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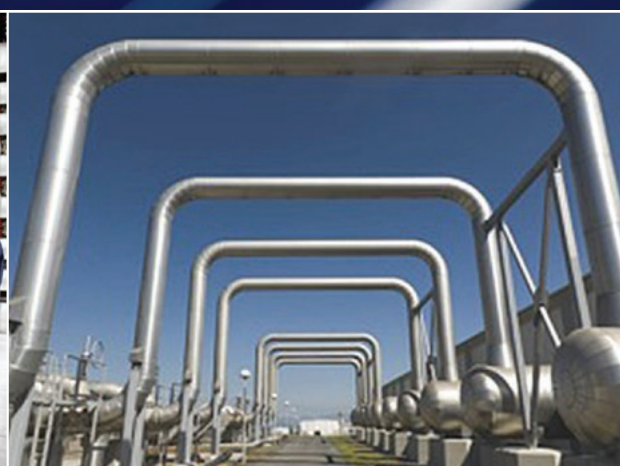

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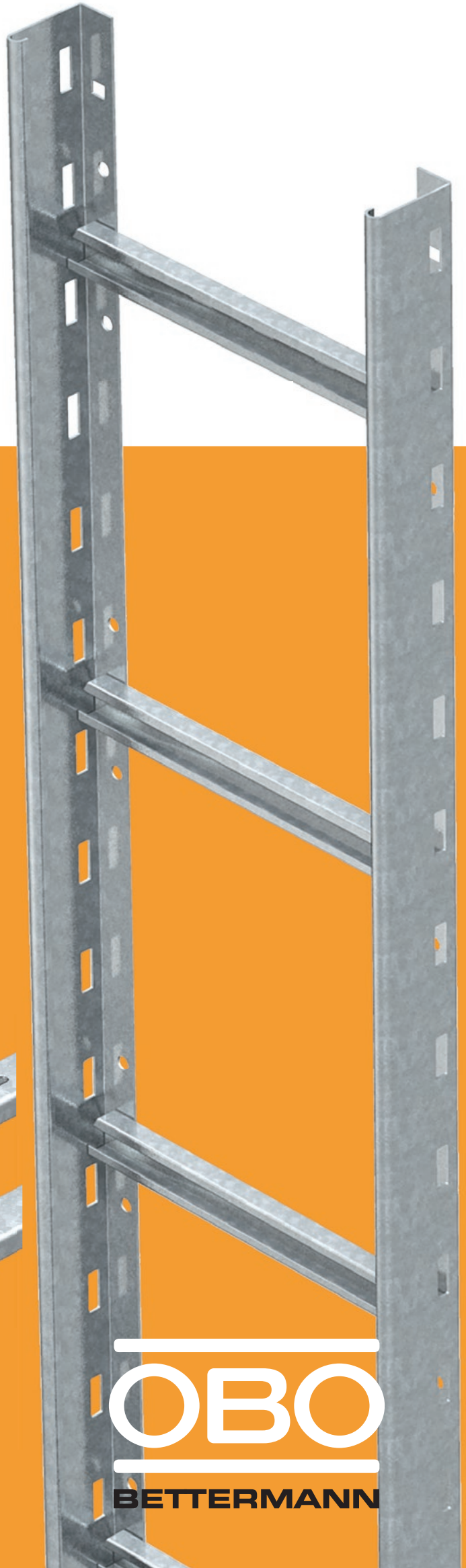

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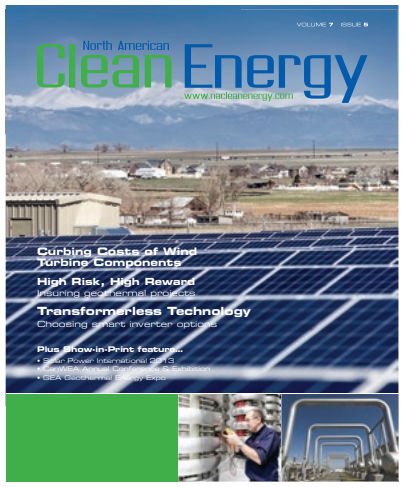

On our cover...
Photo of the 2.3-megawatt (MW) Brighton Solar Energy Project in Thornton, Colorado; courtesy of Samuel Engineering and Bonfiglioli USA (www.bonfiglioliusa.com).

Photographer: Jackie Shumaker

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North American
Clean Energy
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SEPTEMBER / OCTOBER 2013
Volume 7, Number 5

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

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

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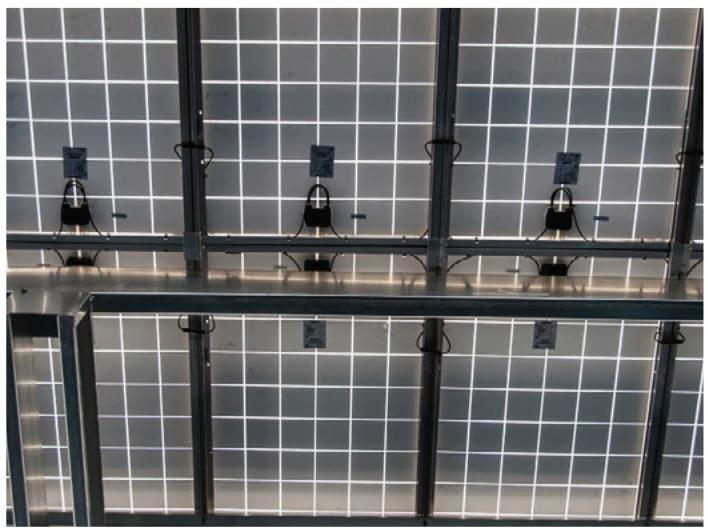

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Photo by Michelle Moore

AS SCIENCE AND TECHNOLOGY advance, the innovations have really been pretty astounding over the years. To think we barely had electricity a century ago (only about 20% of the homes in the early 1920s were fully wired to an electrical supply), and today we power everything from coffeemakers and televisions to our own personal laptops and cell phones—sometimes even wirelessly. These inventions would have amazed many of our ancestors.

Today, we travel further (around the world if we so desire and can afford it), build more (entire, self-contained cities) and, for the most part, live longer than ever before. Even the first bionic hearts for humans have become a reality in the United States, developed and advanced over the last decade by an American biotech company called Abiomed. With continued trials, the AbioCor artificial heart is made from a high-tech plastic, which the body doesn't react against, so the immunosuppressive drugs required after a transplant surgery aren't needed (http://texasheart.org/Research/Devices/abiocor.cfm).

For power, an internal battery is used, which is recharged by an external pack that passes energy through the patient's skin using electric currents. But, much like a natural heart, the AbioCor artificial heart is designed to beat quietly in much the same manner, is about the same size, and consists of two blood-pumping chambers. Seems as much as we attempt to defy nature, we also often attempt to mimic it.

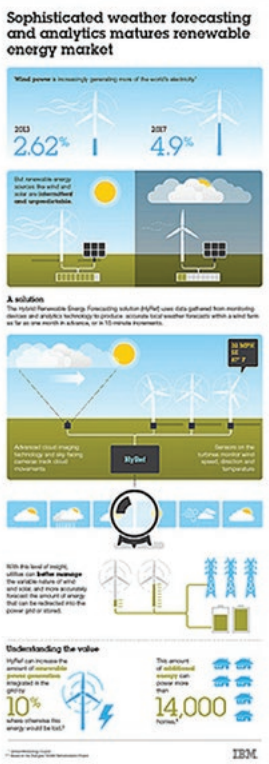
On a smaller scale, the human body is serving as somewhat of a model for preserving solar energy cells. Or, at least, our vascular system is. The "branching," vascular channels that circulate blood throughout our bodies—or, similarly, that distribute water and nutrients throughout the leaves from plants and trees in nature—are being replicated in solar cells. The purpose is to develop solar cells that can heal themselves.

Researchers from North Carolina State University have shown that: "Creating solar cell devices, with channels that mimic organic vascular systems, can effectively reinvigorate solar cells whose performance deteriorates due to degradation by the sun's ultraviolet rays" (source: www.sciencedaily.com; read more at http://news.ncsu.edu/releases/velev_solar_cell_channel). Solar energy cells that are based on organic systems don't only hold the potential to better maintain their own "health," but are also more cost-effective and more environmentally friendly than silicon-based solar cells, the current industry standard.

Despite our own leaps forward in science, medicine, power, and technology, nature with all of its wonder and beauty, is possibly still the best teacher and still so far more advanced. Ironically, nature—and the energy derived from the sun, wind, and earth—is also what might help save our planet from the destructive waste and future greenhouse gasses that humans are responsible for emitting.

This issue, we continue the trend and look at ongoing advancements, from transformerless technology and "smart" solar systems (see page 24), to remote wind power measurement tools (page 44), and direct current technology for renewable energy transmission (page 60). We also present a variety of new products available for the solar, wind, geothermal, and biopower industries.

We hope you enjoy the read! Michelle Froese



Wind & solar forecasting

IBM has announced an advanced power and weather modeling technology that will help utilities increase the reliability of renewable sources. The Hybrid Renewable Energy Forecaster (HyRef) combines big data analytics, advanced cloud imaging, and weather modeling capabilities to accurately forecast the availability of wind power and solar energy—using methodologies that haven't previously been applied to the renewable energy industry, to achieve a precision that hasn't previously been possible.

This solution will enable utilities to integrate more renewable energy into the power grid, helping to reduce carbon emissions, while significantly improving clean energy output for consumers and businesses. When combined with analytics technology, accurate local weather forecasts within a wind farm can be produced, down to a square kilometer, estimating the amount of energy generated from each turbine.

IBM | www.ibm.com/smarterplanet

California geothermal development

The Bureau of Land Management (BLM) and the US Forest Service Inyo National Forest has signed the Record of Decision, approving a new 40-megawatt (MW) geothermal project near Mammoth Lakes, California. The Casa Diablo IV Geothermal Development Project will be built on lands administered by the Inyo National Forest, and on private lands, within four existing federal geothermal leases. The project will include construction of a new geothermal power plant, up to 16 new production and injection wells, multiple pipelines, and an electric transmission line. When completed, the project would produce enough energy to power 36,000 homes.

The Bureau of Land Management (BLM) | www.blm.gov

Ormat Nevada Inc. | www.ormat.com

Metal rooftop PV racking criteria

The Center PV Taskforce released the public version of the "PV Racking and Attachment Criteria for Effective Low-Slope Metal Panel Roof System Integration," earlier this summer. The document contains five fundamental principles for the effective deployment of rooftop photovoltaic (PV) on metal panel roof systems. Each principle includes examples and recommended action items for the design, installation, and long-term maintenance of rooftop racking and attachment systems.

"For the past two years, the Center PV Taskforce has filled a critical gap in communication between the solar and roofing industries," said Center VP of Sustainability James Kirby, AIA. "The dialogue within the Taskforce focuses on the long-term performance and reliability of both the solar energy system and roof system, which are critical elements to the long-term success of the rooftop solar industry as a whole."

The document is the second in a series of guidelines published by the Center PV Taskforce. Download the guidelines at www.roofingcenter.org/special/pv

The Center for Environmental Innovation in Roofing (Center) | www.roofingcenter.org

Commercial-scale cellulosic ethanol

Florida is now home to the nation's first commercial-scale cellulosic ethanol production plant, at INEOS Bio's Indian River BioEnergy Center in Vero Beach. Developed through a joint venture between INEOS Bio and New Planet Energy, the project uses a unique hybrid of gasification and fermentation technology to convert wood scraps, grass clippings, and other waste materials into transportation fuels, as well as to energy for heat and power.

The Indian River County BioEnergy Center will have an annual output of eight million gallons of cellulosic ethanol per year from vegetative, yard, and municipal solid waste, as well as six megawatts (MW) of clean, renewable power annually—that's enough to run the entire facility and provide excess power to the local community.

US Department of Energy ~ EERE | www.eere.energy.gov

INEOS Bio | www.ineos.com

Did you know?

According to the Global Renewable Fuels Alliance (GRFA), 62 countries now have biofuel-friendly policies in place, with ethanol production alone replacing the need for over two million barrels of crude oil per day. The significant growth in the global biofuels' industry can be viewed online at the GRFA's new interactive World Biofuels Map.

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Slow and Steady Wins the Race

A look at global solar installation challenges

By Jill Hansen

A 9.8 MW Talesun solar project on the rooftop of their manufacturing facilities in China

IN 2009, the world carefully monitored the United Stated, a country slated to be the global solar leader by 2013*. At the same time, Germany continued to top the charts, while Chinese module manufacturers were making forays into the market to establish their presence (see Chart 1).

By 2012, amid policy and permitting challenges, the US ranked fourth in the world for installed photovoltaic (PV) projects. The following provides a high-level look at the global solar market, and the top three barriers slowing the US from becoming the once-predicted world leader in renewable energy—a goal that that nine out 10 Americans fully support.

Reaching the top

While the United States did not skyrocket on the solar front as forecasted, it maintained a steady plod upward, which one could interpret as a hallmark of sustainable growth. The good news is that Greentech Media projects the US solar market will continue to grow through 2016, increasing to over a nine-gigawatt (GW) market (see Chart 2).

So, what's stopping the US from topping the charts? Here are the top three reasons...

1. Politics and the grid. Around the world, countries are reporting issues with the grid, so the United States isn't alone on this front. Policy and utilities are taking center stage as they struggle with the new landscape of renewables. With different agendas in play, utilities are positioning to decrease rates for solar power and increase rates to customers. Germany continues to set precedence with policy as their utilities struggle to build new infrastructure and balance grid stability. Italian utilities are reported to be a bureaucracy challenge.

Currently, in China there are reported constraints with infrastructure and grid connection. The China Electricity Council reports that more than four gigawatts of utility PV plants have been installed in 2012, while only three gigawatts connected to the grid. Early reports on the Japanese feed-in tariff (FIT) are that developers must seek FIT approval from the local utility, which is deemed difficult due to grid capacity constraints.

2. Standardization. Though just one country, the US is often likened to 50 different countries due to its great variation across jurisdictions. Not alone in this analogy, similar occurrences are reported in other countries, too. Informal developer reports indicate bureaucracy is particularly onerous in Puerto Rico, Spain, and Italy—meaning projects often face red tape and developmental delays.

In contrast, Germany's entire rooftop solar registration process is done online with the Federal Grid Agency, resulting in minimal setbacks or delays. But Germany only has four major grid markets, while the US has 10 electric power markets, each fragmenting to various municipalities. Plus, geographically, Germany is smaller than Montana, and so the US has much more ground to cover and more jurisdictions.

In terms of standards, there are two main considerations affecting project development: permitting and transmissions.

• Permitting

Ontario, Canada serves as a case-in-point for potential permitting delays, as this province has 89 different utilities. Ontario tried to streamline processes by removing municipalities from the equation, but was hit hard with protests. Processes were then revised to include city-level input. Early indications are this will slow installations and complicate the process.

US permitting for public land is fairly clear, but private land varies state-by-state. Developers must submit their plans to specified governing bodies for reviews. Whether projects are rejected or accepted takes a considerable amount of time and iteration. And, once accepted, project plans can still be appealed.

"Federal and state agencies need to streamline processes across jurisdictions to create clarity and certainty," according to Perry Fontana, president and CEO of Fontana Energy Associates. "At this point, the most important factor for investors' consideration is transparency. They need to understand what the financial investment will be."

• Transmission lines

One of the primary problems affecting non-residential solar project development relates to

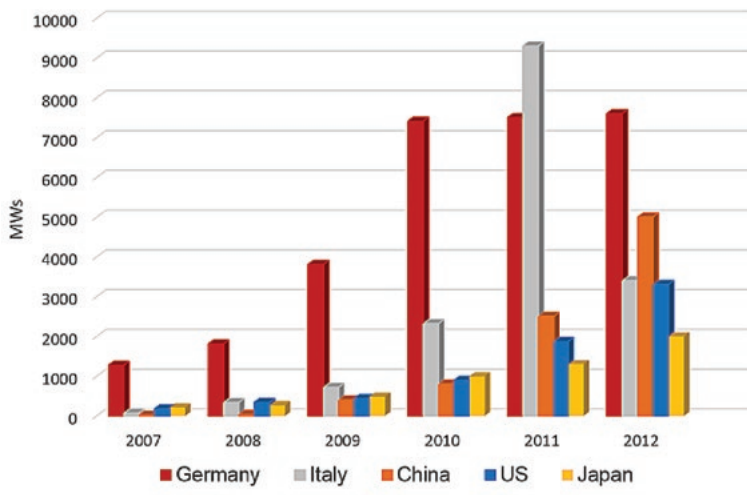
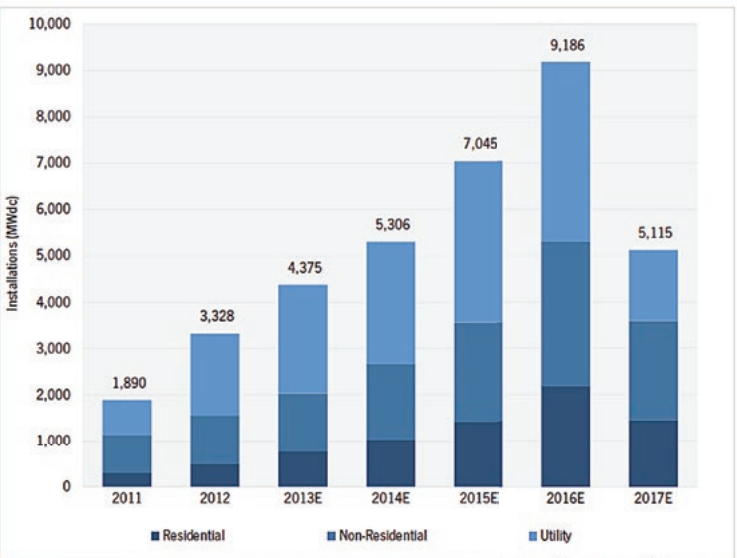


Chart 1. *PV installations of the big five solar countries; 2007-2012*



Total	2011	2012	2013E	2014E	2015E	2016E	2017E
Residential	303	494	770	1,032	1,414	2,175	1,446
Non-Residential	827	1,066	1,263	1,632	2,149	3,133	2,140
Utility	760	1,769	2,342	2,641	3,482	3,877	1,529
Total	1,890	3,328	4,375	5,306	7,045	9,186	5,115

Chart 2. *Greentech Media projects the US solar market will continue to grow through 2016 (www.greentechmedia.com)*

Residential Installations	Utility-scale Installations
United States: 4.5 months	**United States:** 6 months to 2+ years (depending on the state)
Germany: 1 month	**Germany:** Installed very few utility-scale projects in 2012
Japan: 1.5-2 months	**Japan:** 1 year
Italy: 1 to 1.5 months	**Italy:** 6 months to 1 year
China: N/A	**China:** 6 months

Table 1. *Comparison of solar system installation times per country*

right-of-way transmission lines. Here's a breakdown of the differences between some countries.

- ***Ontario, Canada:*** For main transmission lines here, the utility negotiates and runs the line connections, dealing with land owners to sort out rights and rates.
- ***United States:*** Developers are left on their own to make necessary arrangements, often resulting in undeterminable costs and potentially high legal fees.
- ***Mexico:*** New laws specify the government will take on this responsibility, though it's yet to be determined how that will play out.
- ***Italy and Spain:*** Right-of-way transmission lines are regulated by the law, however, this can sometimes work against project developers as utilities are left to interpret the laws.

Regulations and legalities are, perhaps, the largest issue affecting successful project development. "Legal requirements for project development is one of the greatest expenses, and may have been the downfall of many projects that initially looked viable," explains Milfred Hammerbacher, CEO of s2e Technologies. "Delays in projects translate to added costs and, without transparency, unforeseen requirement adjustments are another layer of confusion and expense."

3. Financial support. It should be as simple as buying a car. You select your system and apply for financing, but currently less than five percent of US banks actively finance solar projects. Frustrations with the solar market may not be isolated to the US. The World Economic Forum 2012 Financial Development Report states in the executive summary that financial systems across the world appear to have stalled.

As Javier Latre Gorbe, VP of technical operations at ESA Renewables, maintains, "We need policy in place to standardize financing, just like the mortgage on your house. The financial community needs to take risks and innovate to help renewable energy gain sustainable market share in the United States."

Japan recently announced it will make secure low-interest loans, available through government financial institutions for residential rooftop installations. Variances in the time to install per country may be offset by general business challenges within that region.

Extracted from "Forbes' Best Countries for Doing Business in the World," are the top five countries for solar: United States (#12); Germany (#21); Japan (#30); Italy (#36); and China (#96). And, interestingly, in much the same order is the "World Bank's Ease of Doing Business Index 2012" for the top five solar countries: United States (#4); Germany (#20); Japan (#24); Italy (#73); and China (#91).

Conclusion

The three top barriers to growing the solar market in the US are interdependent. There are no quick or easy answers, but the United States is recognized for its ability to innovate. One thing of certainty is that the world of renewables is growing, and the future looks promising. In the words of Bill Clinton, "You know you're gonna win this thing, it's just a question of when."

** References available upon request*

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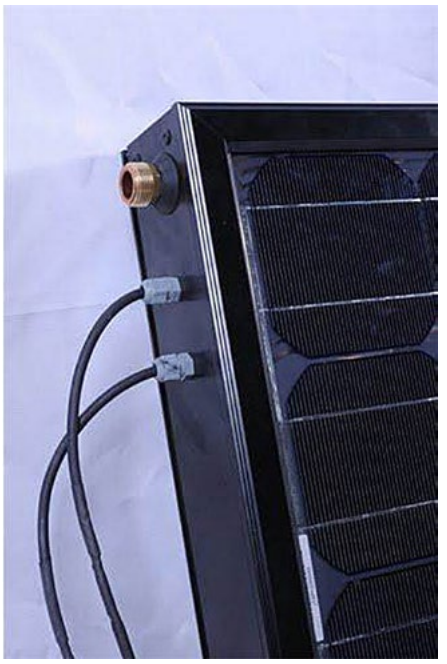

Left. *Putting solar panels to the test for optimized performance and reliability*
Above. *PVT Module: Combining PV with solar thermal*

Testing, Testing!

Addressing the growth of solar technology

By Sunny Rai

ONGOING GROWTH IN THE SOLAR ENERGY INDUSTRY has led to the development of numerous new technologies and products on the market. Previously, standard flat-panel photovoltaic (PV) modules consisted mainly of silicon or thin-film structures, which only received direct sunlight activation on one side of the module. Now, products utilize bi-facial cells that allow light activation on both sides. Herein, special optical elements are employed, wherein holographic film or prisms are utilized to couple light into an active PV cell. Hybrid systems are also gaining popularity where a standard PV module and a solar thermal system are combined, known as PVT (photovoltaic + thermal).

These new technologies are designed to improve the efficiency of current modules. Despite such advancements, however, the solar industry has yet to maintain standardized, reliability testing. And, current standards for solar panel safety and performance don't completely address the different testing methods required for new products. But, to prove the quality and reliability of products, solar manufacturers must still test new technology, regardless of the limits of existing standards and test methods.

Module testing

The significance of product testing in the solar industry can be seen with bi-facial cells. These cells operate at a higher current level than modules that receive only front-side illumination. Depending on installation, the bi-facial module may be placed at such an orientation that its backside receives significantly more light than expected. As a result, testing of modules containing bi-facial cells must be performed at higher current levels.

Testing methods must also be modified for optical elements that utilize holographic film, since film can improve module performance and reduce the number of active bi-facial cells required. Holographic film, for instance, not only has various "reflectivities" depending on the different angles of light entering the module, but it's also influenced by light reflected from the surrounding background. Therefore, the total module power output varies depending on the wavelength and angle of incoming light, causing testing for holographic modules to differ from those modules without an optical element.

Prisms are another optical element being integrated into new products. By including a prism in the module, the solar product essentially becomes a window in which diffused light can be directly transmitted. This allows light to be coupled into an active cell, so electricity is produced. Due to this unique configuration, normal testing methodology must be modified to ensure the maximum output power can be determined.

Hybrid products, such as PVT (where a PV module is combined with a solar collector), also face reliability and performance testing challenges. For example, PV modules for the US market must comply with UL 1703, which explicitly states that combination photovoltaic-thermal modules or panels aren't covered. As a result, a hybrid testing procedure had to be designed to ensure electrical, fire, and mechanical safety.

Equipment, standards & performance

Although these testing methods address new technologies to the best of their ability, there are limitations on the test equipment available. For instance, simulators that can take a flat-plate module and expose it to 100% of light on the front and back sides currently just don't exist. Even so, safety testing is crucial and it's still important for manufacturers to test new technologies within the limits of existing standards.

There are also multiple efforts currently occurring in the industry to ensure the performance of new and old modules. Among laboratories and the testing community, discussions are taking place and performance standards initiatives are underway by the National Renewable Energy Laboratory (NREL) in the United States and with the IEC (International Electrotechnical Commission) in Europe.

In addition to standards development, laboratories are creating test programs to address issues of performance. To do this, they are taking old test methodologies and expanding them based on the failures happening out in the field. A test program that would typically test a module for 100 cycles, for instance, now tests it for 200 or 250 cycles to see how the module will react under the most extreme environments.

To address issues of performance, some laboratories are also developing factory audit and pre-shipment processes. Follow-up factory inspections help ensure quality is maintained, while the pre-shipment review provides buyers with assurance that what they receive is exactly what they ordered. These types of processes are crucial for gaining the return and benefits expected from solar power projects.

Whether designing modules for commercial installation or for use on the rooftops of single and multi-family homes, testing is an essential step of a successful product and solar project. Technology testing also helps solar manufacturers ensure that only safe, quality products are available in the market.

Sunny Rai is the regional vice president for renewable energy at Intertek, providing strategic directions for the PV, wind, smart grid, and semiconductor businesses. After more than 25 years with the company, he has helped several solar manufacturers establish product safety and global regulatory compliance programs.

Intertek | www.intertek.com/solar

Optimizing Ground-mount PV Installations

Racking system considerations

By Sam Veague

AS PHOTOVOLTAIC (PV) PROJECTS have evolved over time, the industry has focused on reducing costs to increase the adoption of solar power. This reduction has been dramatic, and the corresponding increase in solar PV projects is exciting, with new records in project size and overall deployments announced nearly every year. As solar project costs drop so, too, have racking costs through the utilization of improved engineering analysis, appropriate and efficient material selection, and improved manufacturing approaches.

Knowing that racking continues to play an integral role in solar installations, savvy project integrators are paying more attention than ever to products and solutions available to reduce costs and create jobsite efficiencies. To help end-users optimize PV installations, the following breaks down the project development and construction process, from start to finish.

Getting started

A racking system is the single product that has the largest impact on the construction phase of any PV project. Although several other components play a leading role in the overall electrical design of a solar project, the most significant phases of construction are all directly impacted by the size and type of racking system selected. These include civil work and foundation design, material logistics, racking installation, system adjustment and alignment, and module mounting. Each step is based on the design of the racking system, and should be given full consideration when evaluating different options.

Foundation options

To be effective, the racking design must optimize the foundation for a project, which often equates to drastically different solutions for different sites. For example, sites with challenging soils that require extensive groundwork may benefit from larger foundations. If added work is required to build each foundation, it makes sense to maximize that capacity, while reducing the number of times that a foundation must be installed.

In some cases, however, ground conditions may have limited bearing strength or other depth limitations that make larger foundations more challenging to install. Herein, designing a rack with a smaller base requirement could provide more flexibility at the project site.

Efficient logistics

Ensuring the right material is properly distributed to the right locations within a jobsite can reduce time and logistical steps as a project progresses. This step might seem obvious, but for any efficient operation, organization is key. Beyond organization, selecting efficient components and an effective project design helps. For instance, pre-assembly and an optimized rack design can reduce the number of components to move.

Full pre-assembly of a racking system can further reduce parts, but it can also mean larger equipment and greater logistical challenges when it comes to placing and locating a racking system at a jobsite. In evaluating racking products, review the number of components, the flexibility in placement of components, and any equipment that may be necessary to move system parts.

Installation speed

Most racking solutions tout their installation speed, but it's important to consider how those installation features translate to benefits in real-world project conditions. Many basic products have several loose pieces, including nuts, bolts, and other hardware. Products with quick connections and pre-assembled hardware are quite common, and will help minimize the handling of loose hardware.

To take this one step further, some new products provide hardware that's not only pre-assembled, but also pre-located on the racking system. This not only eliminates the handling of loose hardware in the field, but it also eliminates the time it takes to measure and adjust components in the field. With connection points established in a quality controlled, factory setting, racking can be built quickly and correctly the first time.

Site adjustments

As previously mentioned, no two sites are equal and the variation in site features mean that adjustments can be a critical and time-consuming step in the installation process. All connections should allow for adjustments, but infinite adjustability can become a major challenge to a rack being built in a timely manner.

Rather than trying to adjust an entire rack after it's assembled, it can be helpful to utilize a product that allows the installer to establish and lock each adjustment during a single step in the assembly. In this approach, the installer can adjust the racking to a fixed height in one step, and then adjust to a fixed front-back position in the next step, and so on. Minimizing the number of connection points that are tied to the adjustment of the rack will also save installation time.

Module placement

Mounting modules to the racking is a seemingly small step in the construction of a system, but one that can add a considerable amount of time to the construction process. In the past, racking products provided no provisions for module alignment, leaving the installer to measure and adjust every module one at a time. In these instances, multiple workers were usually required to hold the modules in place as each one was slowly shifted into the right position, and the clamps assembled—adding time-consuming and tedious work at each module location.

Recent innovations in racking products have led to major improvement in how modules are positioned. Many newer products now have features, such as module retention ledges, built into the racking. This not only allows the installer to quickly rest a module in perfect alignment with the rack each time, but also allows the module to be supported hands-free until the clamps can be positioned. Advancements have also been made with regards to clamping, with products offering faster connections that take over the role of traditional bolted connections.

Supply partner

Designing a structurally adequate racking system is relatively straightforward. However, with ongoing pressure to bring down the cost of solar systems, there's a fine line between material optimization and risky design. To ensure the best results, choosing a reliable, bankable partner is as critical in racking as it is in the power producing components of the system.

A strong racking supply partner should have the engineering strength to make sure a system is well designed for not only the installation phase, but also the entire life of the project. In addition to racking systems, some supply partners are even able to offer end-users additional products and services, leading to additional savings in time and expenses.

Sam Veague is the solar sales and marketing manager for Eaton's B-Line business.

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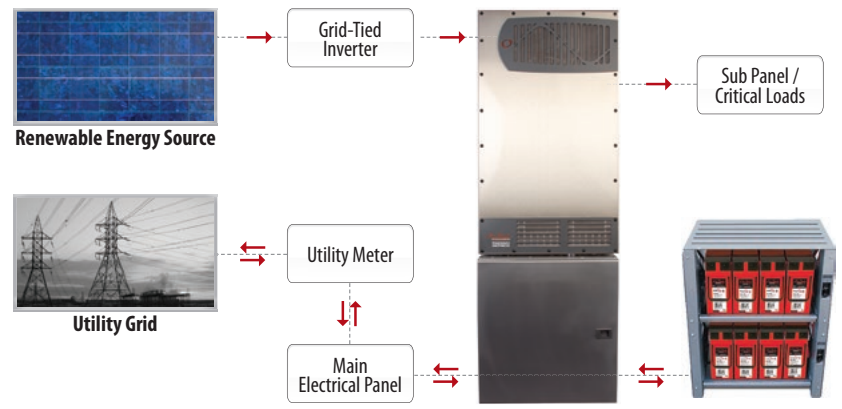

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Reducing Solar Tracking & Racking Costs

With roll forming & captive fasteners

By Dave Case & Jeff Lachine

Figure 1. *Installation sequence: Installation tool, sheet material and nut*

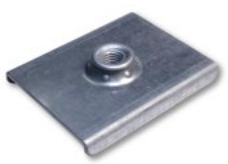

Figure 2. *Sheet metal with visible radial ribs*

Figure 3. *Six ribs*

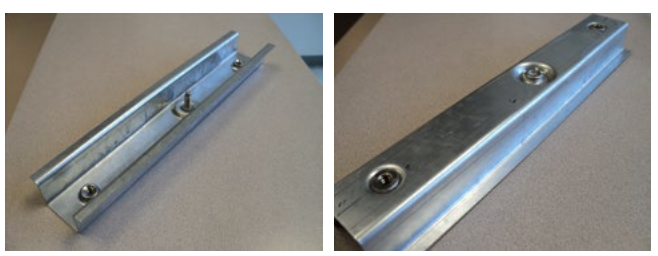

Figure 4. *Left image shows the underside view of the hat section, with nuts and stud, while the right image shows the top view*

ROLL FORMING IS AN IDEAL PROCESS to fabricate the sections typically used in solar tracker and racking structures for utility-scale photovoltaic (PV) projects. The roll forming process has the capabilities to deliver custom roll formed and welded shapes for solar energy projects—from simple to complex—to fit a customer's exact specifications.

As a wide variety of materials can be processed and choices made in the fabrication, a roll former and engineered fastener manufacturer can work together to reduce the costs associated with these projects. Decreasing the amount of loose hardware, for instance, and using pre-installed fasteners shifts installation labor from the construction site to the roll form line—saving workers valuable time at the project site. Including high-performance, easy-to-install components, such as captive fasteners, can provide additional benefits.

The process

When it comes to the roll forming materials for solar tracking or racking systems, various choices are available. Most commonly formed steels, including HSLA steels and aluminum, are used. Some alloys may allow thinner parts to be molded, while also meeting strength requirements. Hat and channel sections are widely used, but any open or closed profile needed for these solar structures can be roll formed. Pre-punched holes of any shape and location are easy to add in-line.

For utility-scale projects, part length is limited only by one's freight carrier, and parts up to 47' have been designed. Secondary operations, including finishing, welding, and fastener installation, can add customer value to the roll forming process.

Cost considerations

Tracker and racking manufacturers are facing tremendous pricing pressure and increased scrutiny as PV module price reductions stabilize. Customers are not only expecting decreases in component costs, but also in the labor expenses required to install solar projects. This is particularly apparent in utility-scale projects, where adding single-axis trackers now pay for themselves in improved efficiency in comparison to fixed-tilt mounting systems. In terms of efficiency, some tracker designs can even serve as the PV panel mounting system.

Regardless of whether installing single-axis trackers or fixed-tilt racking, however, some assembly and fasteners are required—and both require a portion of the assembly to be done on the project site by the construction crew. For ease of assembly, parts are typically designed with pre-punched holes to be used with loose nut and bolt hardware. Project size also makes a difference. Utility-scale projects tend to require a lot of fasteners, with some projects using up to 70,000 bolted connections per megawatt. Project quantities can often be in the multi-millions, affecting construction labor requirements.

To reduce the amount of loose hardware used (and possibly lost) at the construction site, captive fasteners can be installed by the roll former. A factory environment typically results in applied cost savings compared to fieldwork. In addition to a labor cost reduction, quality control is improved. Some projects use skilled trades at high wage rates. For example, temporary personnel are often added to meet contract deadlines, but it can be challenging to train for such short-term work. Clearly, large projects with millions of fasteners can benefit from pre-installed hardware.

Choosing components

Selecting captive fasteners that install quickly and meet all design objectives will minimize installation time and costs. Fasteners are usually installed by roll formers as a secondary operation, using dedicated presses and economical tooling. In-line installations may be justified if the project volume and timing warrant. Secondary operations can be set-up quickly, and are the best fit for most utility-scale projects. Blind rivet fasteners, rivnuts, and rivstuds, have also been commonly used. These are installed from one side of the part, and are the ideal and only choice for closed sections because they don't require access to the opposite side.

