty impressive that the resulting animal byproducts could be transformed into clean, renewable, natural gasses that can serve to power our communities.

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



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## Valuing Geothermal Power

### In today's renewable energy market

**AS STATES, SUCH AS CALIFORNIA,** move ahead with more aggressive Renewable Portfolio Standards (RPS) and seek to reduce greenhouse gas emissions, state officials are finding they need to consider the full value of the power sources they use.

The RPS places an obligation on electricity supply companies to produce a specified fraction of their electricity from renewable energy sources. A full understanding of the energy sources available and their inherent benefits are, therefore, important to maximizing clean power. Such a review is critical to ensuring consumers are offered the most affordable overall energy system costs, with a complete understanding of the many different reasons for choosing clean, alternative power sources.

As far as power goes, geothermal provides a uniquely reliable and continuous source of clean energy. As a baseload renewable resource, a geothermal energy plant operates 24 hours a day and seven days a week, regardless of changing weather or the time of day. Unlike burning fossil fuels, geothermal energy has minimal impacts on the environment, as the process emits no greenhouse gases, pollution, or hazardous wastes.

This form of energy is nothing new. The very first recorded geothermal power generator was tested back in 1904 in Italy, and successfully lit four light bulbs. By 1911, the world's first commercial power plant was built there. But the largest group of geothermal power plants in the world is located at The Geysers, a geothermal field in California.

Today, the global geothermal market has approximately 12,000 megawatts (MW) of geothermal capacity on-line. Plus, there are some 1,766 MW of new geothermal capacity in early stages of development, or under construction, in 70 countries and territories around the world. Developers are continuously and actively exploring potential new developments.

To help address any related questions that arise, a new, joint report has been released, entitled "The Values of Geothermal Energy: A Discussion of the Benefits Geothermal Power Provides to the Future US Power System." The report highlights the values of geothermal in today's renewable energy market as a viable power source option.

#### Key timing

"This is a timely report," said Karl Gawell, executive director of the Geothermal Energy Association (GEA). "The California PUC recently noted active questions before policy makers in California and elsewhere, specifically: 'How increasing amounts of intermittent

generation are impacting grid reliability, quantifying the impact and benefits of various resources to integrate intermittent generation, and what new policies should be adopted to manage the changing electric grid.'"

As the report indicates, these questions are gaining in importance as the United States expands its renewable power production, which today means, "generating approximately 14% of the electricity" nationwide. Much of this is coming from wind and solar photovoltaic technologies that rely heavily on the prevailing weather conditions in order to generate power.

According to the report, "Geothermal power offers both firm and flexible solutions to the changing US power system by providing a range of services including, but not limited to: baseload, regulation, load following or energy imbalance, spinning reserve, non-spinning reserve, and replacement or supplemental reserve."

Geothermal's baseload capacity makes it particularly valuable for replacing retiring fossil fuel facilities. "Geothermal energy is a renewable power source that can provide baseload and flexible power, quickly adjusting to fit the needs set by variable renewable energy technologies," states the report.

As the percentage of electricity produced from intermittent sources increases, the stress on an aging power system designed for fossil fuels encourages renewable energy's role as an important part of the power supply mix.

Looking beyond the benefits to the power system, the report also summarizes other key benefits of geothermal power, including various economic and environmental benefits. For instance, one of the most important economic aspects of geothermal energy is that it's completely local. It's generated using indigenous resources, which reduces dependence on imported, environmentally unfriendly energy sources (such as oil). In turn, this also reduces trade deficits.

The industry has positioned itself to grow more by 2020 than ever before. "We are seeing new technology developments move forward, and new projects being announced in every region of the world," remarked Karl Gawell. "Despite slow growth in the United States, the global market continues to gain steam. So, many American geothermal companies are using their industry know-how in friendlier economic and political climates overseas."

GEA president Craig Mataczynski of Gradient Resources has challenged the industry this year, to reach a five percent of total US electricity production. To reach this goal it will take advancements in geothermal technology and recognition of the full value of geothermal power.

“As policy makers at the state and federal level move to address global warming and need to achieve significant emissions reductions,” Gawell said, “geothermal power’s unique abilities to replace baseload fossil fuels or firm intermittent resources provides premium value to fulfill state Renewable Portfolio Standard requirements and meet federal environmental standards.”