Most roll formed sections used in solar trackers and racking systems are hat sections with tooling access available on both sides. Rivnuts and studs are installed manually, and one at a time. In this case, automation is simply too costly and multiples cannot be installed simultaneously. Clinch fasteners can also be used where tooling can be accessed from both sides of the part. These are typically automated with bowl-fed, single-station presses. Multiple clinch fasteners cannot be installed in one press stroke. Mechanical performance (such as torque or push/pull) can be marginal with both rivet and clinch types, especially in thin sheet material. Fastener size and the sheet thickness may need to be increased to meet the customer's structural requirements.

Flangeform fasteners are another alternative. They are widely used in automotive and white goods applications, where high-strength attachments in thin gauge steel are required. Installation is quick, using low-cost manual or automated tooling. Plus, in this case, multiple fasteners can be installed with a single press stroke. Either stainless or carbon steel with zinc rich coatings are ideal choices for outdoor use.

These attributes make Flangeform well suited to PV tracker and racking applications. Access to both sides of the part is usually required. The basic installation sequence is shown in Figure 1. A secondary flange is formed on the backside during the process, and radial ribs are visible in the sheet metal in Figure 2. The six ribs are shown in Figure 3.

Saving installation time

Installation cycle time is critical when a roll former installs millions of fasteners, and component choices can make all the difference. As outlined in the following case study, Flangeform fasteners were employed on roll formed parts for a utility-scale PV project. For this solar project, captive, 300 series stainless steel, rivet type fasteners were specified by the end customer to reduce installation time and field labor. The prototype hat section with M6 studs and nuts is shown in Figure 4. The material is pre-galvanized, HSLA Grade 50 steel, one-millimeter thick—common specs for PV structural parts. The total fastener quantity was >10M pieces.

Excessive labor would have been required to install the rivnuts and studs one at a time, and meet the customer's production schedule. As a result, Flangeform fasteners were a good choice as they could be bowl-fed to reduce cycle time and manpower. The production part was several feet long, and included a mix of studs and nuts installed from the opposite sides of the part, also shown in Figure 4. All fasteners could, therefore, be installed simultaneously in a single press brake cycle (note that press bed length is the only limitation). Improved mechanical performance, especially pullout, enabled the end customer to meet their design objectives for the structure with minimum material thickness and a standard fastener, saving installation costs and time.

The two critical features considered in any solar project today are: cost and time. Saving on both is crucial for success, and the roll forming process can often help with both when it comes to utility-scale PV projects.

Dave Case is a sales engineer for Roll Forming Corporation, a division of voestalpine.

Jeff Lachine is an application engineering manager for PSM International, an engineered fastener manufacturer.

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Material Matters

Aluminum advantages in solar mounting systems

By Jason Weber

WITH RECENT FEDERAL INCENTIVES for renewable energy and increased demand from consumers, the solar industry is starting to heat back up. The industry has now reached a point, however, where differences between systems depend more on how they are installed rather than on the solar panels themselves. Key to this process is using the right material for success.

The benefits of using aluminum in rooftop solar installations have been widely documented. Aluminum is strong, lightweight, corrosion-resistant, and highly recyclable—all of which combine to make it an ideal material for use within solar systems. Factoring in logistical considerations, ease of fabrication, and low maintenance requirements, aluminum's benefits more than compensate for a lower initial expenditure with galvanized steel or other rolled materials.

Another advantage is design flexibility. Through the extrusion process, aluminum can be formed into intricate forms, consistently manufactured to the specifications of complex mounting systems, module frames, and other structural components—a process that would be impossible to replicate with steel or other materials. Extruded profiles also require minimal secondary processing, and make for a speedier installation. Plus, aluminum requires much less maintenance than steel, due to its corrosion-resistant properties.

Making comparisons

Over the years, the mass commoditization of crystalline panels has made photovoltaic (PV) panels fairly uniform. Once unique, solar crystalline panels are now mostly the same as far as installations go, however, the mounting systems that support those panels are not. Yet, these systems are a critical component to solar panel efficiency and effectiveness.

Steel has been the traditional material of choice in solar mounting systems, primarily because it's so commonly used in the engineering world. Designers and engineers are familiar with it, and standard steel shapes are readily available in most design software. Additionally, steel has a high degree of stiffness, which can be valuable in certain system designs.

To achieve comparable yield and strength results using aluminum material requires greater design effort. Despite the familiarity and popularity of steel, times are changing, and the industry is weighing the long-terms advantages and disadvantages of the materials used. An independent study conducted for the Aluminum Extruders Council by consulting firm IBIS Associates* confirmed aluminum's cost advantages over steel. The study showed that although steel is less expensive on a dollars-per-pound basis, aluminum offers significant cost savings over the life of a solar installation.

To properly compare the costs of aluminum to competing materials, the IBIS study established baselines for each category, including ground-mount systems. Researchers created designs by collecting information from a variety of sources, including

	Pitched Residential Roof Top	Commercial Flat Roof Top		Small Ground Mount Utility		Medium Ground Mount Utility		Large Utility Ground Mount	
Scenario	Aluminum	Aluminum	Steel	Aluminum	Steel	Aluminum	Steel	Aluminum	Steel
Component List Price Total	$2,377	$39,187	$43,200	$394,921	$330,000	$1,517,022	$1,450,000	$13,561,286	$13,500,000
Discounted Price Total*	$2,377	$33,309		$335,682					
System Size (kW)	5	80	80	1000	1000	5000	5000	50000	50000
System Price $/W	$0.48	$0.42	$0.54	$0.34	$0.33	$0.30	$0.29	$0.27	$0.27

** List pricing discounted by 15%*

Figure 1. *System acquisition cost estimates (Source: IBIS)*

racking component and system suppliers, PV integrators and acquisition costs, as well as shipping and installation labor expenses. They also obtained price quotes from a range of suppliers, estimating delivery and installation labor costs based on location-specific rates.

For its examination of ground-mount systems, three fixed-axis systems of different sizes (1 MW, 5 MW, and 50 MW) were considered to see whether volume affected pricing. IBIS based the design on the more common installation process, calling for galvanized steel beams being pile driven into the soil (rather than attaching the mounting structure to a concrete foundation). Although aluminum posts cannot withstand pile driving, they can be used as supporting posts.

In formulating a cost comparison, the IBIS consultants determined that although aluminum is a more expensive material on a per-pound basis, its overall cost is comparable to steel (see Figure 1). Moreover, aluminum out-performs steel in installation and shipping cost efficiency.

Recycling reasons

The advantages of aluminum are most compelling in rooftop installations because of the weight considerations. But even when it comes to the largest ground-mount installations, it's worth factoring in reasons such as recyclability, when considering aluminum extrusions.

The IBIS study used a ground-mount system to compare the recycling value of aluminum and steel. Based on scrap values for each material provided by the US Geological Surveys, when decommissioned, the aluminum structure would be worth three times that of steel.

Often times developers only factor in the initial cost of a project, but it's important to think long-term as well, and consider the total installed cost over the lifetime of a project. A steel mounting system might very well cost less than a comparable aluminum system initially, but compared to the additional labor required by a steel system and added shipping costs, aluminum comes out ahead. Plus, when the system is ready to be decommissioned, scrap aluminum is vastly more valuable than steel.

As the Aluminum Association points out, recycled aluminum pays for its own cost of collection, and then some—especially when compared to the recycling costs associated with other materials such as steel, glass, plastics, or paper, which come at a premium.

Recycling aluminum is also far more energy efficient than recycling steel, as this process takes only five percent of the energy needed to make new aluminum, whereas steel requires an equal amount. Another point to bear in mind is that aluminum can be recycled repeatedly without degrading. In fact, approximately 75% of all aluminum ever created is still in use in products today, making this material an ideal match for the renewable energy market.

** For an overview of the study by IBIS Associates, visit www.aec.org/pdfs/AEC_IBIS_PV_CostAnalysisFlyer_03_05_2012.pdf*

Jason Weber is the business development manager for renewable energy at Sapa Extrusions North America.

Sapa Extrusions North America
www.sapagroup.com/na

Left: *Panels can be inserted from underneath the array*
Below: *Insertion rail profile of a clampless mounting system*

Mounting System Section

Reducing hot spots & underperforming arrays

By Christie McCarthy

LONG-TERM PRODUCTION guarantees and operation and maintenance (O&M) contracts have become standard fare in large solar projects. Typically, engineering, procurement, and construction (EPC) companies are on the hook when solar systems fall short of production assurances. Additionally, utility-scale developers are mindful of the financial impact that long-term system output has on the viability of a project. To safeguard against panel under-production or overall system failure, owners and operators are maximizing the technologies available to check and double-check their solar products and equipment.

More and more, EPC's are using infrared images to analyze underperforming arrays, and the pictures are showing hot spots—lots of them. A hot spot indicates an underperforming module, and is typically the result of a cracked cell or failed junction box. Under infrared inspection, hot spots stick out like a sore thumb in an otherwise healthy array.

Most module manufacturers have quality-control procedures in place to ensure any panels leaving their factories are devoid of hot spots. While Crystalline Si cells are inherently sensitive, manufacturers maintain that micro-cracks (which can lead to hot spots) are often the result of thermal expansion cycles that cause mechanical stress on the cells. Manufacturers are also acutely aware that cell damage can occur during the installation process, when installers stand or kneel on the modules to affix clamps.

Today's solar companies are looking for ways to minimize cell damage and maximize production by reducing any and all forces on modules, and they are quickly discovering that one key factor in mitigating risks and boosting efficiencies is a well-designed mounting structure.

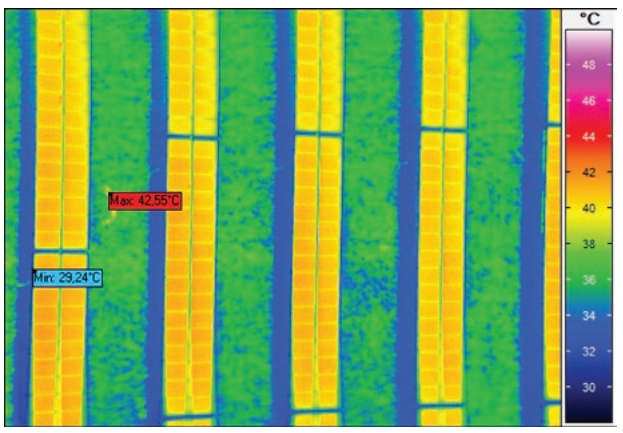
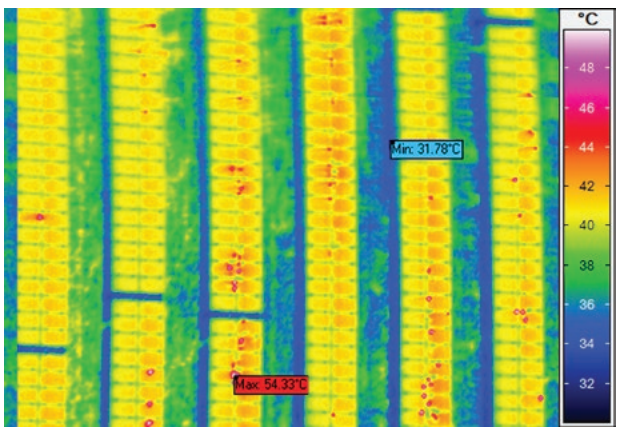


Figure 1.
No hot spots on a clampless ground-mount system (Photos courtesy of Hot Spot Air Service)



Hot spots on a clamping

Comparing systems

Figure 1's thermal images feature two different ground-mount arrays, both three years old. One is mounted with a clampless mounting system, and the other with a traditional clamping system. The size, design, module brand, location, and year built are the same for each array. The pictures were taken on the same day with an ambient temperature of about 90° F (32° C), and an average module temperature at both arrays of about 106° F (41° C).

In these images, the clampless system is homogenous while the clamping system shows visible red dots (hot spots). In typical, large-scale solar fields, a single hot spot will reduce production on an entire string of modules.

A closer look at the clampless system suggests two compelling theories as to why there are no hot spots.

First of all, the clampless or "lay-in" system enables modules to be inserted from underneath the array (in ground-mounts; see Figure 2). As a result, installers aren't forced to straddle or kneel on modules to attach mid-clamps, eliminating the potential for point load stress from bodyweight.

Secondly, mechanical stress from thermal expansion (as the array heats and cools every day and every season) is alleviated by the absence of clamps. When modules can rest stress-free in rail profiles, they're better able to withstand expansion and contraction cycles. For example, the linear coefficient of expansion on a 10-foot row of modules in a 0° F to 120° F (-18° C to 49° C) temperature zone dictates that aluminum will expand or contract approximately 3/16", and module glass approximately 1/16". When clamped, the aluminum rails put force on the module through each weather cycle.

Clamp-free module mounting

Invented nearly two decades ago by solar engineers in Germany, the benefits of clamp-free module mounting were immediately apparent to the designers, and resulted in less stress on modules, faster installation, and better aesthetics (see Figures 3 & 4). Over the last 20 years, the beneficial effects of stress-free insertion rail systems have been realized by many EPC's and solar project owners.

As one, large-scale US project manager asserts, "Our installers can mount modules from underneath the array, and don't have to risk climbing on panels to attach clamps. It reduces our labor costs and the potential damage to cells."

As the solar industry matures at a rapid pace, these types of potential benefits are now being measured with greater urgency and accuracy using new tools like thermal imaging. Of course, mounting systems have always been an essential part of a project's balance of system (BOS), but now developers, financiers, and EPC's are paying closer attention to how the structure impacts system production and the bottom line.

Creotecc is a full-service mounting system manufacturer, specializing in scalable ground-mount systems, with over 600 megawatts (MW) of clampless mounting systems installed worldwide. Demonstration videos, case studies, installation guides, and more can be found online.

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The importance of easily and effectively servicing an inverter over the long-term, potentially a couple of decades or more, is why some inverter manufacturers have begun placing more emphasis in this area

Long-term Inverter Servicing & Training

Keys to sustainability & investment returns

By Thomas Enzendorfer

A photovoltaic (PV) inverter is an electronic device that converts direct current (DC)—the rays from the sun captured by a solar panel—into alternating current (AC) that's fed into a commercial electrical grid. It's that simple and, at the same time, that challenging, especially when it comes to long-term inverter servicing.

At its core, a solar inverter is a mechanical device, which is subject to wear and tear over time, much like any other device. A potential failure negatively affects the PV system's uptime, energy yield, and a system's return-on-investment (ROI). As a result, it's important to easily and effectively service an inverter over the long-term, potentially a couple of decades or more, which is why some inverter manufacturers have begun placing more emphasis in this area.

They've also begun empowering installers to service an inverter at its location, rather than moving it off-site, which only adds time and affects a PV system's ROI. Making that process easier, and providing appropriate training will further benefit future installers and the PV systems they maintain.

In other words, serviceability means not only making sure today's installers can service inverters effectively, but tomorrow's as well.

In-field serviceability

Typically, the primary reason for an inverter failure boils down to one malfunctioning component. Sometimes, though, that single component can be hard to identify. In the past, that meant complete removal of an inverter for servicing to solve a performance or maintenance issue, and/or an outright inverter replacement—a cost that usually hit the installer, and not the system operator.

Inverter failures have long-term implications for PV system operators, which is why in-the-field servicing is so important. When a PV system is idle, the operator has to finance energy until the system's serviced, which can be a substantial expense, even if it only happens once. Depending on where the system is located, it might take more than a day for an installer to arrive, assess the situation, and implement a solution. From this point, it could take days or weeks, particularly if a direct inverter replacement is required.

Inverter manufacturers and the solar industry at large have worked hard to improve component quality and reliability, so as to minimize failures. For example, thanks to developments, such as the SunSpec Alliance communications protocol (www.sunspec.org), installers can now directly communicate with an inverter via the Internet to identify a malfunction. This increases a PV system's reliability because it reduces the time to address a breakdown.

Empowering solar installers to service an inverter where it's located, instead of removing it, positively affects a PV system's ROI

In the past few years, however, inverter manufacturers have seen the importance of having more than just a reliable product; serviceability requires innovation as well. Because it's a mechanical device, odds are every inverter will undergo a failure over its usable lifetime, especially if not properly maintained.

The solution is simple: offering installers the opportunity for hands-on training on how to properly maintain inverters for a more efficient servicing job. Service programs now exist that certify installers to complete board-level replacements in the field, reducing PV system downtime to minutes instead of days (some training programs even allow installers to earn North American Board of Certified Energy Practitioners—NABCEP—credit hours).

The upside for the PV system operator is less maintenance time, less downtime, fewer expenses, and fewer lost revenues. An installer that's certified to complete board-level replacements onsite greatly reduces any delays that diminish energy yield and affect the ROI. Plus, that knowledge can be passed down from one generation of field technicians to the next.

The future

Over the next few years, inverter manufacturers are poised to deliver new technologies to PV system operators. Changes to look for will include overall reliability, as well as fewer inverter failures due to the increased knowledge that drives technological innovations. In addition to more truly field-serviceable inverters, there will also be new developments in serviceability programs, designed to ensure future installers are more empowered to service inverters in the field. With the advent of these changes, expect to see an increase in PV systems globally due to growing trust in the industry.

Thomas Enzendorfer serves as the director of Sales and Marketing for the Solar Electronics Division of Fronius USA, a subsidiary of Fronius International GmbH, which specializes in energy conversion technologies.

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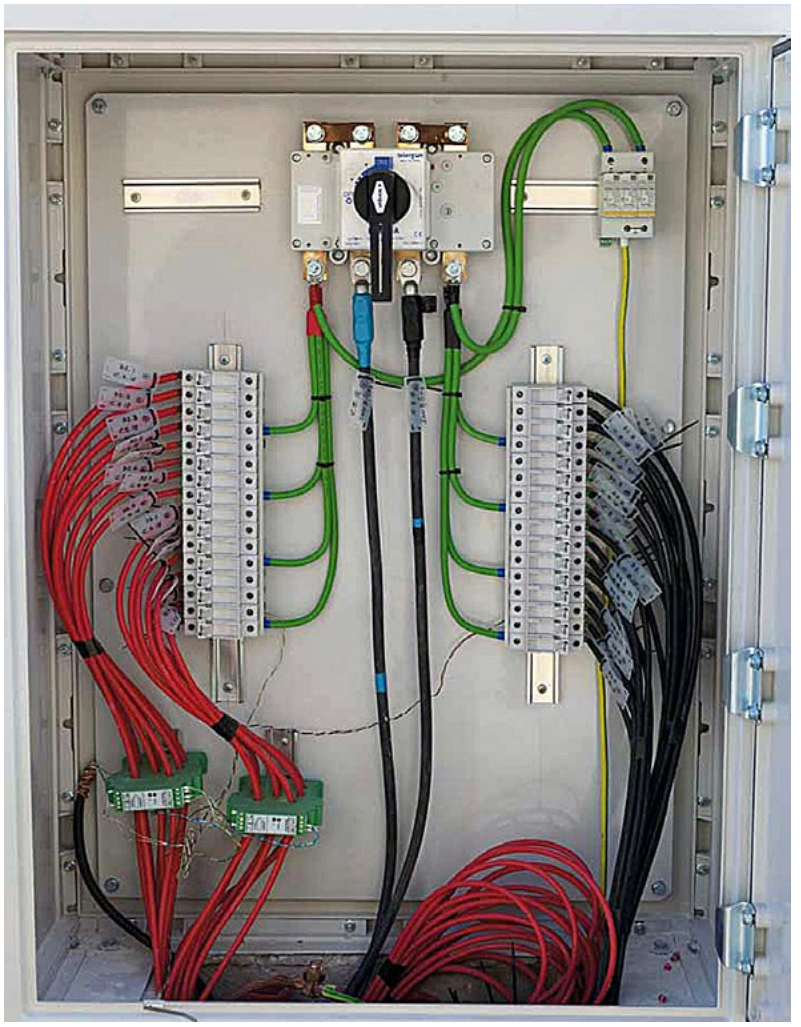
String-level Monitoring

An essential tool for reliable PV operation & maintenance

By Daniel J Sylawa



String-level current monitoring system installed in a combiner box

RELIABLE OPERATION AND EFFICIENT MAINTENANCE are important contributing factors in the success of photovoltaic (PV) plant installations. As installations grow larger through commercial and into utility scale, PV plants are composed of many thousands of modules, parallel strings, and electrical connections. Beyond the scope of just measuring the AC output of a PV plant via a utility-grade meter, the economics of solar energy require that all plant components contribute to the financial success of the installation.

Solar economics usually dictate that large installations utilize central inverters. There are many faults herein, however, that can contribute to a poor yield from an installation, including: module failures; uneven soiling; zonal shading; premature aging; blown fuses; and poor connections. And, due to parallel string connections, these small yet economically important changes in array performance might not be detectable at the large-value, aggregated DC inverter inputs.

To keep measurement efforts of large-scale PV plants low, high-resolution, DC string-level current measurement at the combiner box can offer a suitable compromise when efficiently evaluating the performance of an array. By using this measurement, in conjunction with an array irradiance sensor, real losses that impact plant yield can be determined. When this system is coupled with a supervisory control and data acquisition (SCADA) system, as well as a data historian, real-time and historical assessments can also be made of array performance. Identification and repair of array defects is one critical element in ensuring the proper rate of return on solar investments.

String-level monitoring performance

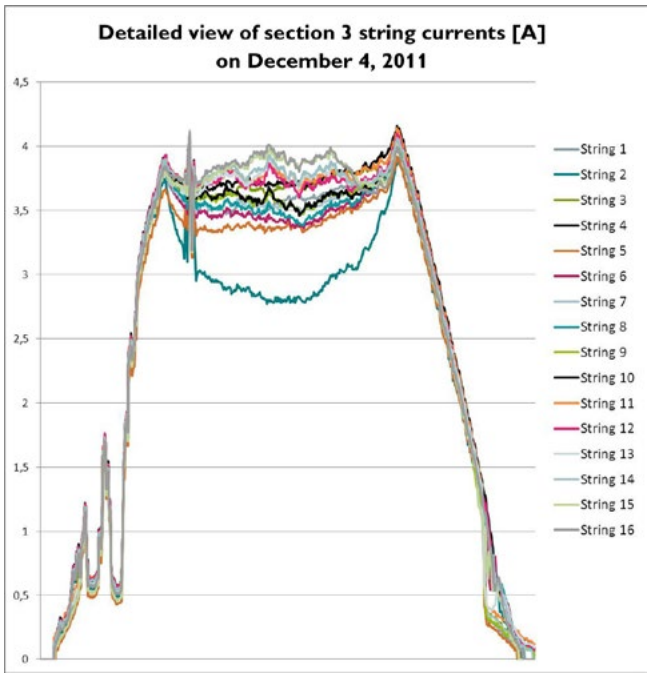
The essential performance elements of PV string level monitoring systems are:

- Diagnostics of solar plant faults;
- Validation of solar array performance; and
- Simple and cost-effective installation.

From a diagnostics perspective, central inverters usually have only a few DC maximum power point tracking (MPPT) inputs. The large number of parallel strings required to be connected to these MPPT inputs, combined with the typically five percent current measurement accuracy, means that small individual string performance changes cannot accurately be measured by the inverter monitoring system.

For validation purposes, string current measurements are evaluated along with array irradiance levels. In certain applications, combiner box level DC voltages are also measured. These parameters can be used to form an inverter-independent evaluation of the solar array performance for diagnostic, validation, and economic purposes.

A simple, cost-effective installation is an essential performance element in implementing a string-level PV monitoring system. Current sensors and other components must fit efficiently into the confines of a combiner box. In addition, data must be efficiently shared with SCADA systems.



Under-performing PV string detected by string-level current monitoring

Implementing the system

The most common sensors seen in string-level monitoring are shunt-type devices and Hall effect sensors. Shunt-type devices measure current by monitoring the voltage drop over a fixed resistance. These devices require that PV string cabling be interrupted for connection, and insertion resistance loses of 0.1 ohm to 1 ohm are typical. Hall effect sensors measure conductor magnetic flux, generating a signal proportional to the strength and direction of the current flow. Hall effect measurements don't require interruption of the PV string cable, and have no insertion losses. Voltage isolation is dependent upon the conductor rating—an important consideration with the movement toward nominal array voltages of 1000 VDC and beyond.

Serial Modbus RTU has become the *de facto* stand for combiner box, string-level communications. Connectivity via Modbus is widely available in many SCADA devices. The 1200 m maximum distance of RS 485 Modbus RTU, and the high number of node addresses, fit

effectively into the topology of large PV installations. Data can be converted to Ethernet Modbus TCP via a device server, usually at a more centralized location. Wireless communication, via Zigbee or other proprietary communications, have also been used. However, most string-level monitoring implementations employ wired communications, which are installed conveniently with array power cabling.

Beyond DC string current and voltage measurement, string-level monitoring devices are most often used to measure combiner box temperatures. Local inputs for the monitoring of surge suppression devices, enclosure door position, as well as weather and irradiance sensors are also seen. Power for the monitoring device is usually 24 V DC, supplied via a DC power supply, which requires that AC power be run to the combiner box. Array-powered DC/DC converters have been used in limited applications. New measuring devices are now also available that combine device power and signal on one cable, eliminating the need for a separate power source at the combiner box level.

From a PV string-level monitoring perspective, one percent nominal DC current sensor accuracy with a 200 mA resolution is considered good performance. As string currents vary with irradiance, data sample rates of under one minute are recommended. These data points can be averaged to provide trend information over longer time periods*.

Detectable plant faults

Under-performing strings represent the most common plant fault characteristic detectable by string-level current monitoring. Unless a significant number of strings under-perform, these faults usually aren't detectable via inverter DC input monitoring. Common causes of under-performing strings may include PV module failures and poor connectivity.

Other fault characteristics can include:

- **Zonal shading & uneven soiling:** usually time of day and/or portion of array dependent;
- **Blown string fuses and complete connection failures:** these might not be caught at the inverter level;
- **Premature PV module aging:** measured by comparing string performance over time; and
- **Cabling short circuits:** determined by measuring current flows when an inverter is off.

Maintenance response to these faults is usually dependent upon the number of faults observed, the value of the electrical power generated, and the expected rate of return on plant investment.

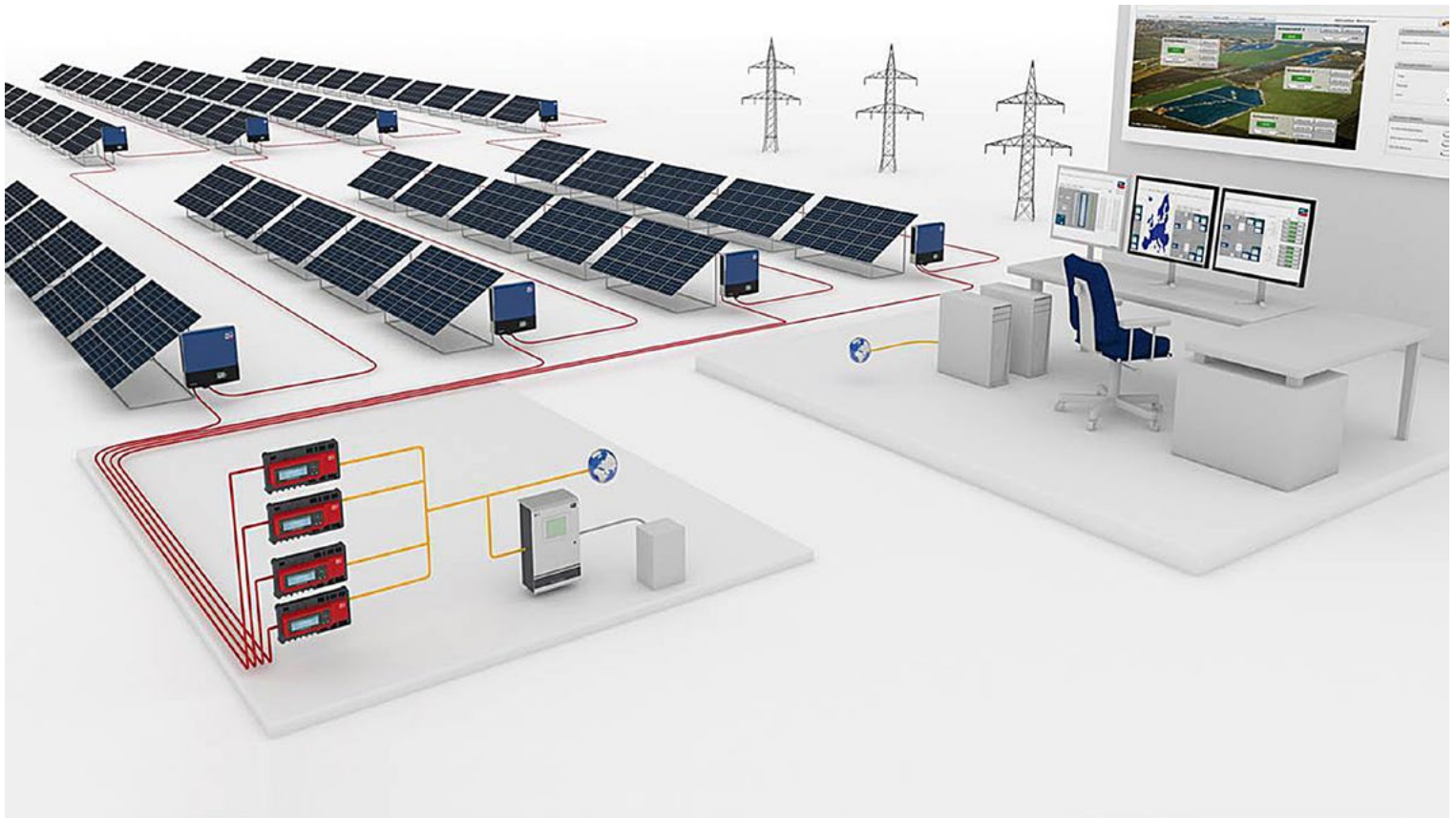
Summary

The evaluation of PV plant performance at the string level has become an effective tool in the validation of solar installation performance and the rapid diagnostics of plant faults, lowering operational costs, maximizing solar plant yield, and ensuring the maximum rate of return on solar investments. Undetected faults prevent power production at the lowest levelized cost of energy. Low LCOE over the entire life of an installation is a critical element in attracting solar power investments.

** SunSpec Alliance, Open Solar Performance and Reliability (oSPARC) Implementer's Guide, Version 1.0.*

Daniel J Sylawa is the business development manager for renewable energy at Phoenix Contact Inc.

Phoenix Contact Inc. | www.phoenixcon.com



A decentralized commercial design provides integrators with flexible design and control options

Transformerless Technology

Smart inverter options for residential & commercial PV applications

By Brad Dore

AFTER YEARS OF INVERTERS that simply pumped electricity into the grid, consumer demand is pushing solar technology in an intelligent direction. Transformerless inverters, for residential and commercial use, are becoming increasingly popular. Without the transformer, these inverters rely on a computerized process and combined electronic components to convert power and provide maximum energy production. The result is a lightweight inverter that offers flexible design, simple installation, and advanced communication and monitoring control.

Redefining the residential market

Installers are now able to provide cheaper, long-term power to system owners by incorporating transformerless inverters into residential array design. Not only are these devices of lighter weight, creating shorter design and installation cycles, but they also offer higher efficiency, greater safety, and a lower levelized cost of energy (LCOE).

At the same time, multiple maximum power point trackers (MPPT)—coupled with shade-tolerant, power point tracking algorithms—mitigate the negative effects of shading to further optimize power production. This makes them a favorite among those utilizing a third-party ownership (TPO) model.

Transformerless inverters are also beginning to incorporate value-added features that target consumer concerns. For instance, they don't only have the ability to deliver standby power during the day, but also to a specified socket in the event of a grid outage. These types of features reach beyond the traditional benefits associated with efficiency and reliability, and address a common misunderstanding among residential solar owners. Homeowners often believe their solar system (particularly when using a transformer-based inverter) will continue to operate, even during a power outage.

Though the ideal solution for constant power, regardless of grid activities, is a fully sized, battery-based system, some transformerless inverters can now provide power where there previously was none. This allows owners to charge or operate small electrical devices, such as phones, laptops, or fans during power loss. It also fills a gap as battery storage systems are often still relegated by cost to areas prone to grid disturbances due to weather or aging infrastructure.

Home energy management

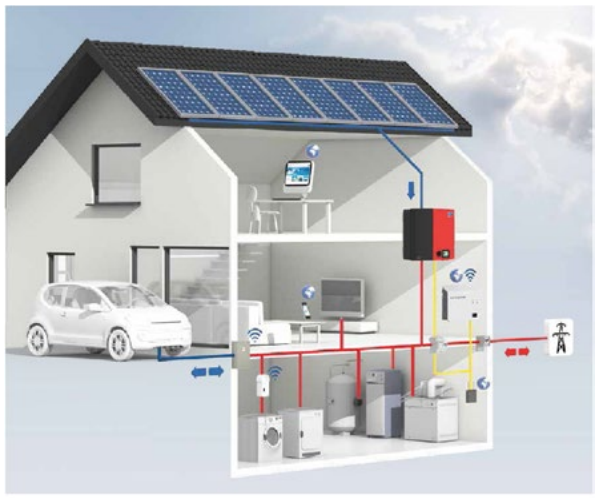
As the solar industry becomes aware of the benefits and role of home energy management, these capabilities are being incorporated into transformerless inverters and other smart inverter solutions.

One such example is the integration of limited storage within the inverter unit, allowing PV power to be used when it's most beneficial. By time-shifting consumption to better match production, a system can be cost-optimized to provide financial benefits to homeowners and utility operators.

When such systems are integrated into home energy management systems, they become the power center for the networked home of the future. Leading communication protocols, such as Zigbee, are already being built into some transformerless inverters, laying the groundwork for added value beyond power production.

Decentralized commercial systems

Like their residential counterparts, transformerless string inverters have also gained acceptance in the commercial-scale PV market. And, in many ways, they have seen adoption at a faster rate. Until recently, most US



Transformerless inverters are increasingly incorporating "smart home" connectivity

Transformerless inverters offer many advantages over their internal transformer-based counterparts

installers and integrators have relied on either single-phase string inverters in a decentralized design, or central inverters for small- and medium-sized commercial systems. There's been little consideration for a mid-tier alternative. However, as the solar industry continues to grow, system design becomes more sophisticated, and decentralized systems using three-phase, transformerless inverters have gained recognition. Decentralized systems with these string inverters have long been a best practice in Europe, and they're the next wave of technology for commercial installations in North America.

Whether it's 50 kilowatts (kW) or two megawatts (MW), under the right circumstances, the business case for a decentralized approach is compelling. Upfront costs are comparable between centralized and decentralized commercial technologies, but long-term and balance-of-system (BoS) costs are generally lower with a modern decentralized design. Three-phase, transformerless inverters are suitable for almost any module configuration, and can be scaled up or down in a cost-effective manner. Designing a decentralized system with these inverters is generally quick and simple, completed at a comparable initial cost to central inverters, but with financial benefits due to simplified operation and maintenance (O&M).

Weighing the benefits

Three-phase, transformerless string inverters for decentralized PV systems are ideal for commercial installations for several reasons…

1. Space-savers. Commercial systems are often built in areas with limited real estate and may be better served with string inverters, which can maximize roof space, as they don't require a lot of room to house an inverter or corresponding equipment.

2. Cost-cutters. Decentralized technology offers a great deal of flexibility, helping to simplify the sizing process. These systems can be installed without heavy equipment and expensive freight transport costs. Multiple MPPTs also lead to greater energy harvest, making the overall system more productive and economically advantageous.

3. Self-sufficient. Decentralized systems require little O&M, and only minimal system management. This means long-term, worry-free operation of the system, making it an attractive option for many commercial building owners without the sophistication needed for a centralized approach.

4. Power-driven. Finally, decentralized systems boast a BoS savings due to shorter DC cabling and the exclusion of a DC combiner box, which is a required component of other types of commercial systems. The financial incentive becomes even more compelling when combined with UL listed, 1,000 V DC technology.

As independent solar installers, TPO companies, and homeowners become more informed consumers, the popularity and use of transformerless inverters is expected to accelerate. Even now, they're beginning to take notice of the advanced, inverter-based toolsets available to help create better, more intelligent PV systems. Early adopters will also benefit in the future with increased production and capabilities from their inverters, as more energy management systems are developed and become available.

Brad Dore is the marketing communications manager at SMA America.

SMA America | www.sma-america.com

Smart module

Silfab Ontario Inc., an integrated manufacturer of PV modules, announces the availability of its newest line: the Silfab Smart Module. Silfab combines the company's high-performance modules, with new technology from Tigo Energy, to deliver a comprehensive solution to maximize roof space, increase power output, and enhance operations and maintenance. The result is better project economics for customers and installers. The Silfab Smart Module uses built-in Impedance Matching technology to accurately and quickly optimize each module. Shading issues that would normally affect the entire module string are isolated, increasing total system production. This innovation results in up to 20% higher power output for arrays impacted by shading, and up to eight percent higher output over standard string designs. Additionally, the Smart Module allows for varying string lengths (up to 30% longer than traditional modules) and roof angles, enabling installers to maximize roof coverage and simplify system design.

Silfab Ontario, Inc. | www.silfab.ca

Compact MV power platform

SMA has introduced an improved, re-engineered version of its Medium-Voltage Power Platform. The new Compact MV Power Platform is an integrated, comprehensive power conversion solution for utility-scale PV plants in the North American market. It maximizes energy production, while minimizing risk to EPCs, utilities, and investors. Available in 1.0 MW to 1.8 MW models, the Compact MV Power Platform provides maximum return-on-investment with a reduced levelized cost of energy, due to simplified installation and enhanced energy production. Combined with SMA's established bankability and high reliability, the Compact MV Power Platform is a turnkey solution for utility-scale PV projects.

The SMA Group

www.sma-america.com | www.sma-canada.ca

Grid-tied PV storage backup

OutBack Power Technologies, Inc. has released its FLEXcoupled AC coupling solution, an integrated system that allows installers to more easily retrofit grid-tied solar power systems with advanced grid-hybrid capability. The AC Coupling GSLC175 system delivers all of the energy storage benefits of grid-hybrid systems in an advanced, electro-mechanical solution that's cleaner, more compact, better performing, and less expensive than many competing options. The system enables owners to store energy from their PV systems while tied to the grid, and use it during utility outages and emergencies.

OutBack Power's AC coupling system is unique in that its foundation is the Radian inverter/charger, which already incorporates desirable AC coupling features, including: split-phase capability; dual AC inputs; transfer switching; power management flexibility; multiple operational modes for a wide range of energy scenarios; and greater dynamic stability. This enables a more advanced electro-mechanical coupling center (the GSLC 175-AC-120/240) to achieve AC coupling, instead of relying on costly, complex frequency circuitry, transformers, and diversion loads used in some conventional systems. AC coupling from OutBack Power is UL1741-compliant, creating generator-friendly battery backup power for existing grid-tied inverter systems.

OutBack Power Technologies
www.outbackpower.com

High-end commercial backsheets

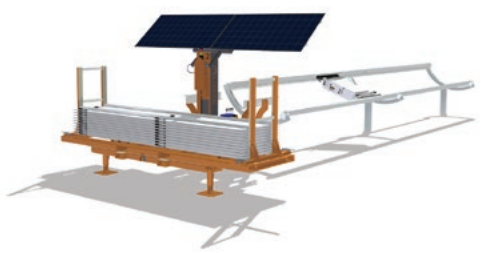
FLEXcon has expanded its solar module backsheet offering with the addition of Black/White and Black/Black products. FLEXcon's existing white backsheet offering, which includes double fluoropolymer (TPT and KPK), single fluoropolymer (TPE and KPE), and non-fluoropolymer (PPE), is ideal for solar farms, as well as commercial and residential installations. The new, more aesthetically pleasing black backsheet products appeal to the high-end commercial market and a much greater portion of the residential market. FLEXcon backsheet solutions not only meet strict performance requirements and industry standards, but their new offering enhances the options for solar module manufacturers to produce solutions that tailor to the needs of a much broader market base.

FLEXcon | www.flexcon.com

Single-point battery watering system

To simplify maintenance of Trojan's flooded batteries, the Trojan Single-Point Watering Kit is now available. Proper maintenance and periodic watering are important factors in maximizing the performance and life of deep-cycle flooded batteries, and the new Trojan Watering Kit is designed to take the guesswork and mess out of properly watering flooded batteries. The single-point watering system can fill a set of batteries in 30 seconds, and is available in three configurations to fit 12 V, 24 V, and 48 V battery models.

Trojan Battery | www.trojanbatteryre.com



Automating PV plant construction

By automating the repetitive process of assembling and positioning the thousands of PV modules required for large-scale projects, Brittmore's flexible, turnkey structural balance of system (SBoS) solution enables megawatt-per-day installation by a small crew with substantial total BoS savings. There are three primary components to the Brittmore System: 1) The WaveRack ground-mount is an economical, fixed tilt rack for large-scale PV installations that assembles quickly and requires no field adjustment; 2) Panelization where PV modules are pre-assembled into larger panel building blocks via Brittmore's Panel Assembly Cell (PAC)—the PAC brings the efficiencies of factory assembly to the field; and 3) Automated panel installation drives the efficiency and speed of the system. Stacked panels are delivered to PV Autoloaders positioned at the ends of the rows, feeding PV Shuttles that quickly deliver panels to their mounting positions, which simplifies site logistics. The shuttles utilize the WaveRack ground-mount as an elevated delivery track, eliminating the need for heavy equipment traveling within the array, reducing dust and site grading/repairs.

Brittmore
www.brittmore.com

Electric power meters

Continental Control Systems recently announced its line of revenue-grade electric power meters, the WattNode Revenue, along with its revenue-grade, split-core current transformers. The WattNode Revenue meters are fully tested and compliant to C12.1, and because of their economical pricepoint and compact design, WattNode Revenue meters are an ideal OEM design for PV production monitoring. Developed for use in any application requiring the revenue-grade accuracy that's often required by each state, the WattNode Revenue meters meet the requirements of ANSI C12.1 and support Modbus, BACnet, or LonTalk communications protocol or a pulse output. The WattNode Revenue meters are designed for 120/208/240 Vac or 277/480 Vac applications, and are UL and CE Marked. In addition to revenue-grade, bidirectional energy (kWh) metering, these networkable meters provide dozens of additional measurements, including: bidirectional power; demand; peak demand; reactive power; voltage; current; power factor; and line frequency.

Continental Control Systems
www.ccontrolsys.com

Transformerless grid-tied inverter

Ginlong Technologies (Ginlong) has released its new commercial solar inverter to the North America solar market. The Ginlong GCI-10K is a three-phase, transformerless, grid-tied string inverter. Ginlong GCI-10K is an ideal solution for commercial distributed solar generations. Designed with the latest Silicon Carbide (SiC) power semiconductor technology from the start of design cycle—together with transformerless topology—the GCI-10K realizes high efficiency (peak efficiency is 98%), strong reliability, power density, and cost savings—all within a lightweight, compact design (88 lbs) for ease of installation. Ginlong also brings a unique wind inverter feature of ultra-wide input voltage range (300 V to 800 V), allowing for design flexibility and long daily operation hours. The GCI-10K has dual-MPP trackers and maximum three strings per MPPT, which optimize the power production, especially in shaded environments. Other advanced features include RS485, WiFi communication, fan-less technology, and web-based data monitoring.

Ginlong Technologies
www.ginlong-usa.com

Residential footings

Quickscrews International has been steadily working on creating a full line of mounting products to meet the needs of the most common residential solar roofs in the US. The newly patented QuickBOLT system is easy to install, and is one of the most cost-effective footing's on the market. The QuickBOLT consists of a bonded compression washer that can be drilled directly into an asphalt roof to create a waterproof fastening. A specially designed hanger bolt, which comes with a Type 17 auger point for easier driving that's reversible, is used to compress the washer down onto the roof. The newly designed flashing and offset L-foot work in conjunction with the QuickBOLT to assist with spacing, and in areas where building codes require it. This unique footing is backed by a 20-year guarantee that it will not leak.

Quickscrews International
www.quickscrews.com

PV heat pump water heater

The Stiebel Eltron Accelera 300 Heat Pump Water Heater can extract up to 80% of its energy requirements from the energy in the air around it. The heat pump portion of the Stiebel Eltron Accelera 300 draws only 500 watts, low enough that it can be tied into a solar PV system. It's possible to use the electric back-up element (+1700 watts), and a back-up grid-tie will probably still be required. But, with a full tank of 140° F (60° C) water and a 78.6 gallon first-hour rating, the daily hot water needs may be satisfied without the back-up element. Solar thermal will always remain a viable solution, but now there's another renewable energy option. The Accelera 300 is Energy Star certified, and eligible for any available tax credits or rebate incentives. There's also a 10-year warranty.

Stiebel Eltron | www.stiebel-eltron-usa.com

Commercial solar thermal systems

Lochinvar offers a complete line of commercial solar thermal systems, including solar thermal panels, storage tanks, pumping stations, and a wide array of system accessories. The most recent introductions to the Lochinvar line are the Strato-Therm+ and Thermal-Stor Solar Thermal Storage Tanks. Designed to provide simple, cost-effective options for integrating solar energy into any application, Strato-Therm+ and Thermal-Stor each offer the functionality of a solar thermal storage tank, indirect water heater, and hydronic buffer tank in a single, space-saving unit. Through Lochinvar's complete offering, designers can specify commercial solar thermal systems utilizing a single source manufacturer.

Lochinvar | www.lochinvar.com

MPPT solar charge controller

Blue Sky Energy, Inc. has released its most flexible MPPT solar charge controller to date, the Solar Boost 3000i (SB3000i). This device allows for a range of batteries to be charged using conventional solar modules, without suffering power losses from voltage mismatch. Using Blue Sky Energy's patented MPPT technology, the SB3000i increases charge current up to 30% or more compared to conventional controllers, saving RV owners and other off-grid solar users on space and system costs. It regulates the transmission of power from the solar module to the battery to improve efficiency, while making the system safer and extending the battery's lifetime. Manufactured in the US and Mexico, Blue Sky Energy's SB3000i is also the company's most user-friendly product, with a built-in digital display providing for monitoring and in-depth system setup. The SB3000 comes with a five-year product warranty, meeting the rigorous standards for durability and reliability.

Blue Sky Energy, Inc.
www.blueskyenergyinc.com

Solar racking cover membranes

Anchor Products, LLC has introduced specialty Cover Strips for solar integrators working with a ballasted rooftop PV system. Solar racking equipment can rub roofing membranes, causing excessive abrasion and potential leaks. To help prevent damage, the Anchor Cover Strips act as a sacrificial layer between the racking supports and the roofing membrane. They match the existing PVC or TPO membrane materials, and come in a variety of widths to provide protection for the full length of a rooftop racking support. The Anchor Products Cover Strips are available in convenient rolls or sheets, which can be hot-welded onto the membrane. Plus, they are accepted by single-ply roofing manufacturers.

Anchor Products, LLC
http://anchorp.com

Compact central inverters

The Danfoss Central Series is an innovative, outdoor solution for the utility-scale market. Designed for harsh weather regions with a product range of 1 MW to 1.5 MW, this new series has been formulated with the toughest criteria in mind for all components, with a NEMA 4 sealed inverter section. The inverter series delivers maximum efficiency without derating, achieving peak efficiencies up to 98%, even in ambient temperatures from -20° C to +50° C (-4° F to 122° F). All of the components remain optimally cooled due, in part, to a liquid-cooled design for semi-conductors and inductors, which utilizes Danfoss' patented ShowerPower switching technology. Liquid-cooled heat sinks keep the unit cleaner, while variable speed controlled fans and pumps help the unit perform more efficiently. The inverter is also equipped with a dehumidifier for water vapor removal. Plus, it's compact size and weight makes transportation simple.

Danfoss | www.danfoss.com/solar

Solar system controller

The iSolar MX LTE is a powerful, multi-functional temperature differential controller with add-on system functions for use in a wide variety of solar thermal heating applications. The MX LTE is equipped with five relay outputs, four are triac pump speed control relays with one dry contact relay, and one 0-10 V pump speed control signal output for new high-efficiency pumps. The controller is also equipped with eight Pt1000 sensor inputs, one CS10 irradiation sensor input, as well as one impulse flow meter input for built-in accurate heat energy metering (BTU meter). It comes complete with five Pt1000 sensors and one 0-10 V adapter cord. The 20 pre-defined system arrangements, with additional optional functions, are configured for control of standard solar water heating systems, multiple storage tanks (up to four total), and more. Along with an intuitive commissioning menu, easy-to-use icons assist to operate and customize a solar water heating system.

Caleffi | www.caleffi.us

Off-grid mini-inverter

CyboEnergy, a subsidiary of CyboSoft, General Cybernation Group Inc., has announced the off-grid CyboInverter, the world's first off-grid solar power mini-inverter. CyboInverter is a patent-pending solar power mini-inverter that possesses the key merits of central inverters and microinverters. Each 4-channel CyboInverter can connect up to four solar panels and generate up to 960 W AC power. Each CyboInverter's input channel has its own control and maximum power point tracking (MPPT) mechanism based on CyboSoft's Model-Free Adaptive (MFA) control technology, so that power production is maximized and the partial shading problem is eliminated. CyboEnergy is offering a standalone off-grid CyboInverter where the AC cable can connect to an off-grid AC circuit and power AC loads, such as fans, lights, TVs, computers, etc.

CyboEnergy | www.cyboenergy.com

PV plant monitoring

Solar Data Systems, Inc. has introduced the Solar-Log App for Android smartphones. This new App offers mobile PV plant monitoring, complementing the Solar Data Systems, Inc. Solar-Log product line. The Solar-Log App provides graphic visualization of PV plant yield and consumption data, with current and past data available as daily, monthly, annual, and total overviews. The CO_2 savings from the plant, power consumption, and self-consumption are also displayed.

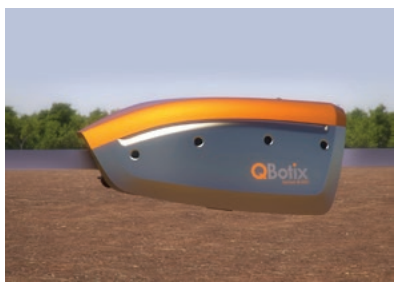
Several plants can be monitored by the Solar-Log, and an intuitive design allows for quick navigation between different time periods. The App caches all of the data it receives for quick retrieval, even when no Internet connection is available. The slideshow mode makes it convenient to view the system continuously, so it's easy to see a plant's current power output at a glance. PV plants with a Solar-Log already installed can use current data to provide insights into performance capabilities.

Solar Data Systems, Inc.
www.solar-log.net

Ballasted flat-roof system

Unirac, Inc., a Hilti Group Company, introduces a new, ballasted flat-roof system. The Unirac Roof Mount (RM) is designed to reduce overall project costs, risks, and complexity. An intuitive solution that resulted from listening to feedback from installers nationwide, the RM part list consists of only two major components: a fully assembled ballast bay and module clip. Each ballast bay is compact and easy to handle, weighing less than 3.5 pounds. The modular design allows installers to seamlessly navigate modules around HVAC units or other roof obstacles, maximizing power density. The RM also supports most framed crystalline modules, and is backed by an industry leading structural performance warranty of 10 years.

Unirac, Inc. | www.unirac.com



Robotic tracking system

QBotix recently unveiled the SolBot R-225, and other enhancements for its Robotic Tracking System (RTS), a next-generation system for optimizing the productivity of solar power plants. The SolBot R-225, a mobile robot for positioning solar panels and collecting data, builds upon the technical innovations of the SolBot R-200. The SolBot R-225 is smaller, lighter, and requires fewer components than its predecessor, which increases reliability and allows the SolBot to operate in a wider variety of extreme environmental conditions. The SolBot R-225 can manage 340 kilowatts of solar panels, a 13% improvement over the SolBot R-200. Additionally, the tracking rail for the SolBot R-225 consists of two pre-assembled pieces, rather than multiple parts so it can be quickly snapped together onsite.

To accommodate the broadest possible spectrum of customers, QBotix increased the flexibility and versatility of the communication network for the RTS so that it supports international and domestic frequencies. It can also coordinate and control the activities of multiple robots simultaneously.

QBotix | www.qbotix.com

Rail-free compatible microinverters

SolarBridge Technologies has announced the availability of Pantheon II microinverters, which are compatible with Zep Solar's rail-free installation platform. Zep Compatible module manufacturers can now integrate SolarBridge microinverters for a TRUEAC module solution that installs faster and easier, with an aesthetically pleasing low profile that's adaptable to any roof structure. SolarBridge is the first and only microinverter company that currently offers this double-level of TRUEAC integration—first with factory installation of the microinverter onto the solar modules, and now with the Zep Solar installation solution. TRUEAC modules reduce installation time and lifetime costs, eliminating the need for installing separate inverters, AC cabling, and copper ground wires. Those with the Zep Solar system have added benefits, eliminating the need for installing a separate grounding electrode conductor (GEC) and saving significant installation and material costs. Moreover, since an equipment grounding conductor (EGC) is connected automatically as modules are plugged together, Zep Compatible TRUEAC module arrays require no additional labor to meet all electrical code grounding requirements.

SolarBridge Technologies

http://solarbridgetech.com

http://solarbridgetech.com/products/our-solution

PV fuse holders

Woehner USA has received a notice of authorization from Underwriters Laboratories (UL) that three of their fuse holders for 1500 Vdc PV applications have been certified to the UL4248-18 standard. The three fuse base holders—PVH-NH1XL, PVH-NH2XL/3L, and AMBUS EasySwitch holder for 10X85 cylindrical fuses (AES10x85)—are all traditionally panel-mounted and suitable for DIN-rails or mounting plates.

All three fuse base holders are used in balance-of-system (BoS) assemblies, produced by combiner box and inverter manufacturers to protect the wires and cables in a DC power distribution system of either utility or commercial-scale PV installations. As PV system voltages migrate to higher levels, and with 1500 Vdc now the new target, manufacturers will be looking for the ability to mount fuses associated with the increased value. This voltage enhances the efficiency of the power conversion equipment, and lowers the cost of the copper cabling required on the project.

Woehner USA LLC

www.woehner.com/en/

Rail ballasted ground system

GameChange Racking has introduced the GC Pour-in-Place Rail Ballasted Ground System. This PV racking solution has been specially designed for landfills, brownfields, and sites with rocky subsurface conditions, which make post-driving cost-prohibitive. Rail-based ballasted ground racking costs have long been over $.40 per watt, creating a serious issue for cost-effective PV installations. Made with galvanized steel channels and six-inch tall aluminum rails, the GC Pour-in-Place Rail Ballasted Ground System changes things, at half the price of the rail ballasted ground system currently on the market. Due to its Pour-in-Place technology, the system enables rapid installation, saving labor time and costs, as there's no pushing around heavy, pre-cast blocks and no heavy machinery is needed

GameChange Racking LLC

www.gamechangeracking.com

Flexible, heavy-grade conduits

AerosUSA launches the PA 12 highly flexible and PA12-D flexible, heavy-grade conduits. These highly flexible, heavy-grade conduits are characterized by outstanding resistance to weather and UV (sunlight), and by low-temperature properties. They're designed for use in exterior applications, as well as applications involving movements in extreme weather conditions. The PA12 conduit is manufactured from high-grade, specially formulated polyamide 12 materials. These conduits are widely resistant to acids and solvents, free of silicone, cadmium, and halogen, and demonstrate excellent flame-retardant and self-extinguishing properties. The PA12-D conduits offer a thicker wall, created especially for heavy outdoor applications with high mechanical stresses. The combined features make these products ideal for solar installations.

AerosUSA | www.aerosusa.com

Dual-racking system

Fortune Energy has unveiled their recently developed and manufactured customized racking system with channel feature, called Dual-Rack. The customizable Dual-Rack technology is made and manufactured in the US, and can be installed in two different ways. Either a top-down attachment style or an L-bracket style can be used for installation, depending on design and budget constraints. This advanced formulation means installers have fewer parts to keep track of, resulting in a faster and less expensive overall installation process. Fortune Energy also saves the contractor time, as the system is pre-approved with a Professional Engineer seal. Plus, the simple, advanced design doesn't require any special training to install.

Fortune Energy | http://fortuneenergy.net

Smart meters

Locus Energy has launched the LGate 120 and 320, its next-generation of smart meters designed to allow solar installers and asset managers to more easily collect, monitor, and analyze performance data from residential and light commercial solar PV systems. Together, with Locus Energy's web-based SolarOS monitoring platform, the new meters enable solar fleet operators to efficiently gather data for troubleshooting, asset optimization, and performance guarantee/billing functions. The LGate 120 and 320 offer: ANSI C12.20 class 20, revenue-grade powermeters; an integrated 3G GSM cellular modem and Ethernet connectivity; plug-and-play connectivity with over-the-air firmware upgrades; and options for embedded Zigbee radio, with lower/higher bandwidth settings to optimize cellular data costs.

Until recently, cellular socket meters available for PV monitoring have been mainly re-purposed utility meters. The LGate 120 and 320 are currently the first cellular smart meters designed specifically to measure the performance of PV installations. Both units can communicate directly with inverters to collect additional AC and DC data points, as well as fault-code information.

Locus Energy | www.locusenergy.com

Three-phase transformerless inverters

Solectria Renewables, LLC introduces the new PVI 14TL and PVI 20TL three-phase, transformerless, 600 VDC inverters. The PVI 14TL and PVI 20TL inverters are designed to maximize return-on-investment (ROI) through their lightweight design, high efficiencies, easy installation, dual MPPT zones, and wide MPPT range. Integrated customized options include factory installed web-based monitoring, DC arc-fault protection, and integrated DC fused string combiner. Utilizing these inverters in small commercial applications reduces costs, especially the cost of additional combiners.

Solectria Renewables | www.solectria.com

Online design tool

Schletter has announced updates to its online flush-mount design tool, PV Powerhouse. Designed to make the program seamless, updates include an automatically generated stamped structural acceptance letter with every completed design, thermal expansion calculation, and the ability to design larger arrays. PV Powerhouse instantly generates a flush-mount, rooftop PV design, based on user provided information including roof type, module dimensions, and mounting area. Within minutes, PV Powerhouse produces project layout information, sample installation drawings, a stamped structural acceptance letter, and a complete parts' list. The parts' list can then be exported to the company's eCommerce shopping site for convenient ordering. Systems ordered online are produced and shipped out within two business days.

Schletter Inc.

www.schletter.us | www.pvpowerhouse.com

Solar tracker network manager

P4Q's Suntrack, the largest line of solar tracker controllers, has created a Network Manager to use with their AC Suntrackpro or DC Suntrackpro Lite controllers. The product provides a simple way to manage sensors, such as wind meters, master clock, or other resources, for a field of trackers. Suntrack NCUpro can be ordered either wireless or wireline. To rapidly commission a field of trackers, simply scan the bar code of each controller and then load this into the NCUpro. Once completed, turn on the power and each tracker will be pointed into the perfect sun position. As a failsafe, the solar tracking controllers will even operate if the NCUpro is offline. And, when turned, the trackers will move to a set position for maintenance mode.

P4Q's Suntrack | www.suntrackpro.com

Solar project insurance

A new insurance product now answers a question that bankers continually ask when approached to finance solar projects: what if the sun doesn't shine? Walsh Carter & Associates Insurance Services, LLC have spent over three years carefully creating SolarShield in direct response to growing concerns among financers about investing in commercial solar projects. SolarShield is the first true performance warranty that guarantees the minimum revenue generated by solar PV systems in the event of production shortfalls. Claims do not require proof of negligence or defect on the part of the system developer. The policy will make up any lost revenue due to system underperformance, and it names the bank or financial backer as the loss payee for any claims.

Walsh Carter & Associates Insurance Services, LLC

www.insurancespf.com

Complete system pallet

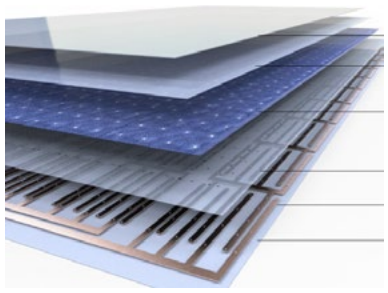
AllEarth Renewables, manufacturer of the dual-axis AllSun Tracker, has released the AllSun Tracker complete pallet system, which allows for simplified, free shipping to installers or directly to the jobsite. The innovative system is designed to utilize the rails of the tracker's frame as the pallet structure, minimizing material costs and shipping waste. The AllSun Tracker complete system approach vastly simplifies supply chain management and installation, reducing procurement time, waste, and cost for installers. The fully pre-engineered system can accommodate 20 or 24 modules for a system range from 4 kW to 8 kW. Each solar tracker includes free lifetime monitoring, and can be shipped the same day it's ordered with panels.

AllEarth Renewables
www.allearthrenewables.com

Mega solar tracker

The Solar Tracker Company is introducing the largest tracker currently sold: the Mega-Monster Solar Tracker. The first in the Goliath-class trackers, the Mega-Monster is designed in the United States and has already been implemented in China. One tracker has the ability to power 100 houses or 600 kW. Even with its size, the system maintains special features, such as the ability to adjust for changes in terrain slope—a major issue with larger trackers. Furthermore, it can easily shake-off any snow accumulation found in colder climates, addressing any major shading events. It's equipped with high-quality control systems, allowing for plug-and-play capabilities, and is fully designed for rapid deployment. Mega-Monster Solar Tracker provides an economical, well-built choice for solar projects.

The Solar Tracker Company
www.thesolartrackercompany.com



Back-contact modules

Upsolar's back-contact modules improve upon the efficiency of traditional products, offering as much as an 11% increase in module efficiency. Through innovative design, energy flows through cells from front to back, achieving better performance by shortening interconnections and lowering nominal operating cell temperatures. Additionally, back-contact modules can be combined with other PV system-enhancing solutions from Upsolar's partners to further accelerate project payback times.

Upsolar | www.upsolar.com

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MOTECH

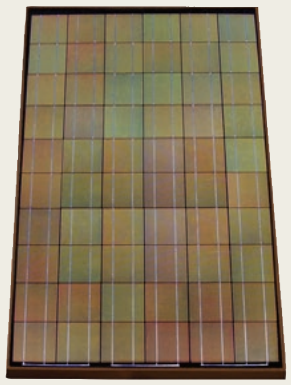
Product: IM60 Series Photovoltaic Module
Available Power: 245 W to 260 W
Maximum Power: 260 W
Power Tolerance: 0~3%
Maximum Efficiency: 15.9%
Size: 37.1" x 65.0"
Weight: 43.9 lbs
Warranty: 25-year progressive linear power warranty, with 10-year material and workmanship

Certification/Listings: UL 1703, IEC 61215, IEC 61730-1,2 (additional international certifications includes JET); Listings CEC, FSEC, ACEC, and J-PEC

Additional Features:

- 1000 V UL certified, resulting in savings from more rapid and reduced-labor installations, increased maximum system voltage, and improved system performance;
- US Manufactured in compliance with "Buy American," under the ARRA; and
- Color options include a black backsheet with a black anodized aluminum frame, or a white backsheet with either a clear or a black anodized aluminum frame.

Website: www.motechsolar.com

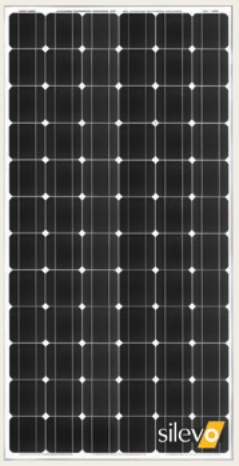


Colored Solar

Product: Stylish Solar Panels
Available Power: 230 W
Maximum Power: 230 W
Power Tolerance: +/- 3 W
Maximum Efficiency: 15.5%
Size: 65" x 39"
Weight: 53 lbs
Warranty: 25 years, with 10 years workmanship
Certification/Listings: ETL UL 1703, CEC, IEC
Additional Features:

- Available in 11 colors.

Website: www.coloredsolar.com

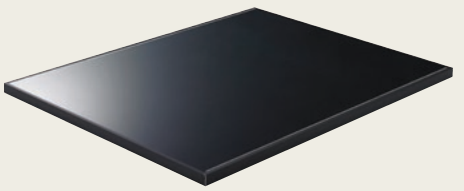


Silevo, Inc.

Product: Triex 355Wp
Available Power: 355 W
Maximum Power: 355 W
Power Tolerance: 0/+3%
Maximum Efficiency: 18.3%
Size: 77" x 39" x 1.6"
Weight: N/A
Warranty: 25-year linear, 10-year product workmanship
Certification/Listings: Third-party tested by Renewable Energy Test Center (TUV affiliated), Pending UL / IEC certifications
Additional Features:

- Offers a -0.27%/C module temperature coefficient; and
- A 60-cell version for residential projects.

Website: www.silevosolar.com



Solar Frontier Americas Inc.

Product: Solar Frontier CIS Thin-film Module
Available Power: 150 W to 170 W
Maximum Power: 170 W
Power Tolerance: 0~5%
Maximum Efficiency: 13.9%
Size: 49.5" x 38.5" x 1.4"
Weight: 44.1 lbs
Warranty: 25-year power warranty
Certification/Listings: IEC61646/61730, UL 1703; Listings CEC, FSEC
Additional Features:

- Black module with black anodized aluminum frame;
- Offers a higher performance ratio than crystalline silicon in hot climates; and
- Made in Japan.

Website: www.solar-frontier.com

The Leader in Off-Grid Solar Power

Under harshest environments, Eoplly solar modules are the brand of choice for 24V off-grid applications.

Used by leading US manufacturers, Eoplly's high-efficiency EP125/72 cell mono solar modules are specifically designed for 24V off-grid power systems. Rated up to 190W, Eoplly modules are integrated into a range of applications from early warning systems for municipalities to water pump stations on ranches. Even on military bases, Eoplly modules are enabling US government facilities to become energy independent through off-grid, solar-powered streetlights.

Backed by a 25-year performance warranty and Zurich insurance, Eoplly modules provide reliable solar power for critical off-grid applications.

Learn more about Eoplly modules at **www.eoplly.us** (US) and **www.eoplly.com** (global).

Eoplly USA, Inc.
1250 Bayhill Drive, Suite 350
San Bruno, CA 94066
+1-650-225-9400
info.eopllyusa@eoplly.com

GENPRO ENERGY SOLUTIONS

Systems and Photos by
GenPro Energy Solutions, L.L.C.,
www.genproenergy.com.

EOPLLY

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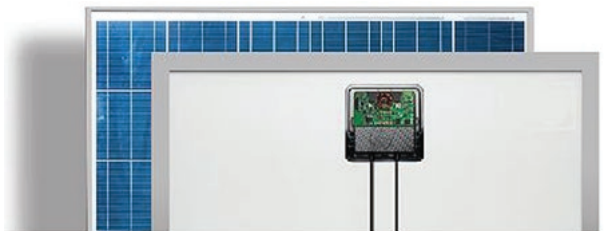

Product: Silfab Smart 60-cell Module
Available Power: 245 Wp to 285 Wp
Maximum Power: 285 Wp
Power Tolerance: 0 Wp to +5 Wp
Maximum Efficiency
Size: 45.7" x 40.0" x 1.50"
Weight: 41.9 lbs
Warranty: 25-year power warranty at 82% rated output

Certification/Listings: UL 1703, IEC 61215, and IEC 61730
Additional Features:
- Smart module technology; and
- Integrated optimizers in junction boxes.

Website: www.silfab.ca

Lumos Solar

Product: LSX 250 Series
Available Power: 240 W to 250 W
Maximum Power: 8.06 A to 8.31 A
Power Tolerance: +/- 3%
Maximum Efficiency: 14.72%
Size: 64.17" x 41.02" x 1.38"
Weight: 62.6 lbs
Warranty: 12 years at 90% of the rated power output, and 25 years at 80% of the rated power output

Certification/Listings: ETL per UL-1703 and CEC listed
Additional Features:
- Frameless module system with integrated racking and wireway; and
- Clear or black backsheet color options.

Website: www.lumossolar.com

MAGE SOLAR

Product: MAGE POWERTEC PLUS 250 PL US AC Photovoltaic Module
Available Power: 250 Wp
Maximum Power: 238 W
Power Tolerance: -0/+5 DC
Maximum Efficiency: 95%
Size: 65.15" x 38.94" x 1.54"
Weight: 47 lbs
Warranty: 30-year power guarantee
Certification/Listings: ARRA, UL 1703, UL 1741, CEC, FSEC
Additional Features:
- MAGE SOLAR's AC PV solution offers an easier, a faster, and a safer installation process;
- Combines high-efficient MAGE POWERTEC PLUS module with a microinverter, mounted directly to the back side of each panel;
- Improves energy production by maximizing energy output of each individual panel and monitoring real-time operation performance; and
- Suitable for any rooftop—even complex or shaded.

Website: www.magesolar.com

The Solar Spotlight features details on specific solar-related products to help readers determine what's available in the market today for their solar energy projects.

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EOPLLY

Product: Off-grid Solar Modules
Available Power: 185 W to 190 W
Maximum Power: 200 W
Power Tolerance: +3/-0
Maximum Efficiency: 15.7%
Size: 62.2" x 31.8" x 1.38"
Weight: 40.2 lbs
Warranty: 25-year, linear warranty
Certification/Listings: CEC, UL
Additional Features:
• Designed for off-grid applications.
Website: www.eoplly.us

Canadian Solar

Product: CS6P-M All Black
Available Power: 250 W to 265 W
Maximum Power: 265 W
Power Tolerance: Up to 5 W
Maximum Efficiency: More that 16%
Size: 64.5" x 38.7" x 1.57"
Weight: 41.9 lbs
Warranty: 25-year industry leading linear power output warranty, 10-year product warranty on materials and workmanship, and 100% non-cancellable, global and immediate warranty insurance coverage
Certification/Listings: IEC61215, IEC61701, VDE, TÜV, MCS, SII, KEMCO, CEC AU, UL1703, IEC61215 Performance: CEC listed (USA), UL1703: CSA, IEC61701 ED2: VDE, IEC62716: TÜV
UNI9177 Reaction to Fire: Class 1
Additional Features:
• Handles heavy snow load, up to 5400 Pa, and withstands potential induced degradation;
• IIP67 junction box, long-term weather endurance;
• Ammonia-resistance, salt mist corrosion-resistance, and suitable for seaside environments; and
• Self-cleaning, with an anti-glaring module surface.
Website: www.canadiansolar.com

Trina Solar

Product: TSM-PDG5 “The Most Durable Module,” a frameless, dual-glass solar module, with high-efficiency poly silicon cells
Available Power: 240 W to 255 W
Maximum Power: 260 W
Power Tolerance: Positively tolerance, 0~+3% of Pmax
Maximum Efficiency: 15.2%
Size: 66.34" x 39.25" x 0.25" (D:1.25" at junction box)
Weight: 52.9 lbs
Warranty: 10-year material and workmanship, with a 30-year linear power warranty
Certification/Listings: UL 1703, IEC 61215, IEC 61730, UL Fire Class A, made in ISO certified facility, CE
Additional Features:
• Dual-rated 1000 V UL and 1000 V IEC, with industry leading one-half percent annual power degradation;
• Dual-glass modules feature improved 3600Pa wind load and 5400Pa snow load standard, with Anti-PID standard;
• Frameless design reduces dirt accumulation from edge build-up of framed modules; and
• Micro-crack free and snail-line free.
Website: www.trinasolar.com/us/product/PDG5.html

SEE AD ON PAGE 38

Company: Helios Solar Works
Product: 6T Series Modules
Available Power: 250 W to 265 W
Maximum Power: 265 W
Power Tolerance: -0/+3
Maximum Efficiency: 15.93%
Size: 66.14" x 38.9"
Weight: 43 lbs
Warranty: 25 years, linear

Certification/Listings: UL, TUV, MCS, JET, CEC, and FSEC

Additional Features:

- Available with black or clear frames;
- White, black, or clear backsheet options; and
- Made in USA.