\* Prepared by Ben Matek (Geothermal Energy Association’s industry analyst), and Brian Schmidt (librarian at the Geothermal Resource Council), as a joint report by the GEA and the GRC to document the value of geothermal power.

The report is available at <http://geo-energy.org/reports/Values of Geothermal Energy Draft Final.pdf>

**The Geothermal Energy Association (GEA)**  
www.geo-energy.org

**Geothermal Resources Council (GRC)**  
www.geothermal.org



### Large-diameter pipe

REHAU introduces its new 1-1/4" RAUGEO U-bend. Previously available only in one-inch diameter, the larger diameter pipe brings the benefits of crosslinked polyethylene (PEXa) technology to bigger, more demanding projects. The new, 1-1/4" U-bend makes it possible to utilize deeper boreholes, increasing the heat exchanged, and potentially reducing the total number of boreholes required for a project. Single or double U-bends are offered in continuous coil lengths of 360, 410, 460, and 510 feet. Composed of PEXa pipe, EVERLOC fittings, and balancing manifolds, the RAUGEO ground-loop heat exchange system is a high-efficiency geothermal energy source for heating and cooling.

**REHAU** | [www.na.rehau.com/raugeo](http://www.na.rehau.com/raugeo).



### Shell & tube heat exchangers

GEA Heat Exchangers, with its GEA Bloksma-Fryer NHP shell and tube heat exchangers, presents a new series that was developed to meet the requirements encountered in the cleaning of 25-ton tank containers. These heat exchangers are designed for pressures up to 300 bar, and are effective for operation with steam and overheated water. Models from the HNP series can be easily uninstalled, which means easy access for service. As a result, the heat-exchange surface can be mechanically cleaned, which extensively eliminates the need for chemical cleaning. The individual units are produced from standard components, according to customer specifications, for output from approximately 100 kW to 2500 kW.

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[www.gea-heatexchangers.com](http://www.gea-heatexchangers.com)

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Hotel Del Coronado—San Diego, California; [www.awea.org/events](http://www.awea.org/events)
- 20-22 **The World Future Energy Summit**  
Abu Dhabi National Exhibition Center—Abu Dhabi; [www.worldfutureenergysummit.com](http://www.worldfutureenergysummit.com)
- 20-23 **National Biodiesel Conference & Expo 2014**  
San Diego Convention Center—San Diego, California; [www.biodieselconference.org/2014/](http://www.biodieselconference.org/2014/)

**FEBRUARY**

- 19-21 **Industrial Pellet Trade & Transport Summit**  
Hyatt Regency Atlanta—Atlanta, Georgia; [www.infocastinc.com](http://www.infocastinc.com)

**MARCH**

- 24 **Pellet Supply Chain Summit (Co-located with International Biomass Conference & Expo)**  
Orange County Convention Center—Orlando, Florida; <http://biomassconference.com>

**APRIL**

- 03-04 **Biogas Knowledge Workshop and Tours**  
London Convention Centre—London, Ontario; [www.biogasassociation.ca](http://www.biogasassociation.ca)
- 09-11 **Northeast Biomass Heating Expo**  
Westin Portland Harborview Hotel—Portland, Maine; <http://nebiomassheat.com>
- 14-15 **CanWEA 2014 Western Forum**  
The Westin Calgary—Calgary, Alberta; [www.canweaforum.ca](http://www.canweaforum.ca)
- 23-24 **International Geothermal Energy Forum & Expo**  
Washington, DC; [www.geo-energy.org](http://www.geo-energy.org)

**MAY**

- 05-08 **WINDPOWER 2014**  
Mandalay Bay Convention Center—Las Vegas, Nevada; [www.windpowerexpo.org](http://www.windpowerexpo.org)
- 05-09 **Alternative Clean Transportation (ACT) Expo**  
Long Beach Convention Center—Long Beach, California; [www.actexpo.com](http://www.actexpo.com)
- 07-08 **CanSIA's Solar Ontario 2014**  
Ottawa, Ontario; [www.canwea.ca](http://www.canwea.ca)
- 18-21 **Strive for Sustainability: Solid Waste & Recycling Conference with Trade Show**  
Sagamore Resort on Lake George—Bolton Landing, New York; [www.nyfederation.org](http://www.nyfederation.org)
- 19-21 **Green Energy Expo Canada 2014**  
Toronto, Ontario; [www.mchewel.com](http://www.mchewel.com) | [www.planetfriendly.net/calendar](http://www.planetfriendly.net/calendar)