Website: www.heliossolarworks.com

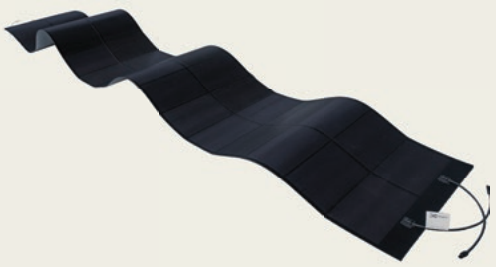
Axitec, LLC

Product: AC-250M/156-60S AXIblackpremium
Available Power: 250 W
Maximum Power: 260 W
Power Tolerance: 0-5 Wp
Maximum Efficiency: 15.98 %
Size: 64.57" x 39.06" x 1.57"
Weight: 42.99 lbs
Warranty: 25 years on 85% of nominal performance, and 12 years on workmanship
Certification/Listings: UL, CEC, FSEC listed; Salt Mist Corrosion, Ammonia Corrosion Certificate, as well as DIN ISO 9001, 14001, and OHSAS 18001

Additional Features:

- Soft-grip frame for better handling;
- 100% electroluminescence inspection; and
- German engineered, with stock in New Jersey and California.

Website: www.axitecsolar.us



Xunlight Corporation

Product: XR36-300
Available Power: 300 W
Maximum Power: 315 W
Power Tolerance: +/- 5%
Maximum Efficiency: 7.2% (aperture area)
Size: 203.3" x 35.0"
Weight: 26 lbs (0.25 lb/square foot)
Warranty: 5-year materials and workmanship, and a 25-year power output with approved installation
Certification/Listings: UL1703, IEC61730, IEC61646

Additional Features:

- Lightweight, flexible, and unbreakable;
- 1/16" thin (no wind load); and
- Portable.

Website: www.xunlight.com

Upsolar

Product: Smart Modules
Available Power: 235 Wp to 300 Wp
Maximum Power: 300 Wp
Power Tolerance: 0%-3%
Maximum Efficiency: 16%
Size: Starting at 164" x 99.2" x 4"
Weight: 41.8 lbs to 59.5 lbs
Warranty: 10-year product warranty, and 25-year performance warranty
Certification/Listings: Certified by TUV Rheinland for safety and performance, and ISO-certified.

Additional Features:

- Equipped with intelligence from providers of power optimization technology;
- Increased power harvest at the module level, and enhanced design flexibility; and
- Simplified installation process to offer customers a lower overall cost of system ownership.

Website: www.upsolar.com

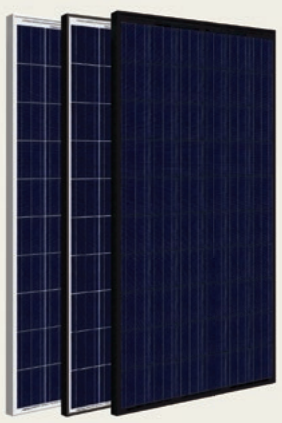
Talesun Solar USA

Product: TP660P
Available Power: 235 W to 260 W
Maximum Power: 211.5 W to 234.4 W
Power Tolerance: 0 W to +5 W
Maximum Efficiency: 14.5% to 16%
Size: 64.6" x 39" x 1.6"
Weight: 41.9 lbs
Warranty: 10-year product, and 25-year linear power performance
Certification/Listings: UL 1703, PID (Potential Induced Degradation), IEC61215, IEC61703, IEC61701 (Salt Mist Corrosion Test), IEC62716 (Ammonia Corrosion Test)

Additional Features:

- Available in standard aluminum or black frames.

Website: www.talesunusa.com/products



Hanwha SolarOne USA

Product: HSL60
Available Power: 235 W to 255 W
Maximum Power: 255 W
Power Tolerance: 0 W to +5 W
Maximum Efficiency: 15.8%
Size: 64.4" x 38.9" x 1.6"
Weight: 41.9 lbs
Warranty: 12-year product warranty, and 25-year linear warranty
Certification/Listings: 1000V UL, CEC

Additional Features:

- 4000 Pa wind load and 7000 Pa snow load;
- Black backsheet, with black frame options;
- Zep frame compatible; and
- Good low-light performance and tariff-free.

Website: www.hanwha-solarone.com

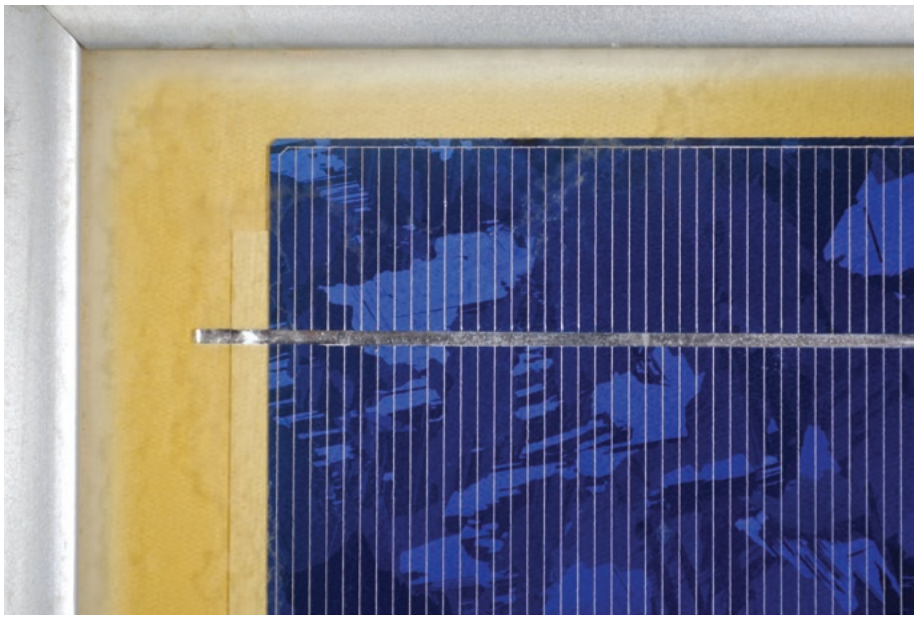
1SolTech

Product: Frameless-Sleek Series
Available Power: 260 W to 280 W
Maximum Power: 280 W
Power Tolerance: 0+3
Maximum Efficiency: 17.7%
Size: 40" x 64.8"
Weight: 55lbs
Warranty: 25 years
Certification/Listings: UL 1703
Website: www.1soltech.com

Less Risk, More Value

Safeguarding solar projects for the long term

By Kurt Theorin



Above: *This panel made with PVDF backsheet shows significant yellowing after less than two years in the field; yellowing is an indication of polymer degradation, which can lead to backsheet cracking, compromised power output and safety*

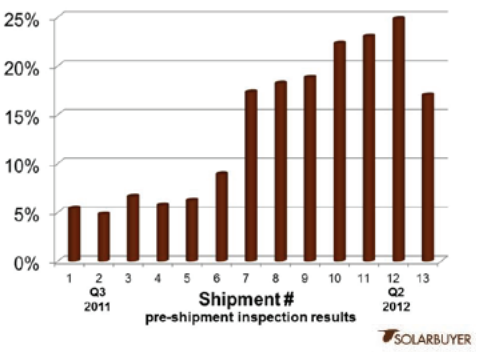


Figure 1. *A recent study of defect rates in panel shipments showed an increase from about five percent in 2011 to nearly 25% by 2012 (Image courtesy of SolarBuyer)*

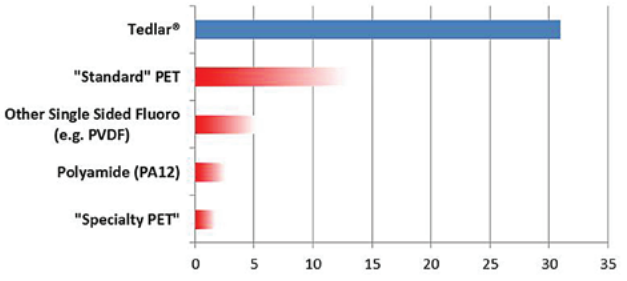


Figure 2. *PVF film-based backsheets have been field-proven for more than 30 years, while alternative backsheet materials are relatively new with unproven reliability in service environments*

SOLAR CONTINUES TO MAKE SIGNIFICANT INROADS as a key element of the world's overall energy mix, and its potential is great—the industry is projected to grow to $100 billion by 2015. North America, in particular, is a high-growth market. However, industry overcapacity and consolidation are driving short-term decisions in some instances that shift more risk to system owners. Faster power-degradation and shorter system life may be the result.

Following are three key myths or misconceptions to guard against when it comes to comparing and selecting the products and technologies for any solar project.

Myth 1: Panels are commodities

All panels are not created equal. Some fail, either in initial testing or after installation. Although many investors expect low, single-digit failure rates among panels, this isn't always the case. A recent study by the National Renewable Energy Laboratory (NREL) indicates that more than 20% of all panels and systems evaluated failed to produce the expected power output over time. Moreover, new panels may be failing at increasing rates.

An independent study of new panel shipments found defect rates increased from near the five percent range in September 2011, to nearly 25% by February 2012. These rising defect rates in newer panels are alarming, and could lead to longer-term implications for projects and failures after installation.

In the race to cut costs, it seems some manufacturers have taken chances by substituting proven materials with unproven or inferior options, while at the same time convincing buyers that solar panels are just commodities—and, that they're all the same. Unfortunately, material performance can vary widely, directly impacting panel performance.

Myth 2: All materials are created equal

Backsheets, for example, are intended to protect and insulate solar panels for their 20- to 25-year lifetime. However, newer alternatives introduced to reduce project expenses are backsheets based on polyethylene terephthalate (PET) and fluoropolymers, including fluorinated ethylene vinyl ether (FEVE) and polyvinylidene fluoride (PVDF). Although these options have only been in the market for a relatively short period of time, they've already been shown to yellow and/or crack after just a few years in the field, seriously compromising a system's power output and safety performance.

The savings panel manufacturers are hoping to achieve by cutting corners only comes down to a few pennies per watt. But, if even one panel fails as a result, an entire solar system is impacted, leading to diminished investment returns. Realistically, most investors or system owners wouldn't risk long-term reliability or investment returns, however, they might not be aware of the materials being used. Or else, a system owner might not recognize the significance of material selection beyond the module itself. As a result, reliability or durability might be sacrificed in favor of small, short-term cost savings.

Case-in-point: decades ago, the US Department of Energy contracted NASA's Jet Propulsion Laboratory (JPL) to develop a reliable, durable, and safe 30-year solar panel. They conducted an exhaustive, 11-year study that cost tens of millions of dollars. Many different types of materials were tested, but all of the recommended final designs contained glass, ethylene vinyl acetate (EVA) encapsulants, and polyvinyl fluoride (PVF) film-based backsheets. During the development process, failure rates dropped from 45% in the early designs to 0.1% in the final set.

PVF film-based backsheet designs have now been in the field for more than 30 years, in all kinds of climates (such as desert, tropical, and temperate), and continue to pro-

Continued on page 43.

The Challenge of Turning Green into Green

By Steve Rodman

As Kermit the Frog once said, "It's not easy being green." The huge growth in shale gas production will make it difficult for renewable energy to achieve parity for electricity generation for a long time to come. Subsidies are losing favor with Washington, and financing is becoming increasingly difficult for anything less than utility-scale projects.

YET, WITH ALL THESE DETERRENTS, the green energy sector continues to show healthy growth in many parts of the country. This is driven largely by a complex currency created by federal and state governments called energy tax credits. However, proper qualification and distribution of these tax credits can either make or break a renewable entity. This is particularly true of smaller projects and for new, start-up renewable energy companies.

Project support

If a corporate entity or partnership isn't properly structured from the get-go, investors will likely miss out on receiving the maximum benefits from tax credits—meaning their project or company could create worthless returns. Even something as simple as setting up an entity's accounting system can be crucial to qualify for financing or for investment tax credits against future income.

To ensure success, a renewable energy company should consider getting structural support from a business standpoint. In the battle to survive tight margins and complex tax codes, a certified public accounting (CPA) firm can be a start-ups best ally. And, in the tough green energy market with ever-changing laws and subsidies, it's worth getting a CPA involved early in the planning process, in preparation of the initial business plan.

Above all, it's important to believe in clean energy and recognize the added investment of time is not only for the future of your company, but also for the future of the planet.

Specialized energy tax expertise has long been the province of large, expensive CPA and law firms, which typically serve the utilities, and the oil and gas industries. But, the majority of new alternative energy and energy efficiency companies are entrepreneurs and smaller project developers that simply can't afford the high fees of the large firms. That's where a smaller CPA firm, with a specialty practice in renewables, can provide a valuable alternative and valuable insight.

However, to create a sustainable business model, a green energy company has to understand the optimal allocations of income and deductions. Many energy and cleantech clients are entrepreneurial start-ups that would do well with extra support, so they aren't exposed to significant liabilities. Every project has its own nuances in determining what qualifies for deductions and accelerated depreciation.

Finding funds

One of the biggest challenges for smaller energy projects is financing. Very few commercial banks are up to speed on energy tax regulations, and fewer are willing to lend money to smaller developers. Cleantech and green energy companies simply don't generate the rates of return that typically attracts venture capital and, as a result, many equity investors are interested in larger projects. That leaves a minimal class of investors that continue to be interested—either individuals who need tax credits to offset passive income, or companies with qualifying income streams that can make use of the tax credits.

Making a case to these investors can mean drafting a complex business plan and partnership agreement in which potential tax credits must be accurately calculated and allocated, taking into consideration each individual entity's tax position.

Maintaining a renewable energy practice that's supported by early-stage clients is, no doubt, challenging. It takes a great deal of discipline and dedication to maintain a strong knowledge base, and a reasonable fee structure. In addition to industry participation and knowledge, maintaining a successful green energy business requires concerted effort in proper brand building and marketing. All of this costs money, while attempting to make money.

The support of a qualified cleantech CPA practice means their staff is prepared, and should have spent a considerable portion of their time keeping up with changes in federal and state energy tax regulations, participating in energy associations and conferences, and keeping involved with the entities that drive energy policy. Doing their job properly means ensuring their client projects start on the right foot and stay on the right foot.

Building a successful green energy practice is all about focus. You can't simply throw a solar panel or two on some rooftop and say you're in the business. You have to maintain a solid knowledge base, cultivate relationships with industry stakeholders, and continue to build the company brand.

Above all, it's important to believe in clean energy and recognize the added investment of time is not only for the future of your company, but also for the future of the planet.

Founded in 1961 and listed in the Boston Business Journal's "Top 50 Firms," Rodman & Rodman, P.C. provides accounting, tax, and business services to small and medium-sized companies. Their "Green Team" is a specialized green energy and clean technology accounting and tax services practice.

Rodman & Rodman, P.C. | www.rodmancpa.com

...continued from page 43.

vide reliable, long-life protection to panels, safeguarding solar systems and enabling long-term system returns.

Myth 3: Warranties cover risk

Often times, system owners believe that warranties on solar panels will help protect their project(s) long term. And, at times, panel manufacturers will claim that the materials employed in their products will support a variety of warranties. But a 25-year warranty from a three-year-old company, attempting to survive in an environment of rapid industry consolidation can have questionable value.

In one recent example, eight panels with shattered glass were found during an inspection of a 37-kilowatt (kW) installation in Delaware. The system owner found itself in an increasingly common predicament when it discovered the panel and inverter manufacturer were no longer solvent—and the installer had been purchased by another company. Unfortunately, this situation left no recourse: the responsibility to safely mitigate the problem was left to the system owner.

Ultimately, the smallest sub-array containing 14 modules was cannibalized for use as replacement modules, and the project owner estimated the issue translated to a loss in net present value of $35,000, due to a combination of less energy produced and increased operation and maintenance (O&M) costs for this sized system. Clearly, expenses for larger system failures can run significantly higher.

Transparency

At the time of the JPL study, there were only five panel makers, marketing five panel designs. Today, there are over 60 panel makers and 900 designs for crystalline silicon panels alone. Panel selection is becoming increasingly difficult, and panel makers rarely offer insight into what materials are used in their designs.

Transparency is key when it comes to safeguarding solar investments. Knowing what materials are used, ensuring they are proven in their reliability, and verifying they are used in every panel in a solar system are three key steps to effectively mitigate the risk of panel failures. The availability of key materials for specification is good in today's market. The capacity for PVF films, for example, has recently more than doubled.

The verification step is important because panel makers are not required to disclose material variations, which can yield safety and performance uncertainty. When changes are made to the bill of materials, panels perform differently. Interestingly, in the PVDF example above, panels made with different materials were supplied for the same installation, resulting in some panels that yellowed or cracked, while others did not.

In the end, the success of the solar industry depends on ensuring less risk and more value by building systems that will run for a longer period of time. Buyers must be aware of the potential for panel makers to sub-optimize panel performance through inferior material selection by getting involved in specification.

Investment returns can increase by more than 30% if the lifetime of the solar system can be increased from 10 to 25 years, and the most reliable way to do this is by specifying proven materials in the building of solar panels.

DuPont is a supplier of specialty materials to the solar industry.

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Practical Realities
Of measuring the wind

By Lee Alnes & Naomi Pierce

Remote sensing systems can be sited flexibly; this photo shows a Triton SoDAR at Windland's Tehachapi wind farm

Under pressure, North American wind energy developers are turning to remote sensing systems to complete their projects more efficiently and with less uncertainty

REMOTE SENSING WIND MEASUREMENT SYSTEMS, once regarded as cutting-edge technology, are finding favor among wind developers for the most down-to-earth of reasons: in many locations, they are more convenient and practical than deploying met towers.

As wind energy developers are squeezed between uncertainty about the status of the United States' federal renewable energy production tax credit (PTC) and price competition from fossil fuels, they're turning to remote sensing systems—including SoDAR and LiDAR—to kick-start the development of their wind power projects.

The current extension of the PTC expires at the end of 2013. To qualify, wind projects must be under construction before the end of this calendar year. A critical element in the development phase of a wind power farm is wind resource assessment. And, anything that can help make this more efficient and economical will help wind developers as they try to bring projects through the pipeline more efficiently.

A good resource analysis campaign relies on one to three years of data collected at the site of the proposed wind farm. Traditionally, data has been collected almost exclusively with tall met towers, outfitted with sensors and erected at a site, to measure wind speed and direction. Remote sensing is not a shortcut, however, as a large amount of data is still required to make good decisions. But remote sensing systems can usually be deployed sooner than meteorological towers, saving a significant amount of time.

Ground-based remote sensing systems have been successfully commercialized in the past decade. These systems work by emitting sound waves (SoDAR) or light pulses (LiDAR), and by measuring characteristics of the reflections. Initially developed to provide wind data at higher heights than is practical with a met tower, remote sensing systems are now being used where possible to replace met towers because they have proven to be just as accurate and are more convenient.

Using met towers

Before erecting a met tower, a wind developer may need to submit engineering drawings, perform soil tests, decide on the method of anchoring, and obtain construction permits from the locality and from the Federal Aviation Administration (FAA). Permitting can take anywhere from three to 12 months and, in some cases, involves dealing with local opposition and with public agencies.

Installing a meteorological tower is not a trivial undertaking. Once the tower has been shipped to a site, the installation process usually takes several days (depending on the height, as well as other factors). Met towers must be installed and maintained by qualified installation professionals, who sometimes can be difficult to schedule and aren't always available when needed.

Even once installed, met towers face certain challenges. They pose an aviation hazard, are vulnerable to lightning strikes, and can collapse during winter storms. If a tower is felled by a lightning strike or an icing incident, it can often take weeks or even months before repair or a replacement can be planned, especially in remote locations, creating a significant gap in the wind measurement campaign.

Met towers can also be an eyesore and a nuisance. For example, a farmer whose land is being evaluated for wind potential must mow or plow around guy wires, as well as the tower itself. Ground safety is another concern. The installation of a met tower can be an obstacle to securing permission from a landowner to measure wind.

Choosing remote sensing systems

The logistical headaches of met towers have been driving developers who have experience using remote sensing systems to turn to them to replace towers where possible. Ground-based SoDAR and LiDAR systems offer many advantages as follows:

- **Reduced permitting delays.** Remote sensing systems don't normally require any special permitting from localities or the FAA, unless placed on public lands or in environmentally sensitive areas.
- **No construction delays.** To install a SoDAR or a LiDAR, a wind developer ships it to the location and sets it up. In most cases deployment takes less than one day.
- **Simplified maintenance.** If the sensing system is remotely monitored, any problems can be diagnosed online. In many cases, personnel on location can perform simple maintenance without requiring a field technician to perform a service visit.
- **Portability.** Once a wind assessment has been completed in one location, the remote sensing system can be moved to a new location and used for another project. Remote sensing systems are capital assets that can be amortized over many projects, and have a lower cost of ownership over time.
- **Durability.** SoDARs and LiDARs are much less vulnerable to weather and other events than met towers. In the event of a disaster, they can be more easily repaired or replaced.

Conclusion

Of course, no measurement system is perfect and remote sensors can have good days and bad days, just like met towers. Meteorological towers still play an essential role in wind resource assessment and may be required as part of the wind farm financing process. The new challenge facing meteorologists, consultants, and developers is determining the proper mix and timing of towers and remote sensing systems to collect the best data for their wind measurement campaigns.

As more wind developers seek creative ways to save time and money, however, remote sensing systems will continue to gain ground in the wind industry for the simplest of reasons: practicality.

Lee Alnes is the vice president of business development & sales at Second Wind. Naomi Pierce is the marketing communication's manager at Second Wind.

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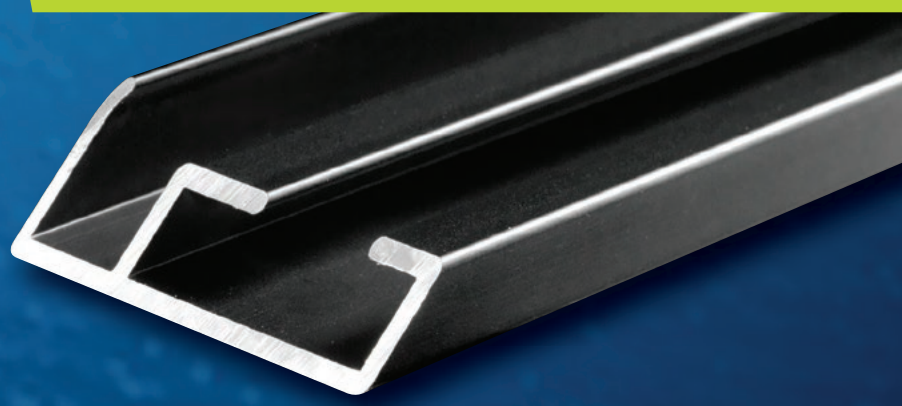

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Making the Most of Measurement Data

Stretching a forecasting resource

By Craig Collier

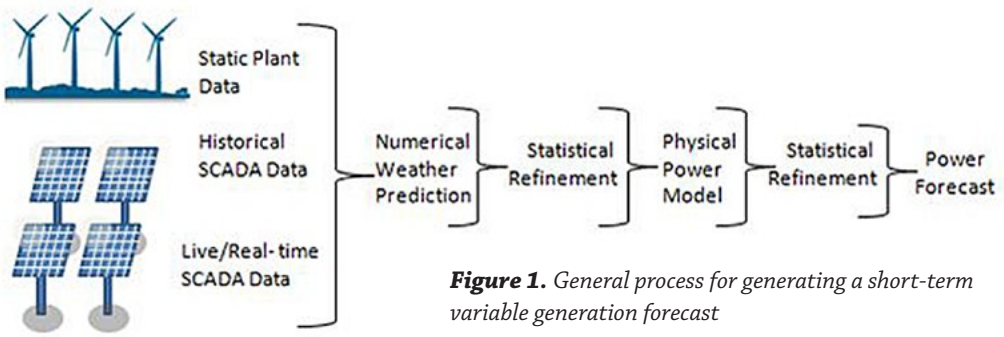

Figure 1. *General process for generating a short-term variable generation forecast*

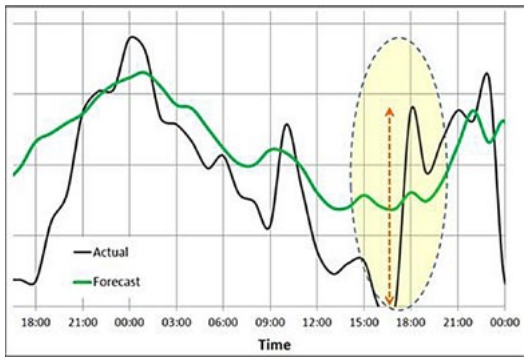

Figure 2. *Actual versus forecasted wind power production over a 30-hour period for a plant in the central US*

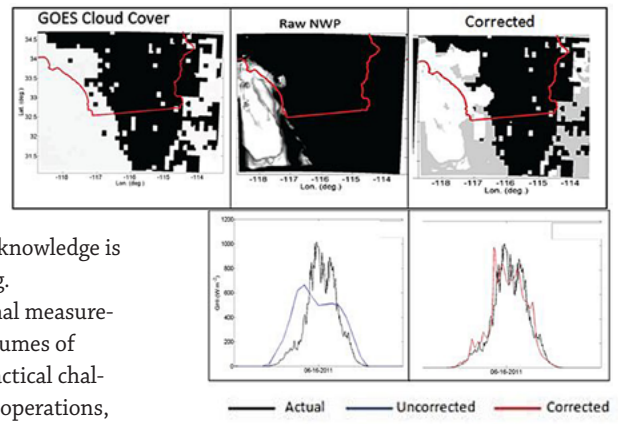

Figure 3. *High-resolution, cloud-assimilating NWP. Image on top left shows a cloud field over southern California, as measured by geostationary satellite; the top middle shows a raw NWP initial condition; and the top right, a corrected initial condition. The bottom middle image shows an irradiance forecast (W/m^2), where the initial condition is uncorrected; the bottom right shows a forecast with the satellite data correction.*

WIND POWER GENERATION already accounts for almost a quarter of energy generation in states such as Iowa and South Dakota, decreasing reliance on non-renewable power sources. One of the keys to integrating greater amounts of alternative generation is the availability of accurate and timely forecasting of individual plant generation. Forecasting enables system operators to effectively manage varying levels of power production for operations to run efficiently and economically, and for traders to make marketing decisions.

However, as new wind farm installations are added at record pace and demands for increasing prediction accuracy mount, forecasters are being forced to advance technologies, stretching existing modeling capabilities for project success.

State-of-the-art challenge

On average, a state-of-the-art power forecast—one that relies on numerical weather prediction, statistical correction, and sophisticated power conversion modeling (see Figure 1)—remains the gold standard for predicting available renewable energy supply in short horizons (i.e. less than a week ahead). Its value well exceeds that offered by simple persistence, where forecast errors beyond a few hours ahead often double those of a robust forecast system.

To date, one of the most common challenges seen is dealing with large fluctuations, or ramps, in power over short periods. These events are costly in terms of reserve purchases and/or lost trading revenue. Plant owners and stakeholders are, therefore, eager for the forecasting industry to advance its capabilities so that ramp events are better understood and predicted—ensuring forecast user-confidence through the reduction of overall prediction error.

Addressing forecast concerns can be an iterative task. Errors in numerical weather prediction (NWP) of wind resource and cloud cover may be reduced, either physically within a model or upon statistical refinement of the model's output, through: model output statistics (MOS), machine learning, and regression models.

An event-driven view

There's an inherent level of uncertainty in predicting future conditions. Uncertainty is driven by forecast errors, and for wind (or solar) resources, forecast errors increase for greater look-ahead times. This is partially due to the fact that, as an initial value problem, weather forecasting is highly sensitive to errors in measurement of a model's initial condition. These errors become amplified by the "non-linearities" in the governing equations for the atmosphere as the forecast evolves.

For any given look-ahead time, accuracy of a forecast is often described as an error averaged over a period. However, a forecast demonstrating a low average error might not demonstrate a low error at any given prediction time. For example, Figure 2 shows a 30-hour production time series from a large wind plant in the central United States. The day-ahead forecast is given in green. In a six-month average, this forecast performs reliably, with errors averaging less than 15% of nameplate capacity.

Nonetheless, on the day presented, power production dropped and then increased by greater than 50% of capacity in just 90 minutes (16:30 to 18:00)—an event that was completely missed by the forecast. This difference in the actual and forecasted energy generation has the potential to expose the operator to oversupply penalties, not to mention lost trading revenue for the energy marketer.

Advances with measurements

Despite the impact of these hard-to-predict events, they're a relatively scarce occurrence. In a study of wind and solar power facilities across the US, it has been found that changes as large as 50% over periods of less than six hours occur anywhere from one to two percent of all predictable hours. The low frequency doesn't diminish the importance of such events, but it does challenge the design of reliable and repeatable techniques for forecasting each one.

In recent years, there have been numerous efforts to improve the ability of forecasting tools. For wind, a type of event forecasting makes use of sophisticated in-field measurements to better characterize the vertical structure of the atmosphere and physical processes, which cause sudden fluctuations. Of course, improved knowledge is translated into improved modeling.

In spite of the benefits, additional measurements do come at a cost. Large volumes of measurement data can present practical challenges to the flexibility of forecast operations, data archiving needs, and system maintenance costs. Not all observations are useful, and useful observations are not always free. So, forecasters must be judicious in their choice of data consumption to preserve the efficiency and usability of forecasting tools.

Currently, selection and/or targeting of measurements are active areas of research. In a study combining ambient, near-surface measurements with privately owned, *in-situ* tall tower measurements in regions surrounding wind plants, it was determined that constellations of observations often describe states that pre-cursor wind events at the plant. Data mining and statistical clustering algorithms can then be designed to search for predicted patterns, alerting to potential wind ramps. The resulting statistical methods are an inexpensive complement to the process of assimilating observations into the numerical weather prediction model. Even in isolation, they are valuable for their ability to predict probabilities of events over windows of time.

In terms of solar power, an encouraging technique for enhanced ramp prediction is derived from an improved use of cloud measurements from geostationary satellite. In a simple cloud-data assimilation scheme, a NWP model's initial conditions for cloud coverage, altitude, and composition can be altered and updated based on translating live satellite image data. Over southern California, the method often reduces intraday solar resource prediction bias by more than 10%, relative to the actual resource.

A sample of such improvement for forecasts at a PV plant along the southern California coast in June is shown in Figure 3. This forecast was generated and issued prior to sunrise for the current day. For large model domains, improved initial cloud conditions can even benefit day-ahead forecasts, assuming coherence of large-scale cloud systems as they propagate toward a plant location.

Conclusion

In the current state, power forecasting is evolving as the design and implementation of higher-resolution weather models are increasingly influenced by stakeholders in the renewable energy industry. As weather models change, forecasters can make use of expanding observational systems to investigate the impacts of measurement, both onsite and offsite, for improved power prediction.

In the treatment of low-frequency, high-impact events, there's considerable scope to make use of observational data to improve deterministic forecasts (through direct model revision), as well as the probabilistic forecasts for these events. The value in the probabilistic forecast may depend on its presentation by the forecaster and its operational application by the consumer, and there may be a ways to go yet toward perfecting each.

Craig Collier is the North American practice lead for forecasting with GL Garrad Hassan. The author would like to acknowledge Craig Houston and Patrick Mathiesen for their valuable contributions.

GL Garrad Hassan provides power-forecasting services for over 35 gigawatts (GW) of installed capacity worldwide, in 14 countries.

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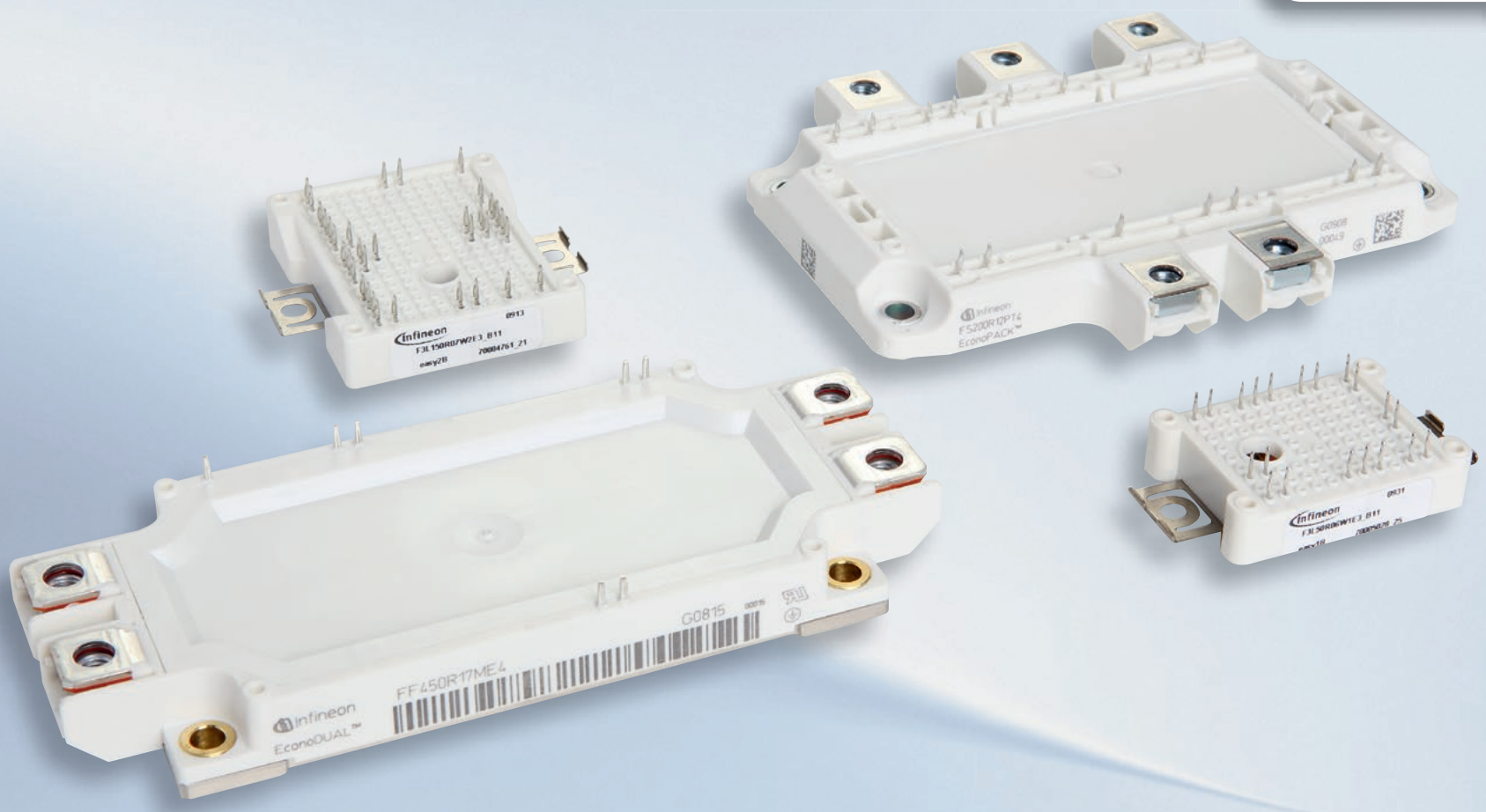

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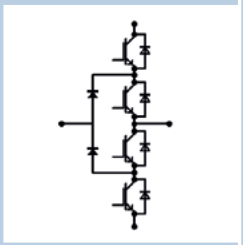

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Overcoming Obstacles in Wind Energy Construction

By Lydia Adams

Contractors and developers in today's renewable industry face many challenges—from the planning and permitting stage, all the way through construction. This is especially true for constructors of wind energy farms, whose role in a project may take years.

Choosing the site

Although access to the electric transmission grid is one of the biggest factors in a potential new project's site selection, several other limitations make choosing an appropriate location more difficult. The site for a wind farm must be able to accommodate wind speed, variability, availability of land, and the ability for the ground to support the weight of often more than 1,000 tons.

Then, there's the logistics of getting huge equipment pieces to the area, possible environmental concerns, and the legalities of contract development. With the remote locations of many wind sites, it's also sometimes necessary to build suitable roads to transport large turbines, and to use specialized trucks to carry equipment from the manufacturing site.

For the many wind turbines placed in rural areas, building a strong relationship with the community is also an important piece of the planning stage. Residents may be resistant to wind farms based on many factors, including large amounts of noise and visually imposing structures. In many cases, gaining community trust must precede breaking ground.

The right people

Whether it's the engineers who are planning the civil, electrical, and environmental design of the structures, or the machinists, welders, and electricians onsite, the work force for wind is specialized with unique training needs.

Like all energy projects, highly educated engineers are required to bring a wind energy project to fruition. Beyond the basic licensure and education necessary to perform these tasks, engineers must also have additional training for weeks or months prior to assignment, in addition to on-the-job training. As wind power is a fairly new discipline, it may be difficult for project managers to find candidates with the years of experience required.

Although not all crafts are represented on a wind farm jobsite, many of the same needs are present, including electricians, welders, assemblers, and quality control

inspectors. Some crafts people can easily translate experience on previous non-wind energy sites, while others must take additional training in preparation for the job. Of course, safety prevails as the most important requirement of any project.

Wind projects also require more civil engineering and construction skills than traditional gas-or-coal-fired power plants. Plus, more road and underground utilities are needed. Crane operators and high-lift portable cranes are key. Because of the recent surge in wind power, it can be difficult for contractors to find workers with a background specific to the industry, causing additional work for a project manager and the hiring decision-makers.

The American Wind Energy Association (AWEA) estimates that 85,000 Americans are employed in wind energy, mostly in the Midwest, Southwest, and Northeast regions of the United States, with California, Iowa, and Texas employing the most.

Transmission

The need to build or upgrade transmission lines for a wind energy project accounts for higher risk to the contractor and developer, and can result in challenges throughout the negotiation process. The aging US electrical transmission grid also presents issues, such as limited geographic capacity, difficulties with scheduling, and construction delays. Further complicating the issue is the fact that most wind farms are built in remote areas of the country, where these resources are at their lowest.

In many cases, as part of the wind construction efforts, transmission lines present a large part of the effort, which increases costs and reduces the feasibility of a project, causing developers to take on the risk of the wind project and the eventual transmission expansion. One solution to this problem has been successful in Texas, where the Electric Reliability Council of Texas (ERCOT) ensures a reliable grid and takes on additional costs for transmission lines based on state policy. Another option, Smart Grid, has made strides in adding efficiency to the system, however, some fear it could also reduce resilience.

Energy policies

The ever-changing political sphere is a continued consideration when building wind farms, just as it is for other renewable energy projects. The biggest energy policy concern is the debate over whether to continue federal subsidies that are currently available. So far, those have been only extended for one or two years at a time, but there's much debate each time these come up for renewal.

The most recent law enacted in this area, The American Recovery and Reinvestment Act, opened doors to the renewable industry, but also left many unanswered questions related to project qualifications and long-term project support and success. Some of these questions can be tough to answer with an uncertain political climate and environmental concerns on the rise.

Continued growth

Despite difficulties with wind farm development, it continues to be the fastest growing sector in renewable energy. Although wind represents a small segment of the overall energy portfolio, it makes up around 50% of renewable sectors compared to solar power, hydroelectric, geothermal energy, and biomass.

According to AWEA, since 2000 wind energy has jumped from under 3,000 megawatts (MW) of power to 35,000 MW—that's enough to power 9.7 million homes. Experts expect the trend to continue throughout the next decade, meaning wind energy construction challenges will continue but, hopefully, will also lead to new solutions, technologies, and to new projects.

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Lightning Detection

And the effects on wind turbines

By Melanie Scott

LIGHTNING ATTACHMENT TO TALL OBJECTS has been studied for decades. In fact, the attachment of lightning to electric power transmission towers in elevated terrain drove much of the quantitative assessment of lightning characteristics in the 1970s and 1980s. And, over the last decade, there has been renewed interest in the study of lightning attachment to tall objects in general, and following the establishment of large wind farms in lightning-prone regions. Lightning activity is, currently, being studied to determine its behavior near wind turbines, and to learn how the industry can best manage a turbine or blade that has been damaged by a lightning strike.

> Blade damage was also more likely to occur as a result of a direct, downward, negative cloud-to-ground flash.

North American wind farms incur significant blade repair costs as a result of lightning strike attachments. Some blades must be repaired or replaced after a lightning strike, or they might operate at a reduced aerodynamic efficiency, potentially presenting a safety hazard. Unfortunately, it can be difficult to identify if blades have received a strike, and to measure the performance of the lightning protection system relative to design standards (ex. IEC 61400-24).

Lightning detection network data provides a good starting point, as it can show which wind turbines had the most strikes nearby after a large storm. What isn't clear, however, is what strike characteristics (proximity, number of strikes, peak current, etc.) correlate with the damage to a wind turbine blade, making it difficult to narrow the focus of an analysis of lightning detection network data. There's also concern that lightning detection networks might not report upward-initiated lightning, which can also result in blade damage.

Lightning detection networks

More than 30 years ago, researchers and agencies partnered together to create the first lightning detection networks, which have become a unique combination of scientific discovery, inter-organizational cooperation, and technological development. There are several lightning detection networks in North America, and each is owned and/or operated by private weather companies. These networks consist of a unique set of ground-based sensors, TCP/IP, and satellite data collection, and information is sent to customers in a variety of ways (such as a software display, for example).

Over the years, the data generated by these networks has helped advance meteorological and scientific understanding of lightning and severe storms. Agencies, such as the US National Weather Service (NWS), major utility companies, and airports, use the data to help improve meteorological forecasting of storm activity; protect critical power, utility, and communications infrastructure from lightning damage; and enable the issuing of safety warnings, while educating the public about the dangers of lightning.

Lightning & tall towers

By studying lightning attachment to tall towers, scientists have determined that in flat terrain, the probability of upward-initiated lightning is negligible for tower heights of less than 100 meters. For tower heights greater than 100 meters, the probability increases roughly linearly with the log of height, reaching 100% at a height of 400 meters. Furthermore, the probability of upward initiation increases when an object resides on locally elevated terrain.

Wind farm developers can include this information in the planning of wind turbine hub heights, determining the best location given the terrain of the area.

Although scientists have come to these conclusions, the research doesn't end with upward-initiated lightning. Downward-initiated strikes, and even lightning behavior around turbine blades, are also garnering attention.

In a recent project, video observations, radiation magnetic field measurements, and *in-situ* peak current measurements of lightning near a large wind farm in the US were collected. The terrain variations within this particular wind farm include small rolling hills, with all the turbines having a hub height of 80 meters and a blade tip maximum height of 125 meters. Two digital video camera systems were configured to self-trigger two-second video sequences. The two cameras had a common field of view that included eight wind turbines. Nearby, lightning detection sensors were used as a reference point to compare and analyze lightning data. The wind turbines, themselves, were equipped with *in-situ* peak current measuring devices.

Video observations of flashes that attached to turbines (all to turbine blades) included at least five natural (downward leader) flashes, and at least six upward flashes (fully developed upward leaders lasting tens of milliseconds). All upward flashes appear to have been triggered by nearby positive cloud-to-ground flashes or energetic in-cloud flashes, resulting in upward (presumably positive) leaders.

This particular study yielded information regarding the interaction of lightning with wind turbines on flat terrain, the performance of a lightning detection network in this region of the US, and the electrical behavior of thunderstorms at the wind farm site. It was found that all lightning attachments to turbines were to the blades. Detection of downward attachment lightning was 100%, while upward attachment lightning to turbines was most easily initiated by nearby, high-current, positive cloud-to-ground strokes.

Other findings in this study of interest was the fact that there was no correlation observed between the lightning detection network that estimated lightning peak current, the SCADA current measurement, and resultant damage to the turbine blades. This could be explained due to the current traveling in the blade spar, rather than in the down conductor where the *in-situ* current was measured.

Blade damage was also more likely to occur as a result of a direct, downward, negative cloud-to-ground flash. Wind turbines might also have a larger attractive radius for lightning attachment than stationary towers of the same height. This is possibly because space charge accumulation around the moving blades is inhibited.

Further research is being done with lightning detection and wind turbines to verify these results, and to develop best practices for the industry with respect to lightning detection, protection, and reducing risk. In the meantime, it's always advisable to inspect wind turbine lightning protection systems regularly to minimize the risk of damage from lightning strikes.

Melanie Scott is a meteorologist with Vaisala, which specializes in environmental and industrial measurement.

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Left: *Several research and development projects related to wind energy in cold climates have been conducted in a number of countries*

Below: *Ice on a blade can affect turbine performance*

Wind Site Considerations
In cold climate conditions

By Matthew Wadham-Gagnon, Caroline Farley & Cédric Arbez

WITH 59 GIGAWATTS (GW) of capacity currently installed globally according to the "World Market Update 2012 Report," wind energy projects in cold climates already occupy a significant market share. Moreover, of the 11.5 GW of wind power installed worldwide at sites that exhibit moderate to severe icing conditions, the report found that 66% are presently concentrated in North America, with 37% found in Canada and 29% in the United States. With an additional 50 GW expected by 2017, future business opportunities for this segment of the wind industry seem promising.

Cold climate sites are increasingly targeted by project developers, as such areas often exhibit quality wind resources. According to the predictions for 2013 through to 2017, more than half (57%) of the eight gigawatts of global capacity expected to be installed in moderate to severe icing climates will be commissioned in Canada, along with another 17% in the US*. The timing couldn't be better, considering the technological breakthroughs for such conditions are also rapidly advancing.

Cold climate research

But, what exactly is implied by "cold climate?" As defined by Task 19—Wind Energy in Cold Climates research collaboration under the International Energy Agency (IEA) Wind—cold climates are: "regions where icing events or periods with temperatures below the operational limits of standard wind turbines occur, which may impact project implementation, economics, and safety."

The severity of the cold climate characteristics of a wind project site must be determined during the site assessment phase. In fact, Task 19 published a series of recommended practices for wind projects in such climates, and has introduced a method for classifying sites based on the frequency of icing events. As such, it's critical to assess the characteristics of a potential site during the initial phases of wind project development to not only adequately measure the impact of cold climate (particularly icing), but also to quantify any associated production losses. Once this assessment has been completed, it's easier for a developer to properly plan and pursue a project, and facilitate the project financing, while also reducing the risks incurred.

Several research and development projects related to wind energy in cold climates have been conducted, or are under way, in a number of countries. These studies aim to standardize methodologies and develop technologies to meet the challenges associated with forecasting and detecting ice, while assessing the severity of icing and its impact on infrastructures and health and safety, and finding solutions to minimize such impacts.

A measurement campaign focused on ice accretion on turbine blades and nacelle-based meteorological instrumentation, as well as on ice throw, has led to a classification of ice profiles that's based on the ISO 12494 standard, including a distinction

between rime and glaze. Using this methodology and the results of this study, a correlation can be established between the severity of an icing event and turbine production losses. This can also facilitate the development of icing detection algorithms, based on a computer vision system. Lastly, this study will help foster a better understanding of the IEA ice classification proposed by Task 19.

Long-term effects

Although substantial research efforts are currently underway to develop technologies to reduce production losses stemming from ice accretion on turbine blades, the industry still has a limited understanding of the long-term effects of ice loads on the fatigue life of a turbine.

Results from another measurement campaign carried out at two sites, one in Canada and the other in Finland, concluded that icing can cause an aerodynamic imbalance of the rotor, leading to amplified tower oscillations and increased fatigue loads on the structure. The impact of cold climate on the load cases of a turbine will be considered in the next issue of the IEC 61400-1 standard on wind turbine design requirements.

The measurement campaigns described here have also allowed researchers to analyze, in a practical way, the configuration of met masts and their meteorological instruments. Recommendations have been made to optimize the instrumentation for met masts erected in cold climates conditions. Indeed, several factors must be taken into account prior to their installation, such as ice throw, ice accretion, extreme cold, challenges of performing maintenance on met masts in cold climates, tower design, data transfer, and power supply. The recommendations aim to aid wind project developers by optimizing the data available for each sensor used. In this manner, the quantity and quality of data obtained during the energy yield assessment of the site will improve.

Various research projects are being conducted to better understand the issues of cold climate on wind turbine operation. Ultimately, the results of these projects will have tangible impacts on the industry, including risk mitigation during site assessment, the development of ice protection systems, and the drafting of standards for turbine designs adapted to load cases associated with low temperature and icing climates.

All in all, site prospecting in cold climates, in accordance with industry best practices, will help developers reduce the uncertainties and financial risks of their project.

** Read more about the "World Market Update 2012 Report," at www.navigantresearch.com/research/world-market-update-2012*

The TechnoCentre éolien is a research and technology transfer centre that helps companies adapt their technology to withstand the northern climate, develop new products for the wind power industry, and integrate the power supply chain in Québec, Canada.

TechnoCentre éolien | www.eolien.qc.ca

Wind turbine technicians apply wind protection tape to a blade's lead edge (Photo credit: Rope Partners; www.ropepartner.com)

Protecting Turbine Blades

Effectively addressing leading-edge erosion

By Luke Roth

THE WIND INDUSTRY IS PAYING AN INCREASING AMOUNT of attention to the issue of leading-edge erosion of wind turbine blades. To understand why, look no further than recent data showing that erosion can lead to a loss in annual energy production (AEP) of up to 20%*. This can add up to thousands of dollars annually, underscoring the importance of protecting blades against erosion.

Erosion protection is vital, and not simply to avoid a loss in AEP. If a blade deteriorates to a point where water enters it, its structural integrity can be impacted, eventually resulting in blade failure. Although erosion is more often discussed as a threat to land and structures at ground level, it can certainly still occur at wind turbine heights. As wind blades rotate at up to 250 miles-per-hour, they come into contact with rain, hail, salt spray, and other debris. Even small particles can have a significant effect at these speeds, especially as such impacts occur repeatedly over time.

As a turbine blade wears, pitting, gouging, and de-lamination can also take place, reducing its aerodynamics. AEP aside, it's still necessary to correct these issues, so as to keep a turbine in optimum condition and running efficiently.

Fortunately, a number of solutions are available to not only help protect against erosion, but also to repair and restore any related damage to existing blades due to weather or the environment. When considering the available technologies, manufacturers and service providers have a number of options to choose from, depending on the conditions and facilities a product will be applied in.

Protection tape

One well-known technology for leading-edge protection is wind protection tape. This technology has been used for more than 40 years in the aviation industry, and was originally developed for helicopter blades and aircraft radomes. A high-quality wind protection tape is capable of resisting erosion and punctures, and any tearing and/or weathering. Its construction also shields leading edges and surfaces from pitting and wearing, and helps guard against water ingression.

When evaluating wind protection tapes, it's important to examine whether the product is UV stable. It's also worth noting whether the tape requires any special application tools. Tapes are available that are designed for simple application, in either the factory or in the field, via rope or platform access. With a good wind protection tape, turbine owners can maintain equipment efficiency, reducing downtime and maintenance. Tape can also extend the useful life of turbine blades, even when installed in harsh environments.

Protection coatings

Factory applied coatings are also available to safeguard wind blades from environmental stressors. These coatings can help protect the leading edges of wind blades from damage caused by sand and rain erosion, or any minor impacts. When examining coatings, in addition to reviewing performance data, turbine manufacturers should look for a product that can be easily applied and that cures quickly, so as to keep efficiency high.

It's also important to consider additional repair options, such as fillers, abrasives, and accessories. These repair solutions are often used in conjunction with protection tapes and coatings to repair minor damage on a wind blade's surface.

Repair solutions

When selecting a filler to repair the blade surface, consider the chemistry and performance time. There are some solutions that offer cartridge and applicator systems to ensure accurate mixing. These solutions also reduce product waste, eliminating messy and time-consuming hand-mix operations. This can allow for the flexibility to finish and repair blades at the manufacturing facility, or during operations and maintenance repairs either on the ground or up-tower.

Research on leading-edge erosion has not only given the wind industry valuable insight into how much wear and tear problems can cost in annual energy production, but also on the ways that environmental stressors can be effectively reduced, prevented, or treated.

With innovative solutions, such as wind protection tape and coatings, as well as related products like repair fillers, manufacturers and service providers can implement a streamlined system to keep wind turbine blades continually functioning at their peak.

** Learn more about the effects of leading-edge erosion on wind turbine blades at http://onlinelibrary.wiley.com/doi/10.1002/we.1649/abstract*

3M | www.3m.com/wind

DC voltage/current logger kit

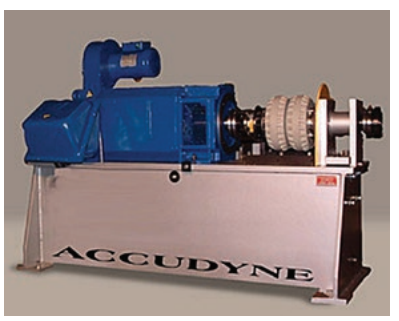
CAS DataLoggers' Electrocorder Two-channel DC Voltage and Current Dataloggers are now available in expanded measurement versions. In addition to the company's model monitoring DC current at +/-10A or +/-100A, new versions are available with current sensors measuring at +/-30A/300A or at +/-100A/1kA. As with all Electrocorder products, the logger kit includes sensors, leads, and software. The dataloggers record DC voltage and current on a large memory at fast sample rates and at high accuracy. The DC voltage and current loggers are ideal for battery testing and viewing DC output in many renewable energy applications, including wind and solar power. Each kit also provides free configuration and analysis software to setup the logger and zoom in on the data. Users can view energy/power costs to identify savings areas with power factoring methods.

CAS DataLogger | www.dataloggerinc.com

Aluminum tower platform

The new Sapa tower platform has been developed to reduce the costs, weight, and installation effort of wind tower platforms, while still meeting the industry's high safety, quality, and load requirements. With simple changes to the length, position, and fabrication of the aluminum extrusions, a custom platform design can be created. Sapa's tower platform will easily accommodate varied needs for diameter, load, ventilation, or position of openings (for cables, ladder, lift, hatch or etc.). The Sapa platform offers: flexible size for different tower diameters; lightweight for easy installation by hand (and no onsite fabrication required); improved ventilation through the tower; excellent corrosion-resistance; 35% to 70% weight savings over aluminum plate or steel; as well as a compact kit packaging for reduced transportation costs. Currently the manufacturing process is based in Europe, however, this platform can be customized to specific North America customer requirements.

Sapa Group | www.sapagroup.com/wind



Wind power testing system

SAKOR Technologies, Inc. announces the availability of its complete AccuDyne AC Dynamometer system for wind power testing applications. The system can be used by multiple engineering groups to test and verify designs, as well as for quality control testing after manufacturing. With the AccuDyne, wind power test centers need only one dynamometer to test a wide range of model sizes, and verify design specifications for multiple product categories and driveline mechanisms.

Ideal for testing active and passive wind power driveline components, the AccuDyne dynamometer system cannot only be used to test turbines and their associated blade pitch control motors, but also their generators, wind-sensing devices, motors, and transmissions. The system can also be used for testing water coolant pumps and other ancillary components as well. Plus, groups of components can be tested simultaneously to see how they work together. The system is ideal for research and development groups working on new turbine and generator designs.

SAKOR Technologies, Inc. | www.sakor.com

Curbing Costs of Wind Turbine Components

Why silica gel breathers just don't cut it

By Cliff Jones

WITHIN THE PAST FEW YEARS, the growing emphasis on proper operation and maintenance (O&M) procedures has created a need for better solutions to protect major wind turbine components—particularly, gearboxes and transformers. Instances of gearbox failures and downtime continue to plague the industry and its users. It doesn't help that as the industry progresses, wind turbines are beginning to be placed in harsher environments, such as tropical climates, arctic climates, and offshore, which only exacerbate maintenance issues.

Some of the most susceptible components to damage and downtime are the gearbox drive system, power transformers, bearings, and hydraulic systems. Properly maintaining clean lubricating oil is proven to be one of the best preventive maintenance practices a turbine operator or owner can make.

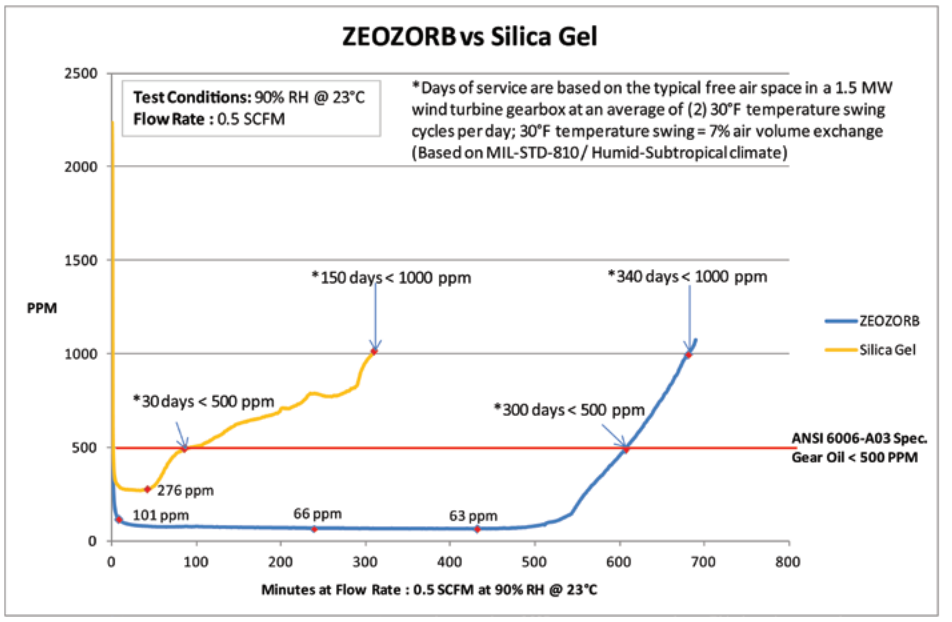
Three major factors influence the quality and cleanliness of a lubricant, which include: monitoring, removing, and excluding contaminants. Removing contamination, in particular moisture and particulate, is more challenging and costly than preventing it. It costs about ten times more to remove contamination than to simply stop it from happening in the first place. Preventing contaminants is clearly the best option, and this is where new solutions should be considered.

Moisture prevention

During their development phase, wind turbines used a basic breather vent to filter out particulate from incoming ambient air, but nothing to filter out moisture from the ambient air. The current design standard, specifically applicable to gearbox design and testing (AWEA/ANSI/AGMA 6006-A03 F.5.3.3.2), states that gearbox lubricating oils should be kept under 500 parts-per-million (ppm) moisture. Water in excess of this standard can lead to: lubricant degradation; degradation of internal components; corrosion of metallic components; accelerated metal fatigue; accelerated additive depletion; accelerated oxidation; as well as interference with an active lubricant film formation.

The solution has been the use of silica gel desiccant breathers, but even their performance is limited.

Lessons can be learned from the Aerospace and Defense industry, where maximizing performance in the harshest environments has been the *status quo* of daily operations. Moisture control solutions are vital for proper operation of various military and



Graph 1

aerospace systems. All of these solutions have one thing in common: ZEOLITE, the desiccant being used.

Although silica gel breathers have been the standard within the wind industry, silica gel isn't the highest performing desiccant available. There's been a common misconception about a desiccant's adsorption capacity by weight when it comes to wind turbines. For instance, the highest performing indicating silica gel can adsorb up to 33% by weight, whereas ZEOLITE can adsorb up to 27% by weight. As a result, it appears silica gel is the better option.

Silica gel might adsorb more by weight but, upon closer analysis, the actual dew point or ppm level achieved is limited to around 250 ppm. And, this level can only be achieved in a narrow operating temperature range. Anything above 25° C

(77° F), and the performance of silica gel drops off drastically. ZEOLITE, however, can provide a significantly lower ppm level—less than 100 ppm, and at a very wide operating temperature range (see Graph 1).

Proper comparisons

Silica gel's higher 33% adsorption capacity is a bit of an unfair claim, since that capacity should be equated to a specific temperature and ppm level. For example, a silica gel providing dry air at 10° Cdp (12,317 ppm) at 30° C (86° F) will adsorb 36% by weight; whereas, a ZEOLITE providing dry air at 10° Cdp (12,317 ppm) at 30°C (86° F) will adsorb 23% by weight. Herein, once again it appears that silica gel performs better.

Certainly, silica gel has a higher adsorption percent by weight, but it only provides relatively dry air, 10° Cdp (12,317 ppm). Consider a scenario where the ANSI 6006-A03 F.5.3.3.2 standard would be exceeded at less than 500 ppm moisture. A silica gel providing dry air at -40° Cdp (188 ppm) at 10° C (50° F) will adsorb 3% by weight, and a ZEOLITE providing dry air at -40° Cdp (188 ppm) at 10°C (50° F) will adsorb 18% by weight. Where silica gel is being used and temperatures exceed 10° C (50° F), the desiccant wont' adsorb any moisture. Therefore, ZEOLITE desiccant should be used as it maintains 5% to 20% adsorption capacity throughout almost any temperature conditions, while exceeding the ANSI 6006-A03 F.5.3.3.2 specification of less than 500 ppm moisture.

Case study

ZEOLITE significantly outperforms silica gel in most any environment, but what does this mean for the wind industry? In one case study, the headspace air dynamics of gearbox lubricating oils were tested (see Table 1). The test results show that samples significantly increased in ppm levels under test saturation conditions.

In Test 3, where ZEOLITE desiccant was used, the specimen from Test 2 dropped dramatically in its ppm level. In Test 4, where ZEOLITE desiccant was used again, the specimen from Test 1 gear oil dropped significantly. This is a crucial dynamic, which proves that by keeping the free air headspace above lubricating oil in a gearbox or reservoir at a low enough ppm level, it will liberate moisture within the lubricating oil itself.

Based on these results, ZEOLITE desiccant should be the industry standard, as its performance is superior to silica gel, actually conditioning gear oil over its use.

Oil	Test 1	Test 2	Test 3	Test 4
A320 Gear Oil	329 ppm	1129 ppm	298 ppm	201 ppm

Table 1
Results
- ***Test 1:*** *New ISO 320 Gear Oil tested*
- ***Test 2:*** *ISO 320 Gear Oil Saturated under the following conditions: 80% RH @ 23.8° C (75° F) for 88 hours*
- ***Test 3:*** *"Test 2 Saturated Gear Oil" conditions: 96 hours in DRYKEEPER box with ZEOLITE*
- ***Test 4:*** *New ISO 320 Gear Oil conditions: 96 hours in DRYKEEPER box with ZEOLITE*

Silica Gel Desiccant volume	Adsorption capacity @ < 500 ppm moisture	Adsorption needed over six months	Amount not adsorbed over six months
3 lbs	82 grams	223 grams	141 grams (1/3 lbs)
ZEOLITE Desiccant volume	Adsorption capacity @ < 500 ppm moisture	Adsorption needed over six months	Amount not adsorbed over six months
3 lbs	299 grams	223 grams	0 grams (76 grams surplus capacity)

Table 2

Standards

Reducing O&M costs have been widely debated, and one suggestion is to extend O&M intervals beyond the six-month industry standard. To accomplish this goal, operators must ensure the size of the breathers employed in their application is sufficient.

Using a manifold that allows for multiple breather use, simultaneously, is one solution. Depending on the environment and free air volume within a gearbox or reservoir, maintenance intervals could be extended beyond two years. However, it does appear that silica gel breathers are being saturated or fully spent well before their six-month lifespan (See Table 2).

A desiccant breather is still a disposable commodity and longer-term solutions should be developed. When servicing a site, owners don't only have to cover the technician labor, but also the added fuel and transportation expenses, often times making the six-month maintenance intervals cost-prohibitive. To achieve full project success, therefore, OEMs must explore new and innovative technologies to provide long-term O&M programs, ensuring turbine gearboxes and components remain fully effective and efficient.

Drytech, Inc.
www.drytechinc.com | www.zeozorbbreathers.com

Maximizing Turbine Performance

Full load gearbox testing

By Justin Hynes

The performance and reliability of a gearbox for a wind turbine is as important to the wind industry as the wind itself. In today's service market, up-tower repairs are becoming more prevalent because they can provide a significant cost savings. More and more gearbox rebuild services can be performed up-tower, however, load testing isn't available in this same manner. Customers are still required to take the time and money to remove the component from the turbine for repair.

Gearbox being loaded for testing

Initial time and costs aside, down-tower repairs need full load testing as an assurance that the repairs performed not only meet the customer's expectations, but also the specifications from the original equipment manufacturer. Not carrying out a full load test for a fraction of the overall down-tower expense could be a costly mistake in terms of future turbine performance and future return-on-investment (ROI).

A full load test to a repaired gearbox should ensure turbine owners and operators quality, reliability, and a guarantee that the repairs have met the same performance criteria as when the gearbox was originally installed. To this end, all original equipment gearboxes are tested before installation and, therefore, should come with validated testing certifications that can be used as a performance comparison to a repaired gearbox.

Failure to perform a full load test to a repaired gearbox means certain quality checks are missed on the work performed. There are five areas of importance when load testing a gearbox, which should be observed: temperature; vibrations; oil cleanliness; pressure; and noise/sound.

1. Temperature

When measuring temperature, there are three locations along the high-speed shaft (HSS) that are recorded. HSS Bearings are the source of many failures in a gearbox, so it's extremely important that the maximum temperatures along the shaft and their Delta are properly measured. The oil temperature in the oil sump should also be measured to check the performance of the cooling system. Assessing the temperatures and their Deltas helps to find potential failure points, allowing a manufacturer to make improvements or share suggestions for upgrades if the parts are sourced from an outside supplier.

2. Vibration testing

When testing for vibrations, there is a five-point test that's performed. These areas include: the high-speed shaft axial and radial directions; intermediate shaft axial and radial directions; and the low-speed gears of the planetary section. By monitoring the frequency of every tooth on the HS shaft, IM shaft, and planetary gear, it's possible to measure if vibrations are either exceeding or are outside of the limits at a given frequency. This, in turn, allows for the identification of a gear or tooth that has a potential issue and is the source of the vibration.

3. Oil cleanliness & pressure

During a full load test, the oil pressure is constantly monitored to gauge the performance of the pump and filtration system. Upon completion of this test, the oil is drained and filtered to check for fine metal particles from the break-in and initial use of the gearbox with new or reworked parts.

4. Noise/sound testing

Using a bi-directional phase-matched microphone, the gearbox is sound tested in three areas, including on the left side, the right side, and at the top of the gearbox. The microphone is slowly moved over the areas in a large and tight "S" pattern. When performing this test, one is looking for the comparison of sound frequencies to the sensitivity of the human ear. It's important to avoid and not have excessive sounds at certain frequencies for ideal performance.

Full load test station

After completion of the full load test a bore scope inspection is performed. The purpose is to look for patterns of wear on the gear teeth. When reassembling a gearbox, the teeth on the gears are dye-coated so, upon completion of the testing, the repair facility can observe the contact pattern of the mating gear teeth. If during the vibration test an issue is found, the gear alignment can then be checked and possible causes detected. If for whatever reason, the cause for the vibration cannot be detected from the bore scope inspection, then disassembly of the gearbox might be necessary. After disassembly to determine the root cause of an issue, the gearbox will go through yet another cycling on the full load test station.

Using a full load test station for gearbox repair often acts as a continuous improvement tool for the rebuilder. Not all third-party gearbox repair facilities have access to this testing station, however, and they might need to outsource load testing. This allows them to monitor and evaluate their work performance, while ensuring any repairs were successful.

Gearbox testing is a significant service to a turbine owner as it potentially lowers operating costs, ideally providing for fewer future onsite or up-tower repairs, or even down-tower repairs. Every failure, whether under warranty or out of warranty, causes lost revenue to the wind farm, ultimately resulting in higher total operating costs to the manufacturer and operator.

When sourcing to have a gearbox repaired down-tower, it's worth taking the time to ask if a full load test will be performed. Some repair facilities only perform a spin test. A full load test simulates what the wind turbine experiences at higher wind speeds and loads. The differences between a spin test and a full load test may be more than just the financial expense—it could be the difference between increased failures and lost revenues, versus achieving the maximum production from a turbine during the warranty and beyond.

Justin Hynes is the product manager for ZF Services, LLC.

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Left: *HVDC valves prep for offshore wind farm installation*
Above: *High-voltage DC test facility*

Edison's Revenge

DC-powered technology will positively impact wind transmission

By Bill Rose

The war of currents was played out 100 years ago between alternating current (AC)—aggressively advocated by Nikola Tesla and George Westinghouse—and direct current (DC), promoted equally hard by Thomas Edison. Alternating current won the war, and AC has been the platform for electrical transmission for homes and businesses across the world ever since.

However, with the dawn of a new century and the imperative to build a smarter grid, direct current is making a comeback. DC is much more efficient at transmitting power over long distances today, which is ironic considering AC was preferred 100 years ago for that very reason—Tesla's transformer boosted voltage to reduce losses over longer distances. In the modern day, DC's long-haul capabilities have become critical to renewable energy sources, such as wind and solar power. High-voltage DC (HVDC) systems hold the capability to transmit power from wind farms in west Texas, for example, to population centers such as Dallas or Los Angeles.

As a result, HVDC is becoming a key technology when it comes to overcoming a major problem that's been facing renewables: the energy produced is seldom in places where it needs to be consumed.

Choosing HVDC

High-voltage DC is now the technology of choice for bulk power transmission over long distances with minimum losses. To their credit, HVDC lines require less space and are capable of going underground or underwater, and without any line compensation required to keep voltage levels up. This is critical for offshore wind in particular, as anything past 40 miles simply isn't feasible with AC power. Also, voltage-source, converter-based HVDC applications in embedded AC grids and for offshore connections have grown substantially, in line with quantum leaps in power ratings and significant loss reductions.

The issue, at least until now, has been that there wasn't any way to create a grid using DC technology, only point-to-point connections. And, a grid is what is needed to effectively balance supply and demand and ensure reliability.