**JUNE**

- 03-05 **EnergyOcean 2014**  
Sheraton Atlantic City Convention Center Hotel—Atlanta Georgia; [www.energyocean.com](http://www.energyocean.com)
- 15-18 **4th International Conference on Algal Biomass, Biofuels & Bioproducts**  
Sante Fe Convention Center—Sante Fe, New Mexico; [www.algalbbb.com](http://www.algalbbb.com)
- 15-19 **Cleantech 2014**  
Gaylord National Hotel & Convention Center—Washington, DC  
[www.techconnectworld.com/Cleantech2014](http://www.techconnectworld.com/Cleantech2014)
- 23-25 **PV America**  
Boston Convention Center—Boston, Massachusetts; [www.pvamericaexpo.com](http://www.pvamericaexpo.com)

**JULY**

- 08-10 **Intersolar North America 2014**  
Moscone Center—San Francisco, California; [www.intersolar.us](http://www.intersolar.us)
- 25 **HydroVision International**  
Music City Center—Tennessee; [www.hydroevent.com](http://www.hydroevent.com)
- 27-29 **2014 Pellet Fuels Institute Annual Conference**  
Omni Orlando Resort at Champions Gate—Orlando, Florida; <http://pelleteat.org>

Send us your clean energy show and event listings. Email information to the Editor at [mfroese@naceanenergy.com](mailto:mfroese@naceanenergy.com)

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64	Kinetic	<a href="http://www.kineticsolar.com">www.kineticsolar.com</a>
46	Kipp & Zonen	<a href="http://www.kippzonen.com">www.kippzonen.com</a>
69	Kureha America	<a href="http://www.kureha.com">www.kureha.com</a>
27	Mattracks	<a href="http://www.mattracks.com">www.mattracks.com</a>
65	Mudge Fasteners	<a href="http://www.mudgefasteners.com">www.mudgefasteners.com</a>
3	PV Hardware	<a href="http://www.pvhardware.com">www.pvhardware.com</a>
53	Quick Mount PV	<a href="http://www.quickmountpv.com">www.quickmountpv.com</a>
47	Quickscrews	<a href="http://www.quickscrews.com">www.quickscrews.com</a>
61	Resol	<a href="http://www.resol.com">www.resol.com</a>
62	Rodman & Rodman	<a href="http://www.rodmancpa.com">www.rodmancpa.com</a>
48	Roll Forming Corporation	<a href="http://www.rfcorp.com">www.rfcorp.com</a>
17	Royal Purple	<a href="http://www.royalpurpleindustrial.com">www.royalpurpleindustrial.com</a>
OBC	Sapa Extrusions	<a href="http://www.sapagroup.com/NA">www.sapagroup.com/NA</a>
45	Schletter	<a href="http://www.schletter.ca">www.schletter.ca</a>
51	Siifab Ontario	<a href="http://www.siifab.ca">www.siifab.ca</a>
50	Solar & Renewable Power Systems	<a href="http://www.srps.com">www.srps.com</a>
67	Solar Fastener Expert	<a href="http://www.solarfastenerexpert.com">www.solarfastenerexpert.com</a>
33	Solectria Renewables LLC.	<a href="http://www.solectria.com">www.solectria.com</a>
43	Surrette Battery	<a href="http://www.rollsbattery.com">www.rollsbattery.com</a>
75	TerraSource Global	<a href="http://www.terrasource.com">www.terrasource.com</a>
19	TWR Lighting	<a href="http://www.twrlighting.com">www.twrlighting.com</a>
39	Unirac	<a href="http://rm.unirac.com">rm.unirac.com</a>
21	Vaisala	<a href="http://www.vaisala.com/3TIER">www.vaisala.com/3TIER</a>

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