The hybrid DC breaker

This past year, a new R&D breakthrough was announced, one that solves a major technical challenge that's been unresolved for the last 100 years—one that was, perhaps, the main influencer in the "war of currents" outcome. This DC breakthrough has made it possible, for the first time, to create a high-voltage direct current grid, allowing the efficient, reliable, high-speed integration of remote renewable energy sources across long distances underground and underwater.

The hybrid breaker combines mechanical and power electronics switching, which enables it to interrupt power flows equivalent to the output of a nuclear power station, all within five milliseconds. That's as fast as a honeybee takes per flap of its wing, in case you're counting. But, it's not just about speed.

The challenge was to do so ultra-fast, but with minimal operational losses. This has been achieved by combining advanced ultrafast mechanical actuators with advanced power electronics. In terms of significance, the development of such a breaker is potentially a game changer, especially when it comes to renewables. It removes a significant stumbling block in the development of HVDC transmission grids, so grid planning can start now.

Grids will enable interconnection and load balancing between HVDC power superhighways, integrating wind farms and other renewable energy sources, and transporting bulk power across long distances with minimal losses. DC grids will enable sharing of resources, such as lines and converter stations, which provide reliability and redundancy in a power network in an economically viable manner. In simple terms, the new hybrid HVDC breaker will enable the transmission system to maintain power flow, even if there's a fault on one of the lines.

A major step forward

This hybrid technology is a major achievement for researchers, who've worked for years on the challenge, and finally come up with a circuit breaker capable of blocking and breaking DC currents at thousands of amperes and several hundred thousands of volts—corresponding to the average power consumption of, say, one million US citizens. It amounts to stopping power capable of feeding a large city more than 30 times faster than the blink of an eye. This speed helps protect the DC transmission system and prevents power outages in new low-loss compact power superhighways.

DC is, by nature, more controllable than AC. In fact, a DC grid can feed into AC systems, but also preserve an electrical boundary line such that disruptions on one side don't infect the other. A DC grid can also give operators the ability to direct power flows more easily by changing direction and amount. A utility, for example, could back off feeding Texas if its own wind turbines are generating a lot of power, and send it to Florida where fossil plants could be dialed back.

This new technology is currently being installed in a couple of select pilot installations in Europe, with pilots for North America coming soon, so utilities and wind park operators will be brought into the discussion shortly. Hybrid DC technology makes it possible for the power industry to build the future DC grid, a much more highly efficient and stable power infrastructure, that will meet many of renewable energy's major challenges for grid integration and interconnection.

Bill Rose is the manager of Corporate Communications and Media Relations for ABB's Power Products and Power Systems divisions of North America.

ABB | www.abb.com

Machine condition monitoring

Next-generation SKF Multilog IMx online monitoring systems introduce advanced technology for a wide range of machine condition monitoring applications, with models specifically developed for wind turbine applications. These robust and programmable solutions equip users with a 24/7 monitoring system, providing timely and true simultaneous measurements of various operating parameters to guide in improving machine reliability, availability, and performance. All IMx systems are engineered to detect faults early, integrate automatic recognition to correct existing or impending conditions, and contribute to condition-based maintenance program objectives.

IMx technology additionally offers an opportunity to convert and upgrade outdated systems and interface with compatible SKF @ptitude Analyst and Observer software. Depending on the model, SKF Multilog IMx units incorporate 16, 32, or 64 analog signal inputs configurable for a variety of sensors to ascertain acceleration, velocity, and displacement. Individual warning and alarm levels, controlled by machine speed or load, can be set for each measurement point, and built-in auto-diagnosis can check all sensors, cabling, and electronics for any faults, signal interruption, shorts, or power failure.

SKF USA Inc. | www.skf.com

Metal enclosures

Hammond Manufacturing has introduced its new HJ H Series, a family of hinged-cover metal enclosures, environmentally sealed to NEMA Type 3R, 4 (IP66), 12, and 13. Designed for wall or bulkhead mounting, the HJ H Series is ideal for housing electrical and electronic equipment in installations where dust and/or water protection is required. The versatile family is suitable for use to house instruments, such as an electrical, hydraulic, or pneumatic control housing, an electrical junction box, or as a terminal wiring enclosure. An initial 27 sizes, ranging from 4.0" x 4.0" x 3.0" (100 mm x 100 mm x 75mm) to 16.0" x 14.0" x 10.0" (400 mm x 350 mm x 250mm), are all available from stock. The body of the unit is fabricated from 16- or 14-gauge steel, and the covers from 14-gauge, powder-coated in ANSI 61 gray. All seams are continuously welded with a smooth finish, so there are no cutouts, knockouts, or holes. External stainless steel hinge and hinge pin, and two stainless steel clamps offer environmental protection, pulling the cover evenly down onto the seamless poured-in-place gasket. The stainless steel hardware allows the units to be hosed down and installed in outdoor locations.

Hammond Manufacturing | www.hammondmfg.com

Emergency & rapid deployment bag

The COR 181833 is the newest in the line of emergency and rapid deployment bags from CORGO INDUSTRIES. This heavy ballistic denier insulated bag with a reinforced bottom, a water-resistant zipper, and handles on all sides, is ideal for use in remote locations. This first responders bag, with its insulated padded lining, is big enough to carry all first aid equipment, including oxygen, AED, and emergency escape gear—along with ropes, harnesses, haul kits, ascender and decenders, and pulleys, etc.—making it an important addition to any wind farm construction or maintenance project.

CORGO INDUSTRIES | www.corgoind.com

Self-retracting lifeline

Capital Safety introduces the DBI-SALA 175' Sealed-Blok Self Retracting Lifeline (SRL), a new addition to the family of products. With the addition of this new product offering, the Sealed-Blok series now includes SRLs ranging from 15 feet to 175 feet. Featuring heavy-duty, durable, aluminum housing and stainless steel end-plates, the 175' Sealed-Blok SRL delivers enhanced sealed performance, resisting water, contaminants, and even corrosion. Dynamic components are safely sealed inside the IP68-rated housing, making this SRL ideal for the toughest working environments, including offshore platform access in the wind energy. With a built-in carrying handle, certified as a secondary anchor point, the Sealed-Blok SRL is also certified for "dropped objects" protection.

Capital Safety | www.capitalsafety.ca

SEE AD ON PAGE 63

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Website: http://equipmentexpress.com

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Website: www.landstar.com

C.H. Robinson Project Logistics

(formerly Transera International Logistics)

Services offered: Project logistics and transportation solutions for the wind power industry, coordinating dimensional heavy-lift shipments via air, land, and sea, including the chartering of ocean vessels, aircraft, and specialized land transport

Min/Max loads/tonnage: Projects are not defined strictly by volume or freight tons, but by the complexity of the cargo and any delivery obligations

Location/logistics: Worldwide

Qualifications: A member in good standing of industry related regulatory bodies, such as The National Customs Brokers & Freight Forwarders Association of America (NCBFAA), Transport Security Administration (TSA), Canadian International Freight Forwarders Association (CIFFA), International Air Transport Association (IATA), and International Federation of Freight Forwarders Association (FIATA), etc.

Additional key features:

- Over dimensional, heavy-lift cargo specialists;
- Vessel/Aircraft chartering, inland transport by truck, rail, and barge;
- Route/port surveys; and
- Onsite supervision and project management.

Website: www.chrprojectlogistics.com

SEE AD ON PAGE 62

CHALLENGER
We go the Distance

Services offered: Complete supply chain solutions, including: truckload; LTL; temperature-controlled; flatbed; special commodities (heavy haul and over-dimensional); warehousing; logistics; waste haulage; air transportation; ocean and cargo freight; and intermodal services

Min/Max loads/tonnage: 170 000 lbs max tonnage

Location/logistics: Canada, the United States, and Mexico

Qualifications: In service for 38 years, and are C-TPAT, FAST, and PIP

Additional key features:

- As a SmartWay Partner in Transportation, Challenger has been granted the SmartWay Environmental Excellence Award for reducing emissions, increasing fuel economy, and improving the environment;
- Specializing in all wind turbine components, complete plant moves, machinery tanks, aircraft, buildings and shelters, as well as water treatment;
- Additional services available for heavy haul, oversize, and specialty jobs; and
- A leading safety record, providing high standards in quality and technologically advanced transportation and logistics.

Website: www.challenger.com

Aeros

Services offered: Point-to-point air-cargo delivery

Min/Max loads/tonnage: 66 tons to 250 tons

Location/logistics: Globally

Qualifications: Over 25 years in LTA manufacturing; multiple FAA production certificates

Additional key features:

- Vertical take-off and landing (VTOL) capability;
- No runway or existing infrastructure needed;
- Internal buoyancy management system; and
- Access to remote, previously unreachable locations.

Website: www.aeroscraft.com

Solar Power International 2013

McCormick Place—Chicago, Illinois
October 21st to 24th, 2013

Solar Power International is the solar energy industry's most comprehensive educational conference and product exhibition in North America. Join more than 15,000 professionals for four days of action-packed show floor hours, with educational sessions and workshops, general sessions and special events, and the opportunity to connect with colleagues and industry leaders.

www.solarpowerinternational.com

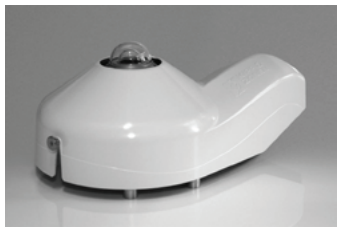
show in print

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

Solar monitoring solution

DECK Monitoring has created an easy, low-cost solar monitoring option for three-phase commercial projects. With Commercial Light, customers get the key benefits of the DECK Monitoring solution with just one device: the kV2c socket meter from GE. This meter includes a cellular modem, so an installer won't have to deal with communications wiring and IT connections. Commercial Light also comes with a five-year data plan from Verizon Wireless Services, so customers can truly have a plug-and-play experience with installation and deployment. A full installation may be accomplished in as little as one hour at DECK Monitoring's lowest price point yet.

DECK Monitoring | www.deckmonitoring.com
Booth 4219



Ventilation unit

Kipp & Zonen introduces the CVF4, a new ventilation unit for its pyranometer and pyrgeometer range. Ventilation of radiometers improves the reliability and accuracy of the measurement by reducing dust on the dome, removing dew and rain droplets, and melting frost and snow, which would otherwise affect the measurement. The latest flow simulation software, microflow, and temperature measurement devices were used in the development process of the CVF4 to maximize its performance. At the top of the pyranometer dome, the flow is very high and it swirls to improve the air distribution over the dome. The position of the heaters and the new cover material ensures only half the heating power is needed to melt frost and snow compared to older ventilation units. CVF4 is easy to use, operates in all weather conditions, and significantly improves the availability of high-quality measurement data from pyranometers and pyrgeometers.

Kipp & Zonen | www.kippzonen.com
Booth 853

MPPT charge controller

The Steca Tarom MPPT 6000 is a high-performance charge controller that combines efficiency with unique protection functions. Generating an input voltage range of up to 200 V for all battery voltages (12V/24V/48V), solar modules of any kind can be used in a wide variety of connection schemes. The Steca Tarom MPPT 6000 combines flexibility with maximum yield and professional battery maintenance, encompassed in an attractive design. The charge controller is equipped with separate inputs and two independent MPP-trackers, making it possible to connect either 1x 60A or 2x 30A. The generously proportioned connection terminals (35 mm²) and the automatic voltage detection ensure simple and fault-free installation. The integrated datalogger provides system data for up to 12 years, optimizing system monitoring. Like the Steca Tarom 4545, the Steca Tarom MPPT 6000 also has an animated graphics display, setting new standards for MPPT charge controllers.

Steca Elektronik GmbH
www.stecasolar.com
Booth 3005

1000-volt utility-scale inverters

Solectria Renewables introduces the next generation of their SMARTGRID inverters, optimized for high efficiency, reliability, and economy. Available in two power classes, 500 kW and 750 kW, these inverters are designed for direct connection to an external transformer for utility-scale applications. The outdoor-rated inverters can also be configured as 1.0 MW or 1.5 MW Solar Stations. Available utility-scale options include a Plant Master Controller and advanced grid management features, such as real and reactive power control, voltage, and frequency ride-through. Listed to 1000 VDC, with a CEC weighted efficiency of 98%, the SGI 500/750XT-1000 inverters set a new standard for large-scale power conversion.

Solectria Renewables | www.solectria.com
Booth 431

Phono® Solar

SHARE THE SUN, POWER THE FUTURE!

Renewable Energy Solutions Partner

Phono Solar Technology Co., Ltd., was founded by SUMEC Group Corporation, a member of the China National Machinery Industry Corporation (SINOMACH). Phono Solar is backed by parent companies with 25 billion USD in annual sales revenue

- Phono Solar has been producing high quality solar products since 2004
- Phono Solar is a leading exporter of PV modules globally
- Sole provider of modules for the 35MW VEPREK project, one of the largest solar projects in the world
- Global PV Solutions Provider with sales offices in USA, Germany, UK, Japan, and other major markets

Performance
2X EL Tested
+ 2% Generation
25 Year Performance Guarantee

Stability
1.5 Billion Credit Line
Bankable with 20+ Banks

Innovation
AC Solar Module
Black Silicon
5-10%
Output Increase
Phonocube

Global Leader
Commercial and Residential Installations in 18 Countries

Certification
1000V Certified
Intertek Certification
IP68 Connectors

Proven Quality
World Leading PV Testing Center
Class A Rated

Visit Phono on **October 21-24, 2013**
Solar Power International Booth No. 2643

info@PhonoSolarUSA.com | 1-855-408-9528

www.PhonoSolar.com

BoS solutions

Eaton is making cost-effective, reliable solar generation a reality for utility, commercial, and residential customers with a complete portfolio of balance of system (BoS) solutions. With expanded engineering services and solutions resulting from the acquisition of Cooper Industries, Eaton solutions are helping the industry maximize solar harvest, reduce installation costs, maintain reliable operations, and enhance safety. Eaton's expanded solutions include: rooftop and ground-mount racking systems; solar inverters and transformers; low-voltage and medium-voltage building and grid-connection switchgear; metering, monitoring, and SCADA systems; DC connectors, wiring harnesses, and cable connection systems; DC combiners, switches, and switch combiners; DC fuses, circuit breakers, and switchboards; as well as engineering services.

Eaton | www.eaton.com/solar
Booths 1648 & 1655

EPC services

groSolar focuses on providing commercial and utility-scale engineering, procurement, and construction (EPC) services to the solar industry. Their team has experience working intimately with developers, investors, project owners, subcontractors, and other partners on megawatt-plus projects—from the routine to the complex. groSolar's portfolio contains installations on: brownfields; capped landfills; open wastewater treatment tanks; commercial and educational buildings; agricultural sites and undeveloped land; as well as manufacturing facilities.

groSolar | www.grosolar.com
Booth 4522

Industrial park

One Thirty Commerce Center is a unique, multi-use industrial park with property and buildings that are ready to lease or purchase. One Thirty Commerce Center provides everything a business needs to be successful, such as sustainable energy sources, access to major transportation routes, access to a qualified workforce, proximity to major markets, and an established infrastructure. The Pflugerville Community Development Corporation can provide incentives to the right companies including, but not limited to, cash grants for employees, tax rebates, reduced cost property, new market tax credits, and EB-5 Financing.

Pflugerville Community Development Corporation
www.pfdevelopment.com | www.130commercecenter.com
Booth 3349

Bonding technology

Whether installing miles of electrical wires or acres of solar panels, it's the components no bigger than a few inches that can give a project long-term success. But as PV technology has evolved, old grounding solutions aren't proving as effective. Rather, it's enhancements in bonding technology that better suit the industry. To help meet this demand, BURNDY now offers the Wiley WEEB (Washer, Electrical Equipment Bond), a simple, reliable, and low-cost method to bond PV module frames and racking together. The WEEB is inserted between the module frame and mounting rail, and 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. Basically the module and rail become like one, addressing several of the challenges that traditional grounding methods pose for solar panels.

BURNDY | www.burndy.com
Booth 2553

Please visit us at SPI – Booth 1039.
October 21– 24 / Chicago, Illinois USA

SOLAR POWER INTERNATIONAL 13

DuraTrack™ HZ

There's one big reason why the DuraTrack HZ single axis tracking system is approaching two billion watts of installed solar PV. It's the enormous value this system brings to the design, installation and improved production of every project. Engineered to perform flawlessly in the most extreme conditions, this proven, rock-solid system utilizes fewer motors per megawatt and can be quickly installed on flat or uneven terrain. All this power isn't going to our heads. It's moving solar technology ahead to provide more sunshine in the day for installers and utility companies, helping all of us make the planet a better place.

ARRAY TECHNOLOGIES

sales@arraytechinc.com | 1.855.TRACKPV | arraytechinc.com

Solar products & services

MOTECH is dedicated to the research, development, and manufacture of high-quality solar products and services—ranging from photovoltaic (PV) cells and modules, to inverters and PV power systems. MOTECH's record for quality assurance is backed by a commitment to quality management to reach excellence; a systematic approach to increasing product reliability; and a rigorous focus on process improvement to raise efficiency and productivity. Modules manufactured by MOTECH have been designed based on the results of 20 years of field-tested products, thereby offering long-term reliability. All modules manufactured in the US qualify for "Buy American," under the American Recovery and Reinvestment Act (ARRA).

MOTECH | www.motechsolar.com
Booth 1710

Battery charge controller

Blue Sky Energy presents the Solar Boost 3024 (SB3024i and SB3024iL) MPPT battery charge controller, with dual 30/40-amp rating, which enhances battery performance. The controller provides for less maintenance and an increased charge current (of up to 30%), when charging flooded lead-acid, AGM, and GEL batteries. It also improves battery performance through its automatic, three-stage charge control algorithm, user-configurable auxiliary output (which can serve as a 20 amp load controller), and IPN network. The IPN network allows up to eight IPN-capable charge controllers to communicate and operate as a single machine that shares an optional battery temperature sensor and remote display. A DUO-Option software upgrade converts the auxiliary output to a diversion-type charge control, and can divert full available power that's not required for battery charging to a useful purpose, such as for heating water.

Blue Sky Energy, Inc. | www.blueskyenergyinc.com
Booth 4216

Siting & permitting support

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 3,565 MW of PV capacity. Their skilled, multidisciplinary project teams help solar energy developers get the green light faster when it comes to solar projects.

Ecology and Environment, Inc. (E & E)
www.ene.com
www.ene.com/service/energy/solar.aspx
Booth 2520

Central inverter

The Parker 890GTS Outdoor Central Solar Inverter is a megawatt-class, free-standing package, designed for utility-scale PV solar field applications. A high-efficiency design integrates proven IGBT power conversion and low-loss, powdered metal core inductors, with Parker's two-phase cooling technology. No air-conditioner is required as the power semiconductors, inductor, and internal ambient air are cooled by Parker's two-phase advanced cooling system. Integrated combiner panel and multiple access panels simplify installation and maintenance. Basic operating modes include Grid Parallel (current mode) and Island (voltage mode) Slew rate control for real and reactive power, making the AC890GT grid friendly. MPPT control ensures the maximum energy harvest, even during non-optimum days. Output power is handled by replaceable phase modules. Each module contains IGBT power semiconductors, long-life film capacitors, and gate drive circuitry. The easily removable modules can be replaced in under 15 minutes.

Parker Hannifin - Energy Grid Tie Division | www.parker.com/gridtie
Booth 4426

GMT.Unirac.com

EXCEED THE STANDARDS OF RELIABILITY.

MAINTENANCE-FREE BEARINGS.

GMT GROUND MOUNT TRACKER

VISIT US AT:

Solar Power International: Chicago, IL
Booth: 1307 • Oct 21-24, 2013

The Power of Simplicity.

UNIRAC®
Bright Thinking in Solar

Roll forming solutions

Roll Forming Corporation (RFC) has more than 60 years of expertise in the design and production of roll-formed steel sections. RFC is in the business of roll forming solutions for its customers' real needs and concerns by utilizing design consultation to develop new solutions, or improve existing shapes using Finite Element Analysis (FEA). Materials range from HRPO, CR, HSLA, aluminum, pre-galvanized, post-dipped galvanized, and powder-coated steel. As part of the world's largest custom roll forming group, RFC offers the latest technologies and innovations from around the world to transform any unique vision into reality, including for the benefits of solar mounting systems.

Roll Forming Corporation | www.rfcorp.com
Booth 9235

Custom extrusions

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_2O) applications; module frames and components; concentrated solar power collectors, inverter housings and components; and thermal management solutions. Supporting Sapa's 16 North American locations is Sapa's North American Technical Center (NATC).

Sapa Extrusions North America
www.sapagroup.com/na
Booth 3208

PV connector system

Phoenix Contact has introduced Sunclix: a DC plug and receptacle connector system for PV applications. The connectors can be assembled in the field or factory, greatly reducing the cost of installation. The one-piece DC connectors use spring technology for quick and easy assembly and termination, without the use of crimp tools. The connectors can only be disconnected with the use of a screwdriver. This eliminates the possibility of accidental release, while meeting NEC requirements. The new plug-in connectors make it possible to connect PV conductors from 14 AWG to 6 AWG, and with voltage of up to 1500 V IEC, using only two versions. The connectors, classified with IP69 degree of protection (2 m/24 h), meet the requirements of the DIN EN 50521 standard and are ETL-certified to UL subject 6703.

Phoenix Contact | www.phoenixcontact.com
Booth 1045

Solar tracker

Solar FlexRack's latest product, the FlexRack Tracker, has a distributive drive system for field layout flexibility, with minimal power loss if a drive fails. The system uses a linear actuator, which requires no maintenance over its lifetime, and Teflon-filled bearings that reduce friction and don't require lubrication. Each tracker also has an automatic stow feature at high-wind detection. The lightweight components of the FlexRack Tracker don't need any heavy equipment during installation, making it a cost-effective solution for today's solar market.

Solar FlexRack | www.solarflexrack.com
Booth 450

Renewable energy batteries

Sun Xtender Batteries (from Advanced Power Products) are developed to offer flexibility when designing battery bank layout and configuration options for solar energy systems. Engineered with the same reliable features used in Concorde's original equipment aircraft batteries, 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. Concorde is currently the only manufacturer that uses PolyGuard, a unique microporous polyethylene separator, around the positive plate and AGM to protect against shorts. 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.

Advanced Power Products
www.advancedpowerproducts.com
Booth 4625

Solar parking structures

Solaire Generation designs, fabricates, and installs integrated solar parking structures, and recently brought to the market its latest carport solution: the Long Span 360. The Long Span 360 covers two parallel parking rows and the internal drive aisle with one contiguous PV-covered canopy. Designed to efficiently maximize any parking lot's solar production, the customizable structure can be up to 110' wide. The Long Span 360, like Solaire's other patented canopies, is available as a single or dual-incline canopy with an optional water management system.

Solaire Generation
www.solairegeneration.com
Booth 3108

I-V curve tracer

Solmetric announces its latest version of the PV Analyzer I-V Curve Tracer for use in commissioning, auditing, operation and maintenance (O&M), and troubleshooting. The PVA-1000S extends the product line to measure up to 1000 V strings. The combination of the new PV Analyzer I-V unit and new SolSensor wireless PV reference sensor dramatically improves accuracy and wireless sensor range. The high throughput analyzer can commission one megawatt in less than two hours.

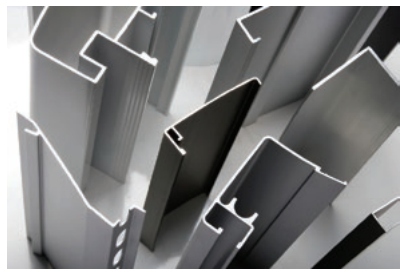
Solmetric Corporation | www.solmetric.com
Booth 3016

Datalogger with service portal

With the new DL2 V2 Datalogger from RESOL, owners of systems that are connected to the Internet can now use the VBus.net service portal. System access is possible with just a few clicks via VBus.net—without any network knowledge or tedious router configuration. Due to the user-friendly platform, system data can be easily processed and visualized. The popular, freely definable live data display and diagram functions are also available. The VBus.net functionality is available for all DL2 Dataloggers, beginning with firmware version 2.0.0. DL2 that have already been purchased, can be updated with the new firmware (found online).

RESOL | www.resol.de/firmware

Booth 3738



Aluminum extrusion & metal fabrication

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. The company has undertaken extensive manufacturing equipment upgrades over the past several months at many of their key manufacturing facilities across the US. Their restructuring efforts, combined with equipment upgrades and a strong financial position, provides Elixir Industries with a solid foundation to support customer success.

Elixir Industries | www.elixirind.com

Booth 3114

Inverters & PV monitoring

Schneider Electric showcases its new, 1000-volt inverter. The Conext Core XC-NA series is a new line of central inverters, designed for high-efficiency and flexibility for any PV panel type and installation. The Conext Core XC-NA's flexibility allows the inverter to be configured with voltage and power outputs of up to 680 kW. With the highest CEC and European Union efficiency ratings of any central inverter in its power range, it contains the latest grid management features to meet global utility requirements. Schneider Electric also offers monitoring solutions for PV power plants. Conext Control is designed to efficiently operate any PV plant by providing site technicians the means to make quick decisions, analyze long-term trends, and manage the life cycle performance of plant assets.

Schneider Electric

www.schneider-electric.com

Booth 2003

Renewable energy deep-cycle system

Crown Battery has paid particular engineering attention to the solar and wind power segments of the residential and commercial markets in the renewable energy field. Currently, Crown Battery offers a complete line of application-driven lead acid batteries to fulfill global, renewable energy needs. Crown's battery line-up includes capacity ratings that range from 120 to 3690 ampere-hours (100 hours), and voltage ratings from 6-volt to 12-volt flooded batteries, to the larger two-volt cell-type batteries. These batteries provide clean power, have no maintenance, offer a universal fit and charge profile, and are built to last.

Crown Battery | www.crownbattery.com

Booth 4706

PV installation tester

Seaward Solar has introduced a new, high-performance combination tester, specifically designed for the fast and effective electrical testing of solar PV installations. The Seaward Solar PV150 is a dedicated, multi-function PV electrical tester for solar panel system installation. It performs: open-circuit voltage measurements (Voc); short-circuit current measurements (Isc); ground continuity; insulation resistance; and operating current (via AC/DC current clamp) checks. Results can be recorded and stored in the tester for subsequent USB downloading to a PC. Moreover, special wireless Solarlink connectivity between the PV150 and the high-performance Solar Survey 200R meter enables real-time irradiance and temperature to be displayed and measured at the same time as electrical testing is being undertaken.

Seaward Group USA
www.seawardsolar.com/usa
Booth 151

PV tracker

Unirac is a PV mounting supplier, offering some of the highest quality and safety accreditations in the industry. They've recently introduced the Unirac GMT, a high-quality, low-maintenance, easy-to-assemble PV tracker solution. Unirac's bankable solar tracker provides one of the best values and currently the top warranty in the market, along with comprehensive service and support.

Unirac | www.unirac.com
Booth 1307

Clamp-free solar mounting systems

Creotecc is a global manufacturer of clamp-free solar mounting systems, specializing in commercial and utility-scale, ground-mount solutions. With over 600 MW installed worldwide, Creotecc's mounting systems feature an innovative insertion rail design, which provides superior module retention without the use of clamps. The "lay in" system minimizes mechanical stress on modules by alleviating thermal expansion pressures and reducing installation times by up to 50%. Creotecc mounting systems are UL 2703 recognized, PE certified, and supported by an experienced team of solar engineers. Creotecc is a subsidiary of BayWa Renewables, a multinational corporation with focus on utility-scale solar, as well as other renewables.

Creotecc | www.creotecc.us
Booth 3408

Solar roof-mounting solutions

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. The GreenFasten system can be utilized on retrofit installations without removing shingles. 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.

EcoFasten Solar | www.ecofastensolar.com

Booth 3149

Solar grounding products

ILSCO presents its line of solar products for grounding, which have recently received UL 2703 Certification. This includes the following products: SGB-4; SGB-5; GBL-4SS; GBL-4DBT; and GBL-4DBTH. ILSCO's solar grounding products are used in utility, commercial, and residential-scale projects. The UL 2703 Certification is specific to rack mounting systems and clamping devices for PV modules and panels. To attain this certification, ILSCO's products were subjected to extensive testing, including temperature and humidity cycling, followed by electrical resistance and conductance analysis, to ensure durable electrical bonding in outdoor environments. ILSCO offers a variety of styles in grounding solutions, and uses materials such as tin-plated copper and stainless steel to ensure lasting connections.

ILSCO | www.ilsco.com

Booth 3716

PV product portfolio

Bonfiglioli, a global supplier within the renewable energy market, designs and manufactures a number of products for the North American utility-scale PV market. The PV product portfolio is designed to shorten the field installation schedule and maximize system uptime, for higher long-term profitability. The RPS Station, a fully integrated, climate-controlled PV power conversion system, is factory-assembled and delivered cabled-ready for simple drop-and-play installation and quick operation. Complete with Bonfiglioli RPS TL-UL inverters and pad-mounted oil-filled transformer, the modular design supports power ratings from 1.0 MWac to 2.8 MWac, and can withstand any environment, to meet even the most demanding requirements. With over 1.6 GW AC installed globally, Bonfiglioli has the expertise to manage each aspect of PV energy generation, from solar tracking to grid feed.

Bonfiglioli | www.bonfiglioliusa.com/pv

Booth 1617

Single-axis, grease-free tracker

Exosun's new Exotrack HZ is a horizontal, single-axis tracker that can boost plant output by 25% in comparison to fixed-tilt installations. The system, created for utility-scale plants, is extremely flexible and adaptable. Because of its simple design, the Exotrack HZ is as fast and easy to install as fixed-tilt systems. What's more, the system offers the lowest motor consumption currently on the market. And, the use of polymer materials makes it completely grease-free. Up to four megawatts of trackers are controlled via a unique centralized control unit, called Exobox. Highly efficient, Exotrack HZ is low maintenance, improving the return on investment for utility-scale solar plants due to its low lifecycle costs. Exotrack HZ is UL 3701 and 2701 certified.

Exosun | www.exosun.net
Booth 4416

Flexible single-axis solar tracker

Array Technologies' DuraTrack HZ single-axis solar tracker delivers proven performance with durability for utility-scale and commercial projects. Employing a proprietary rotating gear-drive system, with fewer motors per megawatt, the DuraTrack HZ system reduces installation time and costs, while utilizing less structural material than other trackers. With its high installation and grading tolerances, the flexible DuraTrack HZ tracker can be deployed on undulating terrain and within irregular site boundaries.

Array Technologies, Inc. | www.arraytechinc.com
Booth 1039

Single-phase string inverter

Fronius USA launches the newest addition to its string inverter line-up, with the single-phase Fronius Galvo. Available from 1.5 kW to 3.1 kW, the Fronius Galvo inverter uses innovative technologies to deliver a future-proof solution for residential applications and small PV systems. It features integrated datalogging, a simple connection to the Internet via wireless LAN, and plug-in card technology for retrofitting additional functions. An integrated energy management function makes it particularly suitable for self-consumption PV systems, and it can be mounted indoors or outdoors for added convenience.

Fronius USA | www.fronius-usa.com
Booth 625

Solar project contractor

Mortenson Construction, a renewable energy contractor in North America, is widely recognized for their expertise in collection systems, substations, transmission lines, interconnect arrangements, and their rapidly growing CSP and PV construction experience. A family owned construction company, Mortenson provides a range of services—from planning, pre-construction, and program management to general contracting, construction management, and design-build, turnkey development. As a full-service engineering, procurement, and construction (EPC) and balance of-plant (BoP) contractor, Mortenson has been at the center of constructing more than 140 solar and wind projects, totaling more than 13,600 MW.

Mortenson Construction | www.mortenson.com
Booth 3837

EPC solutions

Infrastructure & Energy Alternatives, LLC (IEA) was created to integrate a portfolio of energy infrastructure service companies. Through the acquisition of RMT and White Construction, IEA has developed a team of engineering, procurement, and construction experts who can provide turnkey EPC solutions for renewable energy projects. Services include: financial analysis and procurement; site planning; site civil work; foundation and racking system design and installation; underground cabling; substation and interconnection; auxiliary buildings; materials handling; and logistics. IEA offers a full range of services, providing solutions to fit a wide variety of location and terrain complexities, such as ground-mounted PV installations or solar parking structures. IEA makes best use of an available project space to maximize one's return on investment.

Infrastructure & Energy Alternatives, LLC (IEA)
www.iea.net
Booth 3824

Ground-mounted PV panel supports

Legrand designed its FAS Rack system to reduce onsite racking labor by up to 75%, with a system of pre-fabricated components that are easy to ship and quick to install. Pre-engineered for each specific project, FAS Rack eliminates onsite engineering adjustments, and can be installed with two-man crews using simple tools. It features a number of patent-pending innovations, including pier caps that are designed with built-in stops to make grid table positioning easier. All grid tables are factory welded to eliminate labor-intensive, stick-built construction methods. Plus, all hardware is RoHS compliant, so the entire system contributes to LEED points. To date, FAS Rack has been used on a number of solar arrays throughout North America, totaling more than 60 MW.

Legrand | www.legrand.us/cablofil
Booth 3813

Data acquisition system

Campbell Scientific's SOLAR1000 is an automated data acquisition package, designed for flat-panel PV monitoring applications. It meets CaISO EIRP Solar Telemetry Standards. Typical uses include: pre-construction phase solar resource assessment; baseline data collection; and performance monitoring. Systems are also easily customized with accessories for every aspect of the station, from communications to mounting options.

Campbell Scientific
www.campbellsci.com/solar1000
Booth 2446

Solar monitoring web server & modem

Carlo Gavazzi has launched two Eos-Array Web modules: the VMU-C Web Server and the VMU-W Cellular Wireless Modem. They further complement the 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 newly released EOS-Web modules: the 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, is able to gather data from EOS-Array modules, inverters, and Carlo Gavazzi AC Energy meters. VMU-C EOS-Web module, in combination with Eos-Array, is capable of showing the efficiency yield graphs, and handling the management of information, all accessible to the user through the web-browser.

Carlo Gavazzi | www.gavazzionline.com
Booth 3413

Renewable energy batteries

MK Battery is the supplier of Deka Solar Batteries for the renewable energy industry. Deka Solar Photovoltaic Batteries, manufactured in the US and deployed on all seven continents, exceed the highest quality and performance standards of the alternative energy industry. The Deka Solar line includes Sealed VRLA Gel and AGM batteries, in multiple configurations, as well as select flooded products. Deka Solar provides quality and environmentally conscious battery solutions.

MK Battery | www.mkbattery.com
Booth 3827

Surge protector

CITEL's DS2x0-xxDC surge protector is designed to protect equipment connected to a DC power supply (or AC) against lightning surges. These devices are based on high-energy varistors (MOV), matched with the DC operating voltage (from 12 VDC to 350 VDC). The MOV are equipped with internal thermal disconnectors to provide safe end-of-life. The indication of the disconnection status is provided by a mechanical indicator, and is transmitted through a remote signal mechanism. The pluggable module allows for fast and easy maintenance.

CITEL Inc. | www.citel.us
Booth 4636

PV fuses

SIBA Fuses provides PV fuses, and recently announced the release of their new UL Listed PV fuses to meet the UL 2579 standard and IEC 60 269-6. Regardless of location, SIBA's fourth-generation PV fuses are designed for the global market. Whether building inverters, combiners, or re-combiners, whether it's small or utility-scale, SIBA Fuses offer the complete package and the right fuse for the application. PV fuses start at 600 VDC to 1500 VDC.

SIBA Fuses, LLC | www.siba-fuses.us
Booth 2255

Charge controllers/ disconnecting combiners

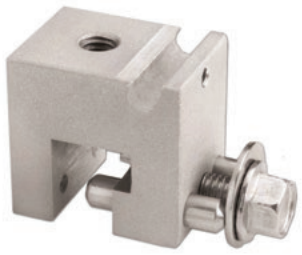
MidNite Solar is a manufacturing company that designs high-quality, cost-effective AC and DC disconnect boxes for the solar industry. MidNite's Classic series of maximum power point tracking (MPPT) charge controllers are powerful, full-featured controllers, and currently the only ETL listed controllers designed to work with solar, wind, and micro hydro-electric systems. MidNite Solar's upcoming line of arc fault disconnecting combiner boxes will meet and exceed all of the new NEC requirements for this class of equipment, providing series and parallel arc fault detection and interruption. MidNite Solar also offers a complete line of pre-wired inverter systems, small breaker boxes, and lightning protection.

MidNite Solar | www.midnitesolar.com
Booth 4827

Solar mounting system

Schletter announces the release of the PvMini, a lightweight, ballasted ground-mount system for landfills, brownfields, and areas with rocky terrain. The system's triangle supports and proprietary new ProfiPlus XT rail design allows for longer spans and decreased ballast weight. The ProfiPlus XT rail is engineered to allow for more lightweight components and increased spans between foundations, thereby optimizing system efficiency—to near 100% in most instances. The new system is designed specifically for single-row vertical or two-row horizontal module configurations, and arrives partially pre-assembled for fast installation with no heavy machinery required. The system comes with a standard 20-year warranty, PE stamped drawings, and features integrated, ETL-listed grounding with the Rapid2+ module clamp.

Schletter Inc.
www.schletter.us
www.schletter.us/featured-product.html
Booth 1943



Solar mounting clamp

Mudge Fasteners and SolarFastenerExpert.com introduce the A-2 AceClamp. Stronger than most single set screw clamps, A-2 AceClamp won't scratch the roof panel when installed. It's designed with a grounding cable groove in the body of the clamp, specifically for use with racking systems. A stainless steel sleeve and screw set hold the grounding wire in place. With the A-2 AceClamp, installers don't have to worry about torque back-out, since the push-pin and washer design locks into the clamp, preventing loosening when subjected to seismic or wind flutter vibration loads.

Mudge Fasteners
www.mudgefasteners.com
www.solarfastenerexpert.com
Booth 1953

Solar roof mounting solutions

Quick Mount PV provides the industry standard for 100% code-compliant, waterproof solar roof mounts. The company manufactures mounting solutions for a variety of roof types, including composition/asphalt shingle, as well as curved and flat tile roofs. The Classic Composition Mount utilizes patented waterproofing technology, the QBlock Elevated Water Seal, for unsurpassed protection against leaks. For tile roofs, Quick Mount PV offers the QBase Universal Tile Mount and Quick Hook USA, which can be configured for either curved or flat tile roof installations. Quick Hook USA is the industry's first flashed tile hook mount, offering superior aesthetics and waterproofing. The double-flashed QBase Universal Tile Mount uses the strongest mechanical roof attachment available. Quick Mount PV has pioneered for roofing best practices in the solar industry, and provides ongoing training to industry professionals. All products are made in the USA.

Quick Mount PV
www.quickmountpv.com
Booth 2815

Smart monitoring & management

Moxa's dataloggers are designed to easily monitor solar production from the Cloud. With features, such as low-power consumption, a compact form factor, wide temperature operation, and support for different communication interfaces (including wireless and cellular), dataloggers are easily deployed and work seamlessly with existing solar monitoring software packages. Moxa also offers a wide selection of hardware to cover other communication requirements.

Moxa | www.moxa.com
Booth 4622

Power management & energy storage systems

Xtreme Power supplies real-time power management and energy storage systems that enable a more sustainable, cost-effective, and reliable electric grid. Xtreme Power's RAMP Series energy storage systems are designed to optimize renewable energy delivery by improving power quality and reducing intermittency. The RAMP Series systems combine the controls of Xtreme Active Control Technology (XACT) and high-performance Power Conditioning Systems, with safe and efficient batteries from manufacturers to quickly and reliably absorb and release power in response to fluctuations in renewable energy output. They also store any power generation that exceeds demand for later use during peak periods. Xtreme Power does more than just ensure a battery energy storage source operates seamlessly with the Power Conversion System, as they're also systems' specialists—well-versed in ensuring integrated systems respond to and communicate with the grid and other external inputs as required by customers.

Xtreme Power | www.xtremepower.com
Booth 4034

Ballasted ground mount

Patriot Solar Group (PSG) showcases their Ballasted Ground Mount. This mounting system makes it possible for solar arrays to be placed in areas that were previously off limits (such as brownfields and landfills), where penetrating the ground is not an option. It also solves a problem that can stifle a solar development by allowing one to place a ballasted mount in an area with challenging soil conditions (such as underground rocks and boulders) that make it impossible to drive a post into the ground.

Patriot Solar Group (PSG)
www.patriotsolargroup.com
Booth 3816

Secondary standard pyranometer

The SR20 secondary standard model pyranometer from Hukseflux offers the most value added features standard within its respective ISO-9060 performance class. Standard features include a case temperature sensor, low-power 12 VDC case heater for dew/frost suppression, as well as a removable signal cable and sunscreen. SR20 also boasts the fastest response time and lowest dome thermal offset-A specifications commercially available for a secondary standard compliant pyranometer. Additional SR20 benefits include a groundbreaking calibration uncertainty of < 1.2% uncertainty.

Hukseflux USA | www.hukseflux usa.com
Booth 1855

Inverter series

KACO new energy provides a global platform with the introduction of the blueplanet TL3 series. In the US, the TL3 family comprises of seven different inverters, from 10 kW to 50 kW, and is available for 600 V and 1000 V DC system voltages. The blueplanet series is an ideal application for commercial, three-phase and utility-scale applications—from flat and multi-angle rooftop to fixed and tracking ground-mount projects. Key advantages include best-in-class 97.5% CEC efficiency, transformerless design, wide input voltage range, ease of installation, and design flexibility, all with globally certified power control features. In this size range, KACO provides one of the best power densities (power-to-weight ratios) available, with the largest operating temperature range. KACO new energy has received numerous certifications for grid support functions, and can meet the requirements for every utility in North America, including Canada, Mexico, Puerto Rico, and all 50 states.

KACO new energy
www.kaco-newenergy.com

PV diaphragms & PTFE materials

Smartech International supplies PV laminators with Steinbach Silicone Diaphragms from Germany. Smartech stocks Steinbach's high-quality solid silicone, as well as their patented Lamibran two-ply diaphragm. Employed around the world, Steinbach's Lamibran has proven its value and durability, as the patented second layer doesn't deteriorate when exposed to the outgassing from EVA film like standard silicone does—greatly increasing the diaphragm longevity. Steinbach's PTFE transport belts and release sheets are custom manufactured to a laminator's specifications. High PTFE-content and anti-static coatings are available in a variety of thicknesses.

Smartech International LP
www.smartechonline.com
Booth 854

AC-coupling solution

Getting more utility out of an existing grid-tied PV/solar system means adding AC-coupling. OutBack Power's FLEXcoupled solution, based on its Radian inverter/charger while incorporating the new EnergyCell Grid/Hybrid batteries, is the only AC-coupling solution that meets UL-1741 standard—and is one brand from end-to-end. OutBack's solution brings grid/hybrid capability (grid-tied during normal conditions; off-grid when it's really needed) to an existing grid-tied-only system by integrating a second smarter Radian inverter/charger, along with a battery bank for energy storage. OutBack's system is unique from other AC-coupling types in that its foundation is a split-phase inverter/charger with dual AC inputs, transfer switching, power management flexibility, and multiple operational modes for a wide range of energy scenarios, including greater dynamic stability.

OutBack Power Technologies | www.outbackpower.com
Booth 2031

Fully ballasted racking systems

Sollega Inc. specializes in fully ballasted racking systems with optional mechanical anchors. Sollega's FastRack (FR5) 5-degree, low-pitch roof solar mounting system compliments their existing InstaRack (IR10 & IR15) product line, and is the first truly universal one-piece modular mounting system engineered to mount all 60- and 72-cell modules. The lightweight, stackable design is efficient to ship and quick to stage and install by attaching easily at the four corners of each module. All attachments utilize one tool, a standard half-inch socket. Engineered as a fully ballasted mounting system, optional mechanical attachments are available for low PSF and seismic requirements. The inter-row spacing is nine inches for a high density on the roof. Manufactured of recycled HDPE plastic that's enhanced with an ultra-violet (UV) inhibitor, the FR5 is guaranteed for 25 years.

Sollega Inc. | www.sollega.com
Booth 2559

Three-phase string inverter

Advanced Energy showcases the company's first three-phase string inverter: the AE 3TL. The AE 3TL is AE Solar Energy's answer to market and customer demand for a distributed inverter that offers the same services and benefits as their central inverters—including, reliability, high efficiency, and customer support. The AE 3TL can be installed within a solar array, which allows for more flexibility, and maximizes available space from a design perspective. This feature makes it well suited for solar projects with unique design or space constraints, such as carports or rooftop ground-mounts. The AE 3TL is UL-certified, with versatile data monitoring options, and a CEC-rated efficiency of 98%. Lightweight and easy-to-install, the product also delivers key features to reduce the levelized cost of electricity (LCOE) and increase energy harvest.

Advanced Energy
www.advanced-energy.com
Booth 1025

Solar hybrid energy system

The Sun Bandit Solar Hybrid Energy System, developed by Next Generation Energy, is a new, patent-pending solution that uses solar electric technology to help meet domestic hot water needs. The Sun Bandit system uses Sun Bandit Micro-grid Technology to power the proprietary Sun Bandit Hybrid Water Heater—without the need for grid-tie connection. By utilizing PV modules instead of solar thermal collectors, Sun Bandit simplifies solar water heating, while reducing the overall cost to the user.

Next Generation Energy
www.ngeus.com | www.sunbandit.us
Booth 4047

Solar sensor

The ML-01 Si-sensor is the link between the reference cell and broadband thermopile pyranometer. Compared to the reference sensors, it has a proper cosine repose and is relatively compact, but benefits from the same characteristics as a PV module (including response time, as well as spectral and temperature response). The ML-01 is an industrial-grade solar sensor, especially made for performance ratio measurements, as well as for irradiance measurement applications for the meteorological, agricultural, and environmental studies. The compact dimensions of the sensor body make it easy to integrate within any application, using it with or without a mounting plate. For global horizontal measurement applications, the sensor can be mounted in horizontal position with the standard removable mounting plate with spirit level and leveling feet. The Mono-Silicon detector, with a UV-resistant diffuser, also gives a cosine response at low-solar elevation angles.

EKO Instruments
www.eko-usa.com
Booth 2519

Flat-roof mounting system

Modernizing the flat-roof mounting industry, the Ecofoot 2 has advanced. It still embraces the key components of the original Ecofoot—speed, low-parts count, and cost effectiveness—with the inclusion of integrated grounding, wire management, and increased weatherability. And, now, a new universal clamping system further simplifies the installation process. By reducing the total part count, and requiring only one tool, Ecofoot2 continues driving down total installation cost for ballasted and hybrid systems.

Ecolibrium Solar
www.ecolibriumsolar.com
Booth 2843

Utility-scale & commercial PV solutions

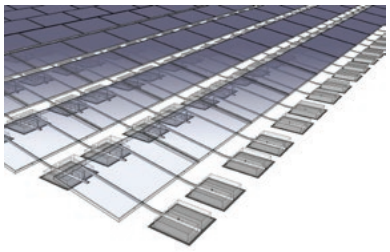
SOLON Corporation is a provider of utility-scale and large commercial PV solutions to the North American market. SOLON delivers turnkey PV systems to its customers with a streamlined approach, from project development, design, and construction to financing, operation, and maintenance. As one of the few full-service providers with expertise in the design, integration, and control of PV combined with energy storage on the megawatt-scale, SOLON promotes the latest progress from its Energy SMRT site—a utility-scale energy storage site attached to a 1.6 MW PV system in partnership with Tucson Electric Power. SOLON Corporation is a subsidiary of the SOLON Group, an international provider of solar solutions for residential, commercial, and utility-scale applications that was founded in 1996.

SOLON Corporation | www.solon.com
Booth 2611

Microinverters

APS America provides microinverters for PV arrays. They will introduce the first true three-phase grid-tied inverter, due for production by the end of Q4 2013. Programmable for all ranges, from 208 V up to 480 V, the APS YC1000 is designed to work with three or four PV modules (up to 310 W STC each), and still provide individual module monitoring. Priced competitively with string inverters, but offering the benefits of microinverters, these units will introduce a new era for the inverter market in commercial PV arrays. The units build on the current success of the APS YC500, a fully dual MPPT 500-watt microinverter, designed to work with all 60-cell or 72-cell modules.

APS America | http://apsamerica.com
Booth 318



Solar mounting & racking

Zilla designs and manufactures solar mounting systems and flashings that make solar installations more practical and affordable. Zilla design facilitates intuitive-use and cost-saving efficiencies throughout the manufacturing, delivery, and installation processes. The Zilla product line applies best-in-class technology to provide high-quality racking and mounting solutions, designed to make solar installations faster, safer, and easier. Zilla offers flat-roof, flush-mount, ground-mount, and custom systems to meet the needs of installers, while focusing on strength, performance, and value.

Zilla | www.zillarac.com
Booth 4831

Deep-cycle batteries

U.S. Battery RE Series deep-cycle batteries include features that give them the highest peak capacity, cycle life, and reliability, providing better performance for solar powered homes and businesses. U.S. Battery's exclusive Diamond Plate technology utilizes synthetic tetrabasic lead sulfate (TTBLS) crystal structures. The TTBLS, result in enhanced performance, charging, and greater lifespan. The RE Series also include Defender moss shields to prevent "mossing shorts" that can further reduce battery life. Available in 6- and 2-volt configurations, RE Series batteries include extra heavy-duty connector lugs, a tough polypropylene exterior case, heavy-duty lifting handles, and the company's SpeedCap Venting positive locking system for easy maintenance.

U.S. Battery | www.usbattery.com
Booth 4438

Utility-scale inverters

Engineered for maximum yield and reliability, the Protect PV Utility-scale Inverters from AEG Power Solutions deliver an efficiency of greater than 98%. The 510 kVA and 630 kVA inverters support DC input voltages up to 1000 volts and flexible grid management features, including reactive power, fault ride-through, and power control. Designed for harsh outdoor environments, the compact outdoor units have double-walled aluminum enclosures and innovative cooling technology. All inverters are also available in a medium-voltage platform solution, fully integrated with transformers and switchgear for rapid installations. The Protect PV Inverters form the basis of the AEG Power Solutions' Battery Energy Storage System. AEG Power Solutions is a global provider of power electronics systems and solutions for all industrial power requirements, offering one of the most comprehensive product and service portfolios in the area of power conversion and power control, including micro-grids.

AEG Power Solutions | www.aegps.com
Booth 2814

Project development and O&M

EDF Renewable Energy develops and builds renewable energy projects that harness the earth's renewable resources, helping to drive the solar and green energy industry and economy. They are experts in all areas of project development, including: site selection; procurement; financing; permitting; project planning and construction; long-term management; operation and maintenance (O&M); as well as project de-commissioning and repowering. Their O&M affiliate, EDF Renewable Services, ensures ongoing profitability for project owners and investors by providing a full range of expertise and O&M services. With nearly 7,000 MW of energy under contract, EDF Renewable Services is a provider of third-party operation and maintenance services in North America.

EDF Renewable Energy | www.edf-re.com
Booth 1352

PV inverters

Ingeteam showcases a new inverter line. The INGECON SUN Power Max U (certified to UL 1741) provides a maximum AC power output of 500 kW and an ambient temperature of up to 50° C (122° F), with a maximum efficiency of 97.2%. This model is specifically designed for outdoor installations (NEMA 3R). The new INGECON SUN Power three-phase inverter with transformer is also now available. Although this single power block model's equipped with a transformer, it can reach maximum efficiency values of 98.4%, operating at output voltages of 208 V and 480 V, while delivering a power output of 125 kW. Directed at the residential sector, Ingeteam presents its single-phase high-frequency inverter with transformer, the INGECON SUN 1Play HF. This model has a 2.5 kW to 6 kW power range, is lightweight and offers greater efficiency values than other single-phase inverters, with a conventional galvanic isolation transformer.

Ingeteam | www.ingeteam.com
Booth 1837

Flashing system

K-Flash is a 100% watertight flashing system, made by Kinetic Solar Racking and Mounting. Backed by a 20-year guarantee, the K-Flash kit includes a baseplate that flush-mounts to the roof surface, a 9" x 12" black flashing plate that maximizes coverage of the penetration points, as well as all stainless steel hardware. The baseplates can be secured to the roof with up to two lag bolts. They also have a separate blind stud on the top for a L-Bracket attachment, eliminating the through-holes that may cause water leakage and lead to dry-rot. Made from lightweight, malleable aluminum, the flashing can easily be formed around roof obstructions. 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 textured, powder-coated flashing blends well with all asphalt roofs, and easily slides under shingles during installation.

KINETIC Solar Racking and Mounting
www.kineticsolar.com

Solar mounting solutions

Applied Energy Technologies (AET), a global provider of solar mounting solutions, showcases their solar racking systems. AET racks fit all major solar modules. Installation is quick and easy. A full layout and loading analysis is provided for every project, and AET offers the shortest lead-times in the industry. Features of AET racking solutions include: racks for all panels available on the market; fewer parts to order; no cutting or drilling required; no heavy equipment required; and a full layout and loading analysis for every project.

Applied Energy Technologies | www.aetenergy.com
Booth 2437

In-line solar fuse

Littelfuse's new SPFI In-Line String Fuse provides full range protection for solar installations, through integration with a solar cable, without the need for fuse holders or a position within a combiner box. Proven technology of Littelfuse string protection can now be attained by crimping on to a cable installation, and over-molding or providing other protection from the elements. With 1000 VDC protection and UL 2579 recognition, the SPFI is available in 12-amp ratings to meet the specific design need.

Littelfuse | www.littelfuse.com/solar
Booth 3616

CanWEA Annual Conference and Exhibition

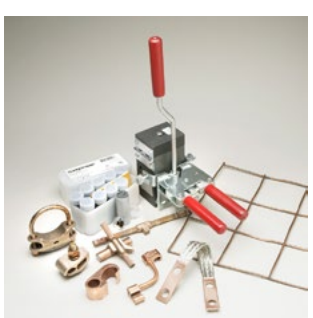
Metro Toronto Convention Centre—Toronto, Ontario
October 7th to 10th, 2013

CanWEA 2013 Conference & Exhibition is Canada's largest wind energy conference, attracting over 2,000 delegates and almost 200 exhibiting companies from around the world. It's the place to see products and services, learn industry brand names, network with industry decision makers, and generate numerous high-quality business leads.

http://canwea2013.ca

show in print

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



Grounding applications for wind farms

BURNDY announces its expanded product offering to meet the needs of wind farm projects. The BURNDYWeld exothermic grounding option provides a portable and efficient method of welding copper-to-copper, and other various materials, without the use of an external power source. The resulting connection is a fusion or molecular weld of virtually pure copper. The BURNDYWeld is ideal for tower grounding applications on wind farm projects. BURNDY's mechanical grounding connectors have been designed for durability and easy installation. Only the finest copper alloys are used in their manufacture, ensuring performance under the most extreme environmental conditions. UL 467 Listed for direct burial applications. The HYGROUND irreversible compression grounding system is a complete system consisting of connectors for cross-grid connections, taps, splices, cable-to-ground rod, ground plates, and terminations. It's acceptable for direct burial in earth and concrete. UL 467 and 96 Listed, CSA certified, and IEEE 837 tested.

BURNDY | www.burndy.com

EPC services

The AMEC Black & McDonald joint venture serves the renewable energy industry by providing a full range of environmental, engineering, procurement, and construction (EPC) services on a design-build basis. Through their incorporation of engineering and construction excellence from both AMEC and Black & McDonald, respectively, the joint venture provides a one-stop solution for a project's development and realization. They are a reliable and experienced contractor, who self-performs all aspects of the EPC contract, with: financial strength and stability; a history of delivering high-quality projects; an investment in customer and community relationships; and a national presence utilizing local resources. Over the past 10 years, AMEC Black & McDonald has constructed over 750 MW of wind and 40 MW of solar development, with another 100 MW of wind and 10 MW of solar, currently underway.

AMEC Black & McDonald
www.amecblackandmcdonald.ca

Safety supply distribution

PSB Securite is a Canadian provider of safety supply equipment, and currently the only specialist in the wind industry in Canada. They work with major players during project manufacturing and construction, as well as for the operation and maintenance of wind farms. PSB Securite offers safety equipment, training, inspection, and re-certification. With high levels of inventory, they represent North American manufacturers, as well as major European manufacturers in the wind industry.

PSB Securite
www.psbsecurite.com

Project development and O&M

EDF EN Canada develops and builds wind and renewable energy projects that harness the earth's renewable resources, helping to drive the green energy economy and industry. They are experts in all areas of project development, including: site selection; procurement; financing; permitting; project planning and construction; long-term management; operation and maintenance (O&M); as well as project de-commissioning and repowering. Their O&M affiliate, EDF Renewable Services, ensures ongoing profitability for project owners and investors by providing a full range of expertise and O&M services. With nearly 7,000 MW of energy under contract, representing over 6,100 turbines and 35 turbine types, EDF Renewable Services is a provider of third-party operation and maintenance services in North America.

EDF EN Canada
www.edf-en.ca
www.edf-renewable-services.com

Turbine design & operation

For nearly two decades, Gamesa has specialized in the design, manufacture, installation, and maintenance of wind turbines. With 27 GW installed, Gamesa's product offering includes four turbine platforms, featuring the robust and reliable Gamesa 2.0-2.5 MW. Delivering an average fleet availability well above 98%, this versatile platform features rotor options from 90 to 114 meters, models for all wind classes, and tower heights ranging from 78 to 140 meters. The platform now includes the G114-2.0 MW for low and medium winds, and Gamesa's newest G114-2.5 MW Class II turbine—which generates 29% more power, and has a 10% lower cost of energy. Gamesa's full-spectrum capabilities include the delivery of customized, long-term operation and maintenance services, and their expert wind farm solutions group, who assists customers in driving wind farm projects to construction-ready status.

Gamesa | www.gamesa.com

Condition monitoring & resource assessment

Renewable NRG Systems (formerly NRG Systems) is an independently owned company that designs and manufactures decision support tools for the renewable energy industry. Featured products include the TurbinePhD condition monitoring system and the Grand Symphonie resource assessment system. Turbine PhD is distinct from other condition monitoring systems by its early fault detection capabilities. Using processing techniques, Turbine PhD can detect faults before they cause secondary damage, avoiding costly down-tower repairs. Grand Symphonie is a resource assessment system that applies advanced technology to reduce overall measurement uncertainty and total cost of ownership. Designed for ease of use, the integrated system of smart sensors, wireless communications, and a cloud-hosted data management portal improves the quality, reliability, and security of data.

Renewable NRG Systems
www.nrgsystems.com

Gearless drive technology

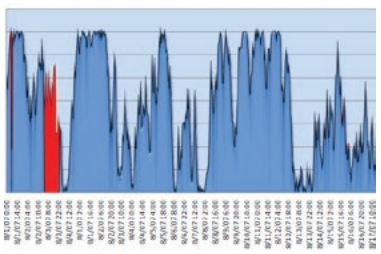
ENERCON is a global provider of wind turbine design and sales. The company is known for their gearless generator technology, high-manufacturing standards, and comprehensive long-term service benefits. ENERCON's gearless drive system, with few rotating components, ensures nearly friction-free energy flow that provides high-quality performance and reliability. As a result, mechanical turbine stress, as well as operating and maintenance costs are reduced, and the system's service life is increased. Over the past years, new system generations have evolved through constant sophistication of existing components. To date, ENERCON has installed more than 21,000 turbines worldwide, ranging from 500 kW to 7.5 MW.

ENERCON Canada Inc.
www.enercon.de

Wind service inspections & repairs

CSS Wind provides BZEE-certified, trained wind service technicians who are experienced in performing various levels of turbine inspections, including: new product installation and acceptance; warranty inspections; periodic maintenance; and unscheduled emergency service. From blade and tower repairs, to large component exchanges, to up-tower gearbox repairs, CSS Wind also provides borescope inspections and reports—with time-tested service expertise and an established safety record. CSS Wind is also the Canadian Distributor for FIRETRACE, a fire suppression system that's extremely effective at protecting micro-environments within the turbine.

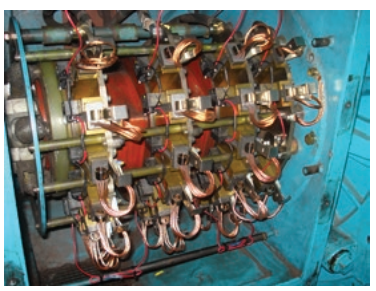
CSS Wind | www.csswind.ca



Real-time data management

The OSIsoft PI System is a real-time data infrastructure, used throughout the wind industry. The PI System collects real-time data from different turbine makes and models, using a vast array of available interfaces. Data is stored in the PI historian and served up to provide fleet-wide visibility of an entire wind farm. The PI System separates operational data from the control network, allowing users to drive real-time business decisions in O&M with asset management and work order system integration. Today's CBM and predictive analytics require the PI System to provide direct access to turbine telemetry. The system provides a flexible, highly available, NERC CIP secure and reliable data infrastructure to drive a project—from the turbine to the operation's center, through O&M, management, engineering, analysis, and the trading desk.

OSIsoft | www.osisoft.com



Engineering & material solutions

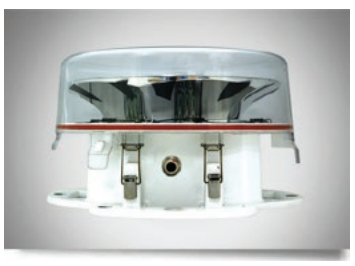
Morgan Advanced Materials provides engineered solutions to the wind industry, with a broad range of technically demanding, high-performance, engineered products. They're presenting their advanced products and materials for collector rings on wind turbine generators, including: brush holder and spring solutions; carbon brush materials; generator slip rings; and pitch control slip rings. These products are designed for longer life and quality performance to reduce maintenance intervals and costs associated with the business end of wind turbine generators. These materials are specifically designed for the variety of harsh environments wind turbines are expected to operate in. Morgan Advanced Materials also provides engineering expertise and problem solving capabilities to address specific customer requirements in these areas.

Morgan Advanced Materials
www.morganadvancedmaterials.com

Wind farm construction

Mortenson Construction has built safe, quality construction projects since 1954. As a full-service engineering, procurement, and construction (EPC) and balance-of-plant (BoP) contractor, Mortenson provides a complete range of services, including: planning; program management; pre-construction; general contracting; construction management; design-build; and turnkey development. Mortenson's Renewable Energy Groups have been at the center of constructing more than 13,000 MW of wind power throughout North America, also providing solar power and high-voltage transmission distribution.

Mortenson Construction
www.mortenson.com/wind



Medium-intensity beacon system

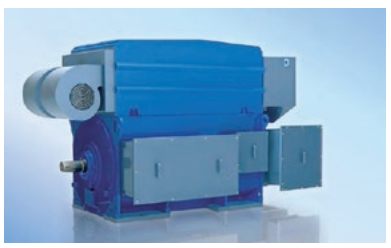
Dialight's Vigilant Series L-864 LED medium-intensity beacon system has achieved FAA certification for wind turbine applications, per the FAA's AC 70/7460-1K specifications for wind turbine farms. Unlike competing systems comprised of separate components, the Dialight Vigilant features an integrated GPS controller and complete monitoring system inside the beacon housing for a more rugged, weather-resistant unit. Global GPS synchronization ensures precise synchronized flashing of multiple beacons, and Dialight's precision, patented optics design offers a sharp cut-off angle for a community friendly lighting solution with maximum aerial visibility and safety. The Vigilant Series also offers a quick payback and a faster ROI, with significant energy and maintenance savings compared to traditional Xenon and incandescent technology—and, even compared to older LED products. The vibration, static, and high-voltage resistant system delivers long-life performance in a maintenance-free solution, backed by Dialight's five-year, full-performance warranty, covering the entire fixture.

Dialight | www.dialight.com

Field and geospatial services

CanACRE is a provider of field and geospatial services to the wind and renewable energy industry across North America. Their in-house team of land professionals have extensive experience in renewable energy and transmission right-of-way development—from the initial planning stages through to construction. Acting as an extension of their clients' development team and providing expertise requirements during the project development and construction process, CanACRE suite of wind services include: land acquisition; GIS/mapping; community consultation; feasibility studies; constraints analysis; land ownership reviews; competition studies; field data collection; permitting support; web-based GIS; data management; and damage settlements. CanACRE offers efficient and value-added services that help clients achieve their development milestones and mitigate potential project risk.

CanACRE Ltd. | www.canacre.com



Generator services

Sherwood Electromotion Inc. (SEI) provides a variety of services related to wind power generators. Supported by four decades of experience in the overhaul and assembly of power generation equipment for major industries, SEI is able to offer manufacturing services for wind power generators that are rated 1 MW to 10 MW, including: overhaul and repair services; contract manufacturing services and partnerships; supply of sub-assemblies and components; and customized service solutions and service programs.

Sherwood Electromotion Inc. (SEI)
www.sherwoodelectromotion.com

Integrated wind resource & engineering

GENIVAR is a one-source solution in wind energy engineering with over 20 years of experience. They provide wind resource assessment and project due diligence expertise, as well as facilities engineering, environmental services, and development support. GENIVAR offers integrated solutions to the international wind energy community, with a unique combination of specialist skills and client services to meet any project challenge.

GENIVAR Inc.

www.genivar.com | www.windserver.ca

Cargo-handling services

Logistec has over six decades of experience in cargo-handling services through a strong network of strategically located terminals in the Great Lakes, St. Lawrence River, Atlantic Canada, and the US East Coast. Logistec has been present since the wind energy sector's explosive growth, working hand-in-hand with the world's largest wind turbine manufacturers, logistics experts, and key transportation stakeholders—offering efficient, cost-effective, and safe cargo-handling services that customers expect. Logistec provides customized solutions to the wind energy sector's unique logistics requirements, based on their expertise, strong market knowledge, and skilled and adaptable workforce. Whether it's unloading or loading ships or barges, loading and securing complex components to truck or rail, or providing assistance in determining the most competitive and efficient cargo terminal in which to handle cargo, Logistec's handles cargo in the safest and most productive manner possible.

Logistec | www.logistec.com

EPC services

H.B. White Canada Corporation, a wholly owned subsidiary of White Construction Inc., specializes in wind and renewable energy power generation projects. With a long-standing history in heavy industrial construction, H.B. White combines high-quality standards and safety practices, providing the engineering, procurement, and construction (EPC) services necessary to provide a turnkey approach to renewable projects. They have the knowledge, experience, equipment, and management to ensure wind projects are completed on time, and within budget, having installed more than 4,600 MW of wind power in North America.

H.B. White Canada Corporation

http://whiteconstruction.com

Wind engineering & development

From concept to commissioning, Hatch's Wind Power group provides a broad range of quality engineering services that support developers in their quest to obtain financing, improve energy output, control costs—and, ultimately, to optimize return-on-investment (ROI). Capabilities include: wind resource assessments; feasibility studies; site research; engineering design services; project management; interconnection services; environmental assessment and permitting; construction management; due diligence; and more. Though Hatch has the flexibility to provide any service individually, in many cases their wind specialists can add even more value by assisting clients in putting the many pieces of a proposed project together in the right order. Knowing how to get lending requirements in place and when to move forward on turbine selection, interconnections, permitting, and other facets of a project, accelerates the overall development process and provides an opportunity to optimize each piece along the way, maximizing ROI.

Hatch | www.hatch.ca

Risk management services

DNV KEMA has been contributing to the successful growth of the global wind energy industry for over 25 years. DNV KEMA provides a full range of technical risk management services for developers, manufacturers, and financiers investing in wind energy. Their services cover the entire lifecycle of projects, and include: resource assessment; project due diligence; development assistance; owner's engineering; accredited testing and instrumentation; wind turbine engineering; type and project certification; marine advisory services; HSE; and asset risk management.

DNV KEMA

www.dnvkema.com/windenergy

Data acquisition systems

Campbell Scientific (Canada) Corp. is a provider of rugged, reliable data acquisition systems. These systems can help determine the potential of wind resources, ensuring best placement and optimized wind capture at any project site. Campbell Scientific has been active for many years in providing wind-profiling systems, and offers a variety of wind sensing options. Their dataloggers come with a standard, three-year warranty, along with a low fail rate. They feature wide operating ranges, durable construction, and dependable stand-alone operation. Campbell Scientific's dataloggers also have low-power consumption from a variety of sources, many telecommunications options, and the flexibility to support a variety of measurement and control applications.

Campbell Scientific (Canada) Corp.
www.campbellsci.ca

Construction materials

Lafarge is a provider of construction materials, with a strong focus on building better cities and communities throughout Canada. Within the wind energy sector, Lafarge offers innovative solutions that explore new ways to construct, accelerate construction, and extend the lifecycle of wind turbine foundations, concrete towers, surrounding access roads, and transmission lines, utilizing cement, concrete, and aggregate technologies. Some of the latest innovations directly result in time, labor, and transportation cost savings, as well as environmental reductions. Lafarge collaborates with owners, developers, designers, engineers, and local communities to resolve even the most complex challenges for all stakeholders involved in a project.

Lafarge Canada Inc. | www.lafarge-na.com

Medium-intensity LED/IR obstacle light

TWR Lighting's Medium-intensity LED/IR obstacle lights (L450-864-IR-G) incorporate red led and infrared led technology into a single, medium-intensity obstacle light. Using advanced optical engineering design, for the CL864 LED and the infrared LED technology, enables this fixture to provide reliable nighttime marking of structures, particularly where military and civilian aviation Night Vision Goggle (NVG) technology is required. In addition, this unit can be interfaced directly to a Radar (VWS) system, using TWR's Radar Ethernet Interface System. This provides reliable control from the Radar System to the obstructions lights "Hot Standby/Instant On" control, simply using a wind farm's current Ethernet network.

TWR Lighting | Orga Aviation | www.twrlighting.com

Land consultation

Elexco is a full-service land company, providing land consulting and land administration services for the renewable energy, utility, and other industries in North America. Services include land acquisitions, land negotiations, right-of-way, leasing, easements, title curative, land registration, GIS services, and customized mapping.

Elexco Ltd. | www.elexco.com

Acoustic services

Aercoustics Engineering Ltd. (AEL) specializes in environmental noise, vibration, and architectural acoustic services. They use a scientific approach to their design philosophy, allowing them to scale designs to all stages of wind farm development—from assessment to post-installation monitoring. AEL has developed innovative tools to help monitor noise and vibration in the most efficient manner. This industry experience and expertise had led them to work with several developers, government agencies, and manufacturers, providing services that include expert testimony, policy advice, noise modeling, environmental compliance approvals, and more. They have completed assessment work for over 850 MW of wind development in Canada, with over 6000 hours of wind turbine sound monitoring.

Aercoustics Engineering Ltd.
www.aercoustics.com

Condition monitoring solutions

Brüel & Kjær Vibro is a global, independent supplier of condition monitoring solutions for rotating machinery, having sold thousands of systems to the wind power sector. Not only has Brüel & Kjær Vibro developed a field-tested monitoring system dedicated to wind power plants, but they also offer a unique service program in which their diagnostics team carries out 24/7 monitoring, diagnostics, and reporting tasks. Their comprehensive product range comprises of: vibration monitors; diagnostic services (GL Certified monitoring body); vibration sensors (acceleration, velocity, and displacement sensors); and VibroSuite monitoring software (a stand-alone solution). These products, plus a suite of comprehensive services, fulfill the most demanding applications for safety, condition, and performance monitoring of drivetrain components in wind turbines.

Brüel & Kjær Vibro | www.bkvibro.com

Lift installation & maintenance

Elevator One Inc. is a privately owned, non-unionized Canadian business, providing wind tower lift expertise. They have the ability to install and maintain lifts in all types of wind towers, as well as all lifts licensed by the TSSA. Elevator One can quickly and efficiently connect with the right people at TSSA to get projects though their difficult and often confusing approval process.

Elevator One Inc. | www.elevatorone.ca

Power from the Ground Up

Insuring geothermal energy

By John McLane

GEOTHERMAL ENERGY HAS, historically, only been possible to exploit near the boundaries of tectonic plates. However, recent technological developments now allow this energy resource to be developed more broadly than previously anticipated. The result has been positive for the industry. Geothermal energy is now produced in 24 countries, and is expected to reach a worldwide generating capacity of 18 gigawatts (GW) by 2015.

In the United States, the world's leading geothermal market, much of the activity is centered in Nevada and California. And, much like any other energy source, whether renewable or traditional, geothermal projects carry their own unique set of risks.

Assessing & insuring risks

Providing environmentally friendly, baseload power, geothermal energy offers one of the lowest levelized costs of any power supply when considering the average cost of power production over the life of a power plant. Unlike other renewables, such as wind or solar power, it also doesn't rely on variable sources of energy (such as the wind blowing or the sun shining).

The rewards of geothermal power are great, but as with any great return, the risks are generally high. The reality is that after much investment and assessment, some projects simply never make it off the ground, so to speak. Insuring the various different steps in a potential geothermal project's development can be the key to success in this industry.

"Construction All Risks" policies primarily focus on the drilling activity to construct the well. Primary considerations are for the installation of capital equipment, without damage or delay. Many developers also opt for "Transit Coverage" to protect the highly specialized equipment required for drilling during its journey to a project site. Replacement of parts, due to damage during construction or transit, can not only be expensive, but also take a long time to procure—thereby impacting the construction time schedule and budget.

Once a geothermal project has been built, the testing and commissioning phase is another important risk hurdle. Any mistake or mis-configuration in the equipment installation could affect the commencement launch, and once again impact a project's schedule and budget. Losses incurred during construction and/or testing and commissioning would be covered under the "Delay in Start-Up" coverage of a "Construction All Risk" policy.

Location is another risk. Many projects are currently situated in areas with intense tectonic activity or extreme climates. They are, therefore, vulnerable to natural catastrophe risks, such as earthquakes. Property coverage in these high-hazard areas covers the above-ground buildings and equipment, just as any other property policy would. "NAT CAT Coverage" is available to protect the project, itself.

Coverage for the below-ground equipment is the most difficult piece of a project to insure, and may require a sublimit, a monetary cap in the reimbursement in the event of a claim, or an exclusion from the policy altogether. "Pollution Coverage" is another consideration for possible exposure to contamination, as drilling can disrupt the surrounding underground water supply or other agriculture resources.

Market support

So, what does all this mean for the insurance markets? And, how can the industry better support these promising new technologies, while getting a better handle on the risk? It starts with the wider market increasing its existing understanding of renewable energy, the technology required, and the sheer scale of the challenges that it faces.

For the geothermal markets, this comes down to money. In order to safeguard the industry's future success, it's imperative for the geothermal sectors to secure adequate risk capital. This enables developers to lock in early-stage financing, manage construction, and instill increased levels of industry confidence in the development of the supply chain.

Collectively, the geothermal risk issues remain largely the same as for the rest of the power sector, although the specific market nuances are, of course, interesting and require a more specialized approach to insurance and risk transfer. Regulatory risk, credit risk, and resource risk remain major barriers that underpin the so-called bankability of a project. These are common issues that the insurance industry quickly needs to address.

But, it's important to note that not all geothermal initiatives are viable. Indeed, while the number of inquiries received to underwrite projects remains high, currently only about one in 10 opportunities are selected for underwriting.

For overall success, it's important for insurance companies to develop comprehensive insurance solutions for clients that value the upfront benefit of the insurer's knowledge and experience within the industry. Insurance companies are also looking for a long-term, commercial relationship. For far too long this level of complex insurance has often been treated as a commodity by developers and their advisers, with the inevitable price race to the bottom. This is simply too much of a short-term view that doesn't offer a full and true understanding of the real risks or the commercial value of an insurance relationship—one that can support a project in turbulent times after a physical damage event.

The geothermal market has yet to realize its potential, and when it comes to underwriting and insurance, a fresh approach is needed; one that engages companies from the start, and positions insurance partners as an important and fundamental part of the project team.

There is no doubt that the wider role of international renewable energy over the next 10 to 15 years is set to escalate, and new technologies are coming to the forefront. To best capitalize on the sectors' potential, it's essential to gain a full understanding of the commercial realities and the risks associated.

John McLane is the president of GCube Insurance Services, Inc.

GCube Insurance Services, Inc. | www.gcube-insurance.com

GEA Geothermal Energy Expo

MGM Grand Hotel and Resort—Las Vegas, Nevada
September 29th to October 2nd, 2013

Every year, the Geothermal Energy Expo (GEA) hosts the world's largest gathering of vendors, providing support for geothermal resource exploration, characterization, development, production, and management. The Expo provides a unique opportunity for exhibitors to showcase their technologies, services, and projects to the geothermal community.

www.geo-energy.org

show in print

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

Airborne full-tensor gravity data

Bell Geospace acquires airborne full-tensor gravity data (FTG), which produces a high-resolution image of density changes associated with variations in geologic structure. For geothermal exploration, FTG data can map and identify areas of hydrothermal alteration caused by either faulting and high-gradient temperature activities. Being an airborne survey, large areas can be mapped efficiently to create regional geological setting and prioritize areas for detailed ground follow-up.

Bell Geospace | www.bellgeo.com

Industrial cooling towers

Industrial Cooling Solutions (ICS) is a turnkey engineering company specializing in all phases of industrial cooling towers—from new cooling towers and repair/upgrade of existing towers, to spare parts supply for all makes and models of industrial cooling towers. ICS combines the skills and expertise of their local cooling tower professionals, with those in their global branches, to become an internationally recognized, full-service cooling tower company. They have a unique ability to provide customers with turnkey engineering, design, and supply of cooling towers, as well as complete cooling tower islands. With a diverse portfolio of projects and experience, they can improve geothermal plant performance and reliability.

Industrial Cooling Solutions (ICS) | www.h2ocooling.com

Liquid ring vacuum pumps

Gardner Denver Nash is a global supplier of gas removal systems for geothermal power plants. Since every geothermal resource and every plant site is unique, their engineers draw on long-standing application engineering know-how and product development data to optimize each system, maximize performance, and prolong the life of every resource. As part of Garder Denver Nash's continuous improvement process, they introduce the 905 series of stainless steel vacuum pumps, with improved performance over the time-tested 904 series. Nash has over 100 years of experience designing and manufacturing liquid ring pumps and steam jet ejectors.

Gardner Denver Nash
www.gdnash.com

Geothermal power producer

Ormat Technologies, Inc. is a geothermal power producer specializing in the design and development of geothermal and recovered energy generation power plants. Ormat offers: a single point of responsibility; full control over delivery time, cost, performance, and completion; field-proven experience and knowledge; proven lifecycle costs; and tailor-made equipment to match any resource condition for optimal power production. Ormat is currently providing more than 1600 MW worldwide.

Ormat Technologies, Inc.
www.ormat.com

Geothermal chemical injection tubing

WEBCO Industries manufactures LaserLine Coiled Tubing for control/injection line applications, and LaserLine SD super duplex tubing for subsea umbilicals. Alloys include lean to super duplexes, nickel alloys, titanium, and stainless steels. WEBCO manufactures tubing for heat exchangers for the renewable industry, along with providing U-bends and low fin tubes.

WEBCO Industries
www.webcoindustries.com

SCADA weather station

The UTILITY-MET100 is a general, utility-grade SCADA weather station, specifically designed for the utility market. Campbell Scientific's standard UTILITY-MET station provides weather station measurements in a configurable, turnkey package, designed to simplify installation and commissioning. This system supports any sensor and communication option. It can also be configured to meet EPA Permitting Guidance Standards for the Prevention of Significant Deterioration. Built-in security features keep the UTILITY-MET station, and its data safe, and secure.

Campbell Scientific
www.campbellsci.com/utility-met100

Cooling solutions

EvapTech Inc. is a cooling tower designer, manufacturer, and contractor, providing innovative cooling solutions for the satisfaction of customer needs in the power generation and geothermal markets. EvapTech offers new and replacement field erected cooling towers, and a variety of field-erected cooling tower after-market services, including parts. EvapTech is a wholly owned subsidiary of EVAPCO, Inc.

EvapTech Inc. | www.evaptech.com

Geothermal power applications

Geothermal Development Associates (GDA) is a privately held company with over 30 years of experience in geothermal power and direct-use applications. Their staff of engineers, geologists, and geoscientists has the capability to oversee projects at every stage, from resource exploration and well testing, to the design, supply, and commissioning of a new power plant. GDA has teamed with The Elliott Group to offer packaged equipment that takes full advantage of Elliott's high-quality turbomachinery. This strategic alliance has enabled specific modifications to Elliott's MYR turbine, making it ideally suited for use in geothermal applications. The Elliott Group has over 100 years of experience building efficient and reliable turbomachinery, including steam turbines, process expanders, and compressors.

Geothermal Development Associates | www.gdareno.com

The Elliott Group | www.elliott-turbo.com

Downhole geothermal pumps

ITT Goulds Pumps and the Frost Consulting Group have partnered to provide over 30 years of experience in downhole geothermal pumps. Frost Consulting Group is a pioneer in the industry, and the exclusive representative and designer of the ITT Goulds Pumps geothermal product line. The downhole geothermal pumps have a wide range of flow rates, deep settings, high temperatures, high horsepower, and long life.

ITT Goulds Pumps

www.gouldspumps.com

www.frostconsultinggroup.net

Geothermal engineering & solutions

Schlumberger Limited engages in the global supply of technology, integrated project management, and information solutions to the geothermal industry. GeothermEx, a Schlumberger company, is an industry engineering and project management firm serving geothermal customer needs. The service product lines in the company operate through three groups: Reservoir Characterization, Drilling, and Production. The Reservoir Characterization Group provides reservoir imaging and monitoring; wireline technology; pressure and flow-rate measurement services; data interpretation and integration services; as well as consulting services. The Drilling Group designs and manufactures roller cone and fixed cutter drill bits and drilling fluid systems; directional-drilling, measurement-while-drilling, and logging-while-drilling services; and well as bottom-hole assembly drilling tools, borehole enlargement technologies, and impact tools. The Production Group offers well services, comprising pressure pumping, well cementing, stimulation, and intervention; well completion services and equipment, such as packers, safety valves, and sand control technology; artificial lift; coiled tubing services; and slickline services.

Schlumberger Limited | www.sib.com

Non-rotating protectors

WWT International Non-rotating protectors (NRPS) measurably improve drilling performance and well clean-out in geothermal applications. Furthermore, they: preserve casing integrity; limit casing wear by maintaining tool joint standoff; protect the drill pipe; reduce torque by up to 50%; reduce surface equipment; and reduce drill-string stress, fatigue, and related downtime expenses. NRPS further reduces drag by +/-25% (Model SS), buckling, as well as any vibration at the surface, and operates without expensive mud additives. It's also possible to increase weight-to-bit, and increase the ROP.

WWT International Inc.

www.wwtinternational.com

Drilling, cementing & mud logging services

ThermaSource provides contract drilling, cementing, and mud logging services to customers in the geothermal industry. They provide stand-alone or integrated drilling solutions, with the goal of managing project risks and costs. With a focus on safety, customer service, and performance, ThermaSource provides high-quality geothermal services to the US market and to international projects, having expanded their reach to projects overseas.

ThermaSource
www.thermasource.com

Non-condensable gas extraction systems

Vooner FloGard Corporation offers complete hybrid gas removal systems for removing non-condensable gases from geothermal condensers. Vooner's conical port, single-stage liquid ring vacuum pumps have capacities up to 14,000 ACFM, 396 cubic m/min. Vooner's engineering staff designs optimal balance of steam injectors, intercondensers, and vacuum pumps. Every vacuum pump is performance tested to Heat Exchange Institute (HEI) standards. Vooner VAC pumps are fabricated in the USA, in welded combinations of VooneRite 12 (12% chrome), 316L and Duplex SS. Duplex SS is used with excessive H2S gas to resist Stress Corrosion Cracking (SCC) of cast 316.

Vooner FloGard Corporation
www.vooner.com

Turbine & ORC solutions

Cryostar is an international company, specialized in rotating equipment for the geothermal industry. Cryostar offers engineering and procurement of customized turbine and ORC solutions, based on their radial inflow turbine technology, which is ideally suited to binary cycles. These highly efficient Turboexpander-Generators offer high-quality, off-design performances. The Cryostar ORC effectively harnesses the potential of a given resource for a maximized annual production. Through its international networks, Cryostar provides local solutions to international standards.

Cryostar | www.cryostar.com

Environmental consultants

Ecology and Environment, Inc. (E & E) offers all of the professional environmental support required to site, permit, and operate geothermal energy generation and transmission facilities. Its planning teams perform environmental constraints analyses, identify permit requirements, and conduct all required baseline studies for hydrogeology, water quality and availability, geology, meteorology, air quality, ecology, and cultural resources. E & E also assists in identifying all stakeholders and engaging them early on to obtain consensus for clients' projects.

Ecology and Environment, Inc.
www.ene.com

High-power geothermal

Atlas Copco provides high-power solutions for low-temperature geothermal power plants. The company's custom-engineered expander generators are designed for Organic Rankine Cycle geothermal power plants. These low-temperature plants are showing promise for the future. Atlas Copco's increasing installed base has proven the efficiency and reliability of this renewable energy source. Available 24/7 and 365 days a year, geothermal energy is truly a baseload and sustainable energy source for the future.

Atlas Copco | www.atlascopco-gap.com

Pipe, valves & fittings

PM International and Butting, a manufacturer of welded pipe and fabricated spool systems, combine their expert level knowledge to deliver corrosion-resistant products to the geothermal industry. PM International is a global supplier of pipe and fittings, valves, flanges, and other products. They are experts in handling large-scale projects—from the specification of product requirements and pre-order technical support, through to the final product delivery and installation. PM International processes more than 50,000 tons of steel a year into longitudinally welded, high-quality stainless steel pipes, vessels, and components. Their spectrum includes: corrosion-resistant pipes; clad pipes; pre-fabricated piping/spools; vessels; tanks; columns; and assemblies. Their material expertise includes: duplex; super duplex; 6% molybdenum; titanium; copper nickel; and nickel alloys. Working together, PM International and Butting bring customers a complete, controlled procurement solution.

PM International and Butting | www.pmfirst.com

Geophysical exploration firm

The Dewhurst Group, LLC (DG), partnered with RESPEC, Inc., specializes in discovery, characterization, and feasibility studies of geothermal resources for electrical power generation. DG/RESPEC features internationally recognized geologists, geophysicists, and engineers, highlighting proficiency in the magnetotelluric method—arguably the most effective geophysical tool for geothermal resource exploration. In addition to proven ground techniques, DG is currently developing small Unmanned Aerial Vehicle (UAV) platforms for collecting magnetic, photographic, and thermal imaging data. Their goal is to reduce project development risk in a pragmatic, cost-effective manner by: identifying, locating, and characterizing exploitable geothermal resources within a client's project boundaries (or conversely verifying that none exist); and optimizing the placement and design of exploration and production wells to maximize exploitation of the resource.

The Dewhurst Group (DG) | www.dewhurstgroup.us

Optimizing Solid Fuel Operation

By Sam Lindsey

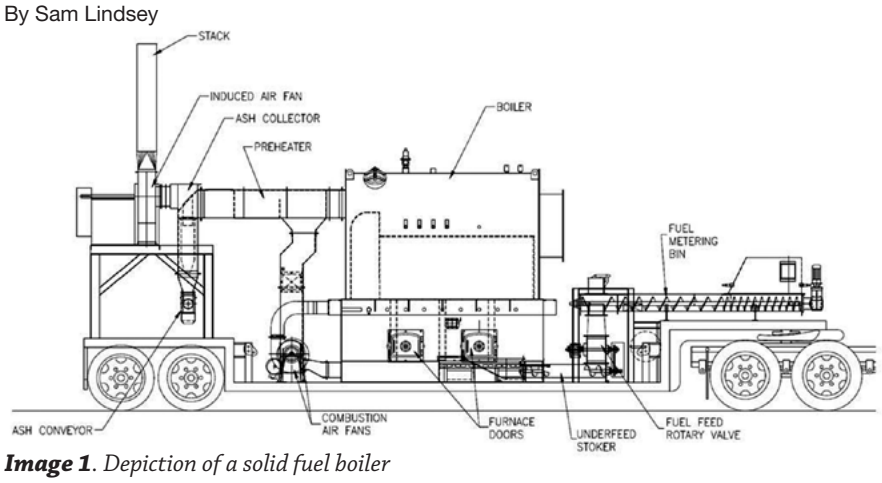


***Image 1**. Depiction of a solid fuel boiler*

JUSTIFICATIONS BEHIND PURCHASING a solid fueled boiler is that the fuel used is a cheaper and/or a more environmentally friendly alternative to oil and gas that can, ultimately, lead to faster payback rates. Years ago, all boilers were solid fueled; however, the convenience of oil and gas piping, along with declining fuel prices, rising labor costs, and strict EPA regulations, has raised questions as to which type of boiler will save more money.

Technology has brought solid fueled boilers a long way in recent years. Systems can be built to run automatically with biofuels, electromechanical fuel feed systems, variable frequency controls, and even automatic de-ash machinery (see Image 1). These boilers can also be set-up to be portable, a versatility that proves convenient for users with seasonal hot water and/or steam heating applications. But, even with modern engineering, savings in a solid fueled boiler must be earned. When operated correctly, these boilers can run continuously, stopping only for scheduled shutdown maintenance and procedures.

To take advantage of the benefits of a solid fueled boiler, a few principles on fuel flow and combustion must be understood and followed. Here are three tips on optimizing the operation…

1. Continuous & uniform fuel feed

A boiler system lives and dies by the flow of fuel into the furnace. Boilers that have the most problems are ones that lack control over the uniformity and consistency of this flow. Even the slightest interruption of supply can cause a disturbance in the load—a principle that's even more important in applications with frequent load fluctuations. The metering of fuel into the boiler has to match the load requirements or the process won't be in equilibrium.

With solid fuels, there's almost always an array of particle sizes. Because of this disparity, the metering of the fuel must keep the flow in constant turbulence, so the different sizes won't separate. If division occurs, the furnace bed won't be uniform, meaning the "burning" will be biased toward certain areas. A uniform consistency of fuel will make for a larger surface area of burning, preventing hot spots and dead air zones within the furnace. One solution is to use a fuel transfer and metering system, which implements augers to transfer fuel, so as to precisely control feed rates and maintain a consistent mixture of fuel sizes.

Screw conveyors also prove to be more effective than chain or belt conveyors. Flight geometry and auger casings allow feed rate projections to be more accurate. Other types of conveyors are notorious for causing the fuel to bridge, leading to uneven layers of fuel on the furnace floor and inefficient combustion. Metering systems that implement screw conveyors also create a plug between the furnace and the outside environment. Chain metering systems don't provide for the same seal, allowing immeasurable amounts of excess air into the combustion zone.

2. Under-fire air: less is more

More often than not, solid fuel systems use too much under-fire air and, consequently, don't have an adequate fuel pile in the furnace. When this air/fuel ratio is imbalanced, combustion occurs prematurely, which doesn't only reduce the efficiency potential, but can also induce damage to the furnace.

As solid fuel burns, it goes through a progression. First, any moisture within the fuel evaporates. Once dry, the fuel will start to release volatile gasses. As more air is introduced, the gasses ignite and release energy. This process will continue until just carbon is left to burn out. Finally, ashes are released and remain to be disposed of (see Image 2).

If completed properly, the fuel pile shouldn't show any visible grates in the furnace. In fact, it shouldn't even seem like the pile is burning. When adequate amounts of air are used, the fuel pile will appear to be "smoking," but what's occurring is the heat and the air are reacting with the fuel, releasing volatile gasses.

If too much under-fire air is used, volatile gasses will release and combust at the same time, creating heat on the furnace floor instead of in the upper section of the furnace where the heat transfer occurs. This premature combustion can rapidly reduce the life of the grates, while impairing the heat transfer process, even entraining ash/dust particles within the flue gasses (see Image 3).

However, it's also important not to reduce the under-fire air so low that the boiler loses combustion. This can be dangerous as the system could react by ramping the fan rates, which will result in more fuel volatizing and filling the furnace. If these gases were suddenly sparked, there could be dangerous blowback,

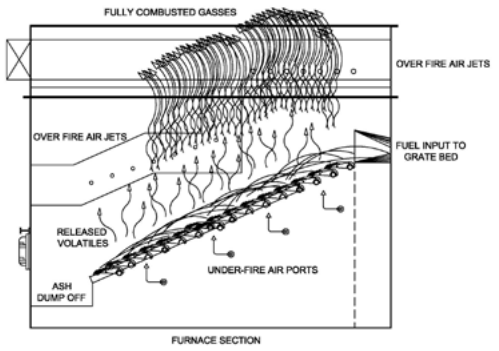


***Image 2.** The process in which fuel enters the furnace and goes through the different stages of combustion*

***Image 3.** Streams of volatile gasses being released from the fuel and rising to the top of the chamber where the combustion process will be complete*

***Image 4.** As the volatile gasses are released from the fuel inside a furnace, they meet streams of high-pressurized air from the over-fire jets…this turbulent mixing of air and gasses completes the combustion process, releasing heat that's to be transferred within the boiler*

causing damage to the boiler equipment and anyone within close proximity.

The best way to ensure an appropriate amount of air is to have a control system that throttles the air input along with the fuel input. For certain kinds of fuels, different ratios will need to be used. Maintain ongoing records to ensure the best fuel pile on the grates is achieved with enough air to volatilize the fuel, so as to keep up with production.

3. Dial-in on the over-fire air

Once the heated fuel reacts with the under-fire air and the volatile gasses are released, over-fire air is used to violently mix with the gasses and cause them to combust—releasing heat that's transferred through the boiler heating surfaces into the water within the vessel. The goal is to achieve stoichiometric combustion, whereby every available fuel molecule released is matched by an oxygen molecule from the fan. This results in a flue gas analysis that reveals no carbon monoxide and no oxygen. This perfect mixing is only possible in laboratory environments, but there are ways to attain efficient combustion within a boiler environment (see Image 4).

Continued on page 97.

Biomass receiving systems

Robert White Industries, Inc. has announced the development of biomass receiving systems, which are designed specifically for receiving biomass discharged from standard or live floor semi-trailers. The system is engineered to deal with the environmental, safety, and material handling challenges presented by biomass unloading, processing, and storage. The receiving system prepares the biomass for storage by smoothing surges at the trailer discharge, metering the product into the handling system, sizing the product to specification, and removing tramp metal prior to storage. The 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

Ultra-low pressure drop mass flow meters & controllers

Alicat Scientific introduces its new MW and MCW "Whisper" series of mass flow meters and controllers with full-scale pressure drops as low as 3.6 mbar, or 0.052 PSI. The Whisper series combines Alicat's laminar flow technology with low-drop proportional control valves and high-sensitivity differential pressure sensors for use in systems with very low differential pressure availability. This innovation is accomplished without compromising Alicat's standard 200:1 turndown ratio, 10-ms meter and 100-ms control speeds, and real-time gas selection from 30 on-board gas and gas mix calibrations. Alicat's MW and MCW series are available in full-scale ranges from 0-0.5 SCCM to 0-500 SLPM, and even the 0-500 SLPM controller at full-scale exhibits a pressure drop of only 47 mbar or 0.69 PSI. Furthermore, Alicat backs every mass flow product with generous customer support and a lifetime warranty.

Alicat Scientific, Inc. | www.alicat.com/whisper

Magnetic separation technology

Caleffi Hydronic Solutions extends its magnetic separator technology to three new hydronic product lines: DIRTMAG dirt separators; DISCAL DIRTMAG combination air and dirt separators; and SEP4 combination air, dirt, and hydraulic separators. Ferrous oxide forms in hydronic systems when iron or steel corrodes, and the abrasive, extremely fine sediment is challenging to remove. It can deposit onto heat exchanger surfaces and accumulate in pump cavities, causing reduced efficiency and premature wear. Caleffi magnetic dirt separators accomplish 21/2 times the ferrous oxide removal performance of standard dirt separators, delivering up to 95% elimination efficiency. All Caleffi magnetic products incorporate a powerful, external rare-earth magnet collar around the lower body. Captured impurities are easily flushed by unclamping the collar and purging—even with the system still operating.

Caleffi | www.caleffi.us

Dual-shaft shredders

Building on the designs originally created and in operation for the last 40 years, Granutech-Saturn Systems' Saturn XT "Xtreme Torque" series is the company's new standard in rugged, dual-shaft shredders. The design features a heavy-duty internal gearbox with independently driven hex shafts, and custom cutter configurations to meet sizing and production requirements. Efficient, durable, and reliable, the Saturn XT Series shredder is ideal for final and pre-processing applications. Built to withstand whatever material it's fed, Saturn XT-Series dual-shaft shredder offers ultimate flexibility in configuration options, including custom sizes and layouts to match the customer's need.

The Saturn series is available in stationary or mobile designs, and features either electric or hydraulic drives, with power configurations of 75 hp to 2,000 hp. For added flexibility, the shredders are also available in single rotor and quad-shaft designs. Saturn shredder applications include: waste processing; waste-to-energy; aluminum, ferrous, and non-ferrous metal processing; and virtually any other application requiring high torque and high performance.

Granutech-Saturn Systems
www.granutech.com

Linear position sensors

LINARIX sensors combine a multi-turn absolute rotary sensor with a heavy-duty draw-wire mechanism. As the wire is drawn off of the device's spool, the encoder measures the rotation and reports the result to the control system. Accurate and durable, the draw-wire mechanisms are rated for over one million cycles, while the rotary encoders are based on non-contacting magnetic or optical measurement technologies that are immune to the wear or corrosion that can degrade the accuracy of potentiometer-based draw-wire devices. The analog output can be programmed so that the full output range (0 – 10 V, 4 – 20 mA) is set to match a specified range of linear displacements.

FRABA-POSITAL's LINARIX linear position sensors have been added to the list of products referenced by the Rockwell Automation PartnerNetwork. Through Encompass Product Partners, customers can quickly locate complementary products that best solve application challenges. LINARIX position sensors are ideal for a wide variety of applications, including packaging and materials handling systems, forklifts, and lifts and flow control gates.

FRABA-POSITAL | www.posital.com

...continued from page 95.

If there's a lack of over-fire air, however, large quantities of carbon monoxide and other combustibles will travel through the system and out of the stack. This waste of fuel leads to heat loss and decreases in efficiency. An over-abundance of combustion air results in heat loss absorbed by the excess air, also decreasing efficiency.

The goal, in this case, is to find a "sweet spot" for the over-fire air. In the same way that the under-fire air should modulate with the fuel feed rate, the amount of over-fire air should be solely dependent upon the amount of oxygen in the stack. Lower amounts of oxygen indicate more efficient combustion. To determine the best oxygen setting for a respective boiler system, it's imperative to take stack readings, which allow the correlation between the carbon monoxide and oxygen levels to be properly matched.

Understanding how a solid fuel boiler works requires an understanding not only of the fuel and the combustion process, but also of the equipment that controls how the fuel is burned. Know the process and the machine. Improper operation can lead to unwanted maintenance time, as well as unnecessary frustration and expenses for the owner of a boiler. When properly operated, solid fueled boilers can be reliable, consistent, and cost effective, particularly for the many types of biofuels available today.

Sam Lindsey in an engineer at Hurst Boiler & Welding Company, Inc.

Hurst Boiler & Welding Company, Inc. | www.hurstboiler.com

Waste shredder

Vecoplan's V-EBS is designed specifically for the production of refuse derived fuels (RDF) from MSW, C&D refuse, industrial scrap, or virtually any other waste stream. The V-EBS has an infeed opening of 2510 mm x 1400 mm, a rotor dimension of 1000 mm x 2510 mm, and has 54 cutting inserts on its rotor. It employs two counter knives for precise cutting of feedstock. Powered by Vecoplan's patented HiTorc, electromagnetic drive, the shredding rotor turns at 150 rpms to 250 rpms and features a throughput capacity of 10-22 t/h. The V-EBS is one of the machines often integrated into Vecoplan's complete WTE and RDF feedstock preparation systems.

Vecoplan | www.vecoplan.com

Shaftless screw conveyor

Sodimate's screw conveyors are designed to transport bulk powder between two points without altering feed accuracy or damaging product particles. Screw size and length are selected according to the type of material to be conveyed. Typical chemicals handled with the screw conveyor include: powdered activated carbon; hydrated lime; trona; and soda ash. The conveyors are shaftless and can easily be bent through flexible pipes to access difficult-to-reach places.

Sodimate Inc. | www.sodimate-inc.com

events**calendar**

SEPTEMBER

03-06 **International Conference on Thermochemical Biomass Conversion Science**
Sheraton Chicago Hotel & Towers—Chicago, Illinois; www.gastechnology.org/tcbiomass2013

09-10 **AWEA Finance & Investment Seminar**; New York, New York; www.awea.org/events

10-12 **Energy Storage North America**
San Jose Convention Center—San Jose, California; www.esnaexpo.com

16-17 **Securing Ontario's Distribution Grid of the Future—Together**
Renaissance Hotel at the Rogers Centre—Toronto, Ontario; www.solren.com
www.euci.com/events/index.php?ci=2045&p=4374

23-24 **5th Concentrated Photovoltaic Summit USA 2013**
Hyatt Place San Jose/Downtown—San Jose, California; www.pv-insider.com/cpv

24-25 **Optimizing Wind Power O&M**
The Mid-America Club—Chicago, Illinois; www.greenpowerconferences.com

24-26 **6th Annual Utility-Scale Solar Summit 2013**
Rancho Bernardo Inn—San Diego, California; www.infocast.com/events

29-02 **GEA Geothermal Energy Expo 2013 & GRC Annual Meeting**
MGM Grand—Las Vegas, Nevada; http://geo-energy.org/events

OCTOBER

02-03 **ALL-ENERGY CANADA 2013**
Direct Energy Centre—Toronto, Ontario; www.all-energy.ca

03-13 **US Department of Energy Solar Decathlon**
Orange County Great Park—Irvine, California; www.solardecathlon.gov

09 **Global Cleantech 100 Summit**
Hilton Washington—Washington, DC; http://events.cleantech.com/global100/

07-10 **CanWEA 2013**
Metro Toronto Convention Centre—Toronto, Ontario; www.canwea2013.ca

17-18 **5th Annual OPIS RFS2, RINs & Biodiesel Forum**
Hyatt Regency McCormick Place—Chicago, Illinois;
www.opisnet.com/events/rfs2rins/index.html

21-23 **Solar Power International 2013**
McCormick Place—Chicago, Illinois; www.solarpowerinternational.com

22-23 **AWEA Offshore WINDPOWER Conference & Exhibition**
The Rhode Island Convention Center—Providence, Rhode Island; www.offshorewindexpo.org

26-29 **Clean Energy BC**; Hyatt Regency Vancouver—Vancouver, BC; www.cleanenergybc.org

29-30 **World Bio Markets USA**
Parc 55 Hotel—San Francisco, California; www.greenpowerconferences.com

NOVEMBER

03-07 **ISES Solar World Congress 2013**; Cancún Center—Cancún, Mexico; www.swc2013.org

06-08 **AWEA Wind Energy Fall Symposium**
The Broadmoor—Colorado Springs, Colorado; www.awea.org/events

11-12 **Solar Energy Focus 2013 Conference**
Washington Marriott at Metro Center—Washington, DC; http://mdvseia.org/events/

12-14 **POWER-GEN**; Orange County Convention Center—Orlando, Florida; www.power-gen.com

13-15 **6th Annual Nebraska Wind Conference & Exhibition**
Cornhusker Marriott Hotel—Lincoln, Nebraska; http://nebraskawindconference.com

19-21 **Geothermal Energy: The 3-Day MBA**; New York; www.greenpowerconferences.com

20-21 **Marine Renewables Canada 2013 Annual Conference**
The Westin—Ottawa, Ontario; www.marinerenewables.ca

DECEMBER

03-04 **26th Annual Industry Growth Forum**
Denver, Colorado; www.nrel.gov/technologytransfer/events.html

09-10 **SOLAR CANADA 2013**
Metro Toronto Convention Centre—Toronto, Ontario;
www.cansia.ca/solar-conferences/solar-canada

10-11 **AWEA Wind Resource & Project Energy Assessment Seminar**
Mandalay Bay Resort & Casino—Las Vegas, Nevada; www.awea.org/events

11-13 **The Solar Power: The 3-day MBA**; New York; www.greenpowerconferences.com

JANUARY

15-16 **AWEA Wind Project O&M and Safety Seminar**
Hotel Del Coronado—San Diego, California; www.awea.org/events

FEBRUARY

4-5 **6th Annual Solar Power Generation USA Congress**
San Diego Marriott Del Mar—San Diego, California; www.solarpowergenerationusa.com

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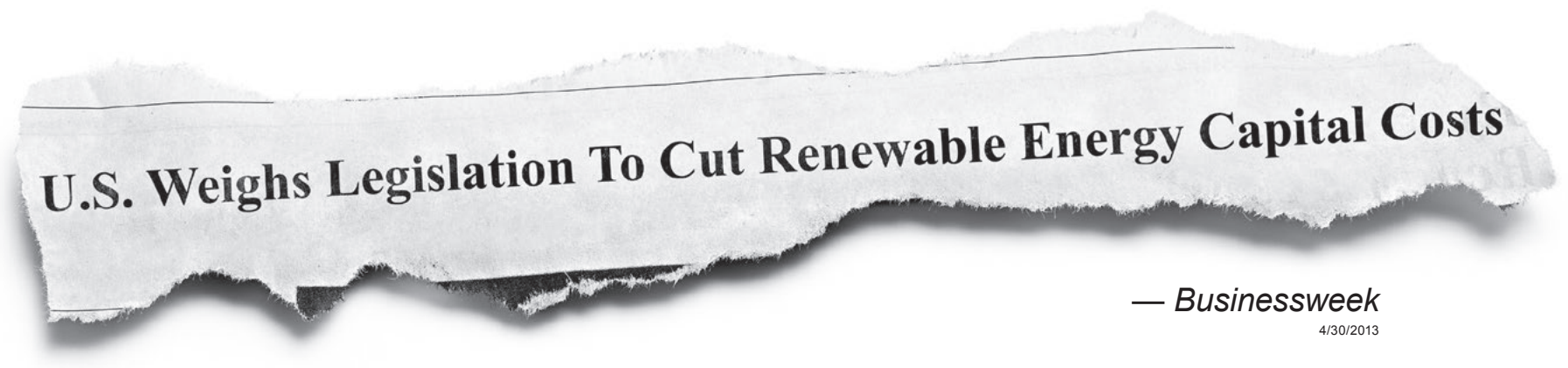

— Businessweek
